Dec. 30, 1952 M. F. ASHLEY 2,623,984

HIGH-FREQUENCY ELECTRIC HEATING APPARATUS

Filed Aug. 6, 1947 4 Sheets-Sheet 1

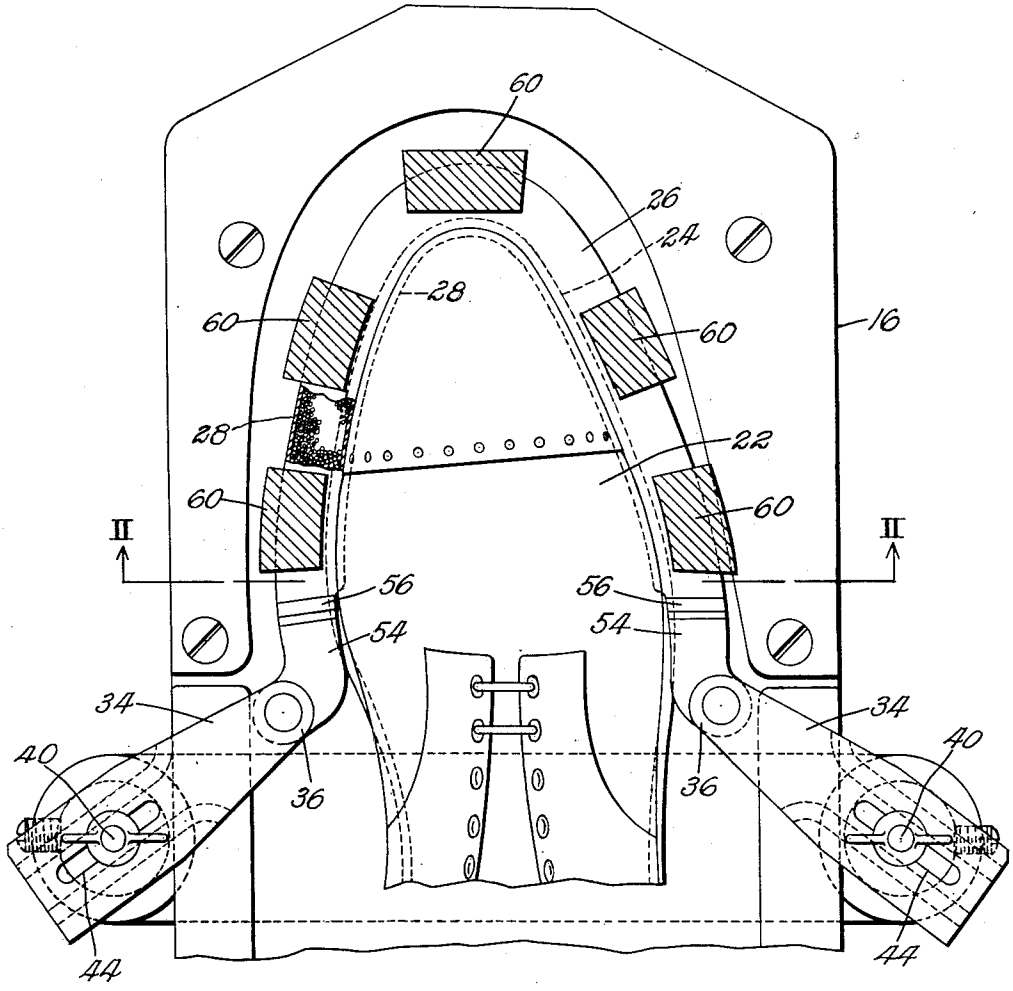


Fig. 1

Inventor
Merwin F. Ashley
By his Attorney
Thomas J. Ryan

Dec. 30, 1952 M. F. ASHLEY 2,623,984

HIGH-FREQUENCY ELECTRIC HEATING APPARATUS

Filed Aug. 6, 1947 4 Sheets-Sheet 2

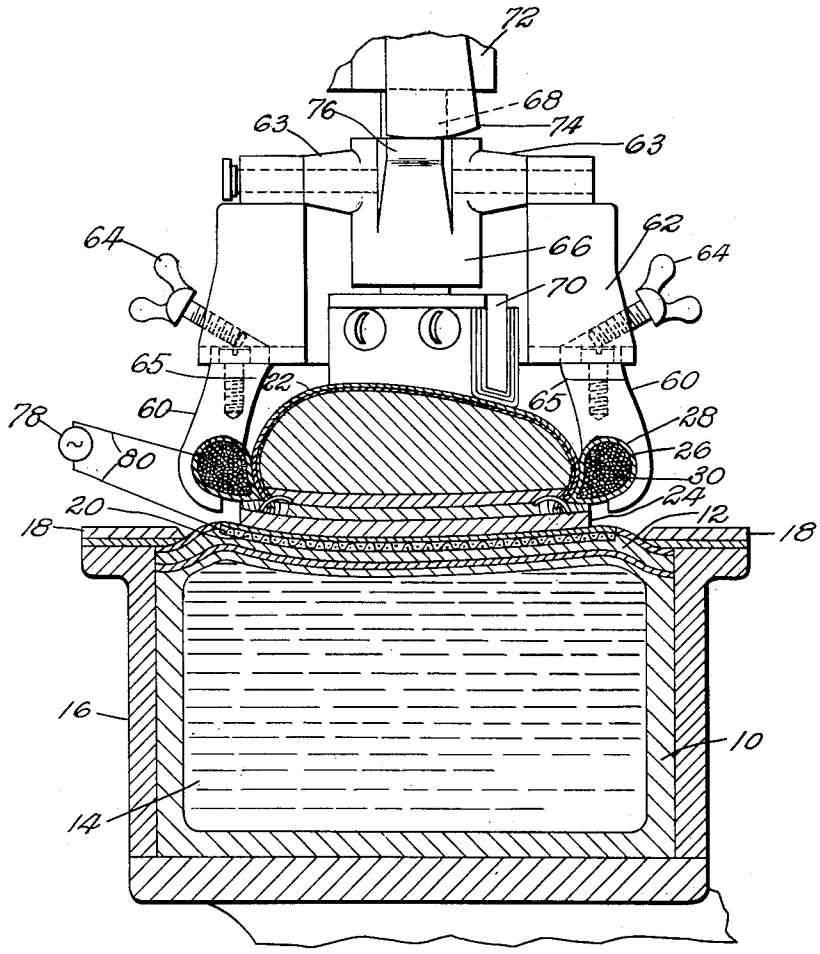


Fig. 2

Inventor
Merwin F. Ashley
By his Attorney
Thomas J. Ryan

Dec. 30, 1952 M. F. ASHLEY 2,623,984

HIGH-FREQUENCY ELECTRIC HEATING APPARATUS

Filed Aug. 6, 1947 4 Sheets-Sheet 3

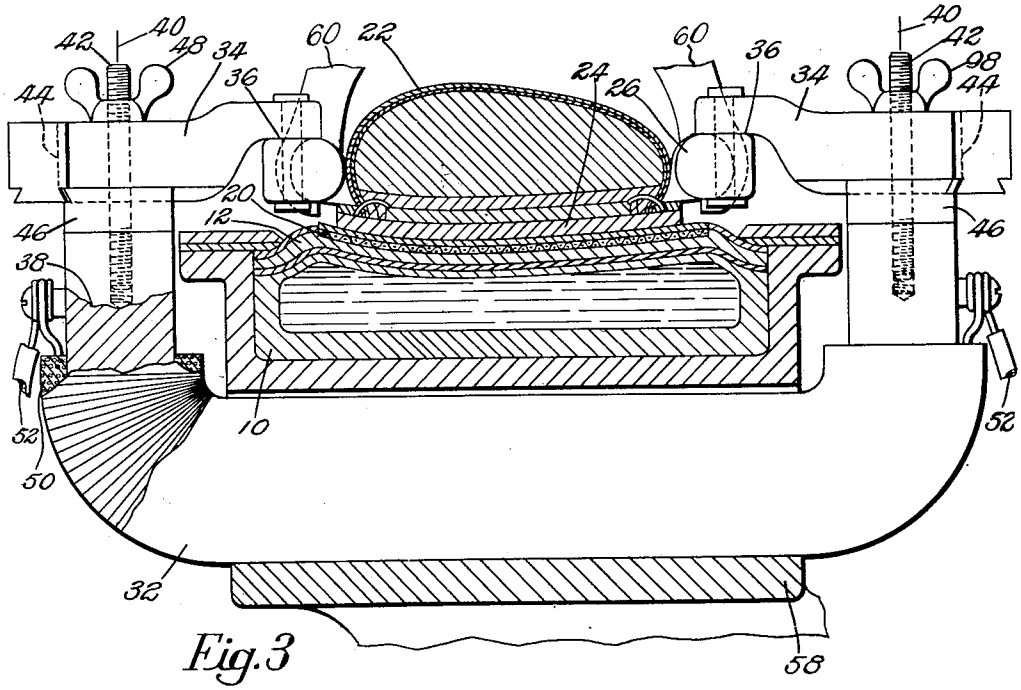


Fig. 3

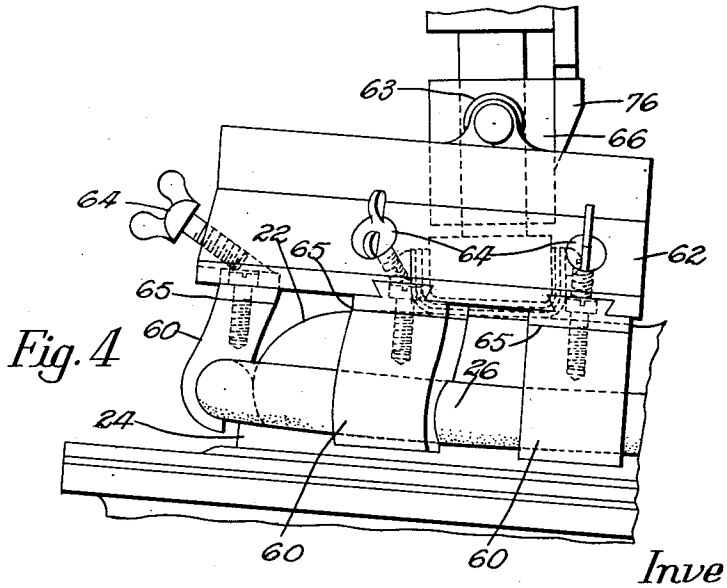


Fig. 4

Inventor
Merwin F. Ashley
By his Attorney
Thomas J. Ryan

Dec. 30, 1952 M. F. ASHLEY 2,623,984

HIGH-FREQUENCY ELECTRIC HEATING APPARATUS

Filed Aug. 6, 1947 4 Sheets-Sheet 4

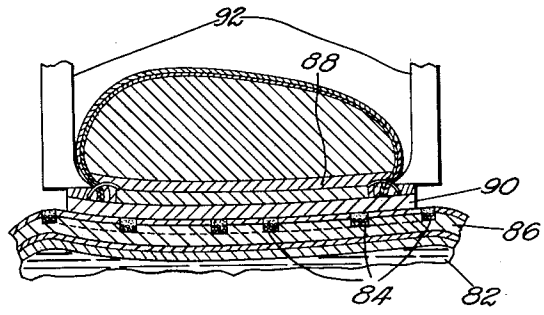


Fig. 5

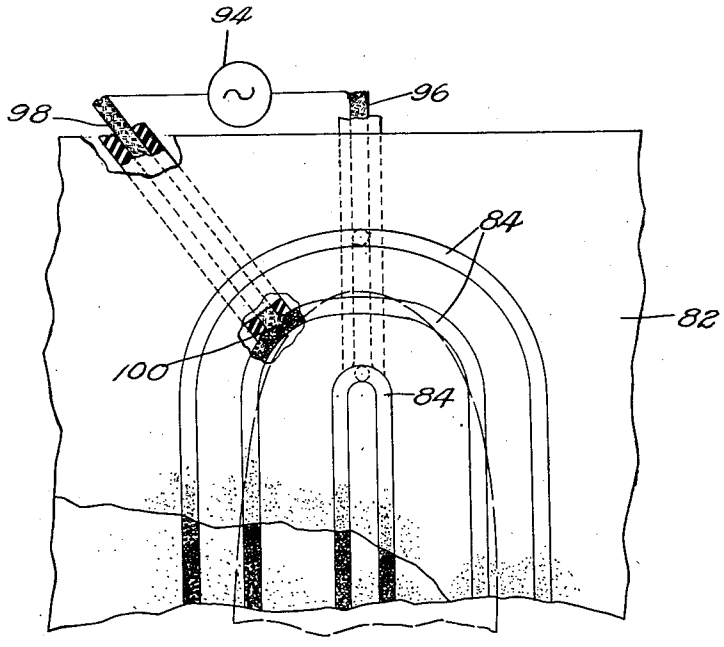


Fig. 6

Inventor
Merwin F Ashley
By his Attorney
Thomas J Ryan

Patented Dec. 30, 1952

2,623,984

UNITED STATES PATENT OFFICE

2,623,984

HIGH-FREQUENCY ELECTRIC HEATING APPARATUS

Merwin F. Ashley, Arlington, Mass., assignor to United Shoe Machinery Corporation, Flemington, N. J., a corporation of New Jersey

Application August 6, 1947, Serial No. 766,825

2 Claims. (Cl. 219—47)

1

This invention relates to high-frequency electrical heating apparatus of a type adapted for use in adhesively bonding together work parts, and more particularly to an improved flexible, welt-crease entering electrode member adapted for use in adhesively attaching soles to welt shoes.

An object of the invention is the provision of a durable elongated flexible electrode to be used in heating an object by means of a high-frequency electric field produced with the use of said electrode, and which electrode may be readily shaped to the contour of the object.

A further object is the provision of a flexible electrode member adapted for use in sole attaching with shoes of different shapes and sizes, and, when so used, adapted to be applied conformably to the welt crease around a shoe forepart and thereafter to be rigidified during the attachment of the welt strip of the shoe to the sole.

In accordance with these objects, a feature of the invention resides in a flexible, high-frequency electrode member comprising a flexible dielectric medium, such as a thin elastic casing, substantially filled with metallic particles, with an external electrical connection extending into contact with the particles as a conductive body. Thus, an electrode of this type may be readily applied, conformably to the curved surface of an object to be treated in a high-frequency electric field, thereby facilitating the setting up of an evenly distributed field through the object.

By employing particles of ferromagnetic material, the electrode, after it has been conformed to the object, may be made rigid by passing a strong magnetic field through the particles as a body, in accordance with another feature of the invention, and, when thus rigidified, will readily retain its assumed shape during its employment in sole attaching. Such a conformable member may comprise an elongated, flexible, dielectric tubing of a wedge-shaped cross-section thereby facilitating its insertion into the welt crease of a shoe where, as illustrated, it will serve both as an electrode and a welt holddown. Thereafter, with the shoe positioned on a sole attaching pad, and with the electrode member magnetized, the shoe sole and welt may be pressed together, and by this electrode, cooperating, for example, with another electrode in the pad cover, a high-frequency electric field may be passed directly through a layer of thermoactive adhesive positioned marginally between the shoe parts, for the activation of such adhesive.

Inasmuch as the metallic particles of such an electrode are in mutual contacting relation, the

2

resistance to flow of high-frequency currents is inappreciable, and the problem of mechanical failure present in flexible electrodes utilizing braided or stranded wires, for example, is not present, because here the flexibility is derived from the flow of the particles and not from the bending of a strand of wire. Moreover, as is hereby achieved, it is especially desirable that the opposing surfaces of the object and the electrode conform closely to each other in achieving uniformity of the field passed through the object for heating purposes, since otherwise the presence of an air gap interposed in the path of the field between the surfaces in any area will weaken the field through that area, thereby retarding the activation of the thermoactive adhesive or other work material in the underlying area.

As herein further illustrated, an electrode of this type may also be utilized as one of a group of similar electrode loops of graduated size embodied within a yieldable sole-attaching pad cover, the series of electrode loops acting together in producing a stray field through the bottom of a shoe placed on the pad. Conveniently, the pad cover may be molded of low-loss rubberlike material with grooves in the cover, of the desired cross-sectional shape, which will be partly filled with small metallic particles and thereafter covered over with a retaining layer of flexible dielectric material. Advantageously, the cross-sectional shape of the grooves and hence that of the completed electrode may readily be achieved in the molding of the pad cover, in accordance with the shape required for the production of the selected field pattern. This advantage will, of course, also be realizable in cases where the electrode comprises a flexible tubing which may be given the desired cross-sectional shape.

These and other features and advantages of the invention, including various details of construction of the apparatus, will now be more specifically described by reference to the accompanying drawings, in which

Fig. 1 is a view taken in horizontal section through the holddown feet of a sole attaching machine employing a welt holddown electrode member of a type contemplated by the invention;

Fig. 2 is a vertical section through the same machine and a shoe in position therein, taken along the line II—II in Fig. 1;

Fig. 3 is a broken sectional view looking at the front of the same machine, and showing the manner of utilizing an electro-magnet for rigidifying the welt holddown member;

Fig. 4 is a partial side elevation of the same

machine showing the forepart of the holddown mechanism in operative engagement with a shoe;

Fig. 5 is a vertical section of a shoe held by means of welt holddown members against a sole attaching pad embodying a series of flexible stray-field electrodes constructed in accordance with the invention; and

Fig. 6 is a partial plan view of such a sole attaching pad.

Referring now to the machine of Figs. 1 to 4 inclusive, a flexible welt holddown electrode member 26 is shown engaging the welt strip of a shoe 22 placed on a fluid-pad 10 having a flexible cover 12. The use of a fluid-pad of this type is well known in the industry and serves the purpose of imparting evenly distributed pressure to the shoe bottom including outsole 24 during a sole attaching operation. Thus, the pad 10 may be filled with a suitable fluid 14 and retained within a pad box 16 having a suitable flange cover 18 for holding the pad and pad cover in position. The pad cover will usually be of a flexible rubber-like material of considerable strength and resilience and in the present application the pad cover embodies a flexible electrode sheet 20 adapted for cooperation with the welt holddown electrode 26. The flexible electrode 20 may comprise a sheet of braided or woven flexible wire which is of sufficient area to underlie the largest shoe to be treated in the apparatus.

By virtue of the inherent characteristics of the holddown electrode member 26, the process of conforming it manually to the welt crease around the forepart of the shoe is a relatively simple matter and may be carried out in a moment by the operator. The novel points of construction contributing to this advantage and to other inherent advantages thereof relate to the use of a flexible, elastic, dielectric containing-medium such as a tubular rubber casing 28 containing metallic particles 30 in packed relation, in this illustration the particles comprising small ferro-magnetic balls substantially filling the casing 28. Normally, these metallic balls will be substantially unmagnetized and will distribute themselves readily by the application of pressure applied manually by the operator in conforming the holddown electrode to the contour of the welt crease, but once the holddown has been laid against the welt crease the balls may be magnetized to convert the holddown electrode into a rigid body, thus holding it in the shape which it has assumed and adapting it for the transmission of pressure uniformly to the welt strip of the shoe. Preferably, therefore, for the desired magnetization characteristics, the metallic balls may be formed of a ferromagnetic material of high magnetic permeability but of low magnetic retentivity.

In magnetizing the holddown electrode, as in the illustrated apparatus, an electromagnet 32 (Fig. 3) is utilized, having pole pieces 34 cooperating with the end pieces 54 of the holddown member 26 through pivotal joints 36, the purpose of the pivotal joints 36 being to permit lateral expansion and contraction of the holddown member for the insertion and removal of shoes in the apparatus and for the handling of shoes of different sizes. In this connection the magnet pole pieces 34 are pivotally mounted on the respective upstanding ends 38 of the main body portion of the magnet, for rotation about vertical axes 40. The ends of the body portion 38 of the magnet are provided with axially positioned upstanding threaded studs 42 which pass slidably through longitudinal slots 44 (Fig. 1)

formed in the pole pieces 34, and the pole pieces are dovetailed (Fig. 3) into collars 46 which are free to rotate about the studs 42. As a result, the pole pieces may be turned about axes 40 respectively and may be slid inwardly and outwardly relative to a shoe to accommodate the different sizes of shoes which may be brought under treatment. When the pole pieces have been positioned properly by the act of the operator in conforming the holddown member 26 to a shoe they may be locked in position by tightening wing nuts 48. Thereafter, the operator may energize the magnet by passing current through leads 52 to a magnet field winding 50 from any suitable direct current source (not shown). As shown, the end pieces 54 are ferromagnetic and the ends of the casing 28 are secured to them by means of encircling metallic bands 56. The ferromagnetic particles filling the casing 28 will thereby be retained by the inner faces of the end pieces 54, thus forming a continuous magnetic path around the holddown and through the magnet. Conveniently and as shown, the magnet may be mounted in a recess provided at the bottom of the pad box, supported on a plate 58, and secured in this position in any suitable manner.

For the purpose of bringing compacting pressure to bear against the holddown electrode member 26 for transmission to the welt and sole of the shoe there are various suitable mechanical devices available, among which the illustrated device is considered to be particularly suited for the purpose. Such a device comprises a plurality of spaced holddown feet 60, in this case two such feet positioned on either side of the shoe and one at the tip, engaging the holddown 26 at spaced points along its length. In accordance with the illustrated construction of the holddown feet, the holddown electrode member 26 is retained within a semi-cylindrical recess formed near the base of each foot, thereby lending certain assistance, if it be desired, in maintaining the cross-sectional shape of the holddown electrode member 26 when downward pressure is applied by the feet. In setting up the apparatus for use, the holddown feet 60 may be brought inwardly into engagement with the holddown member 26 by a sliding action, for which they are dovetailed (Figs. 2 and 4) into the bottom of a swingably mounted, semi-annular supporting member 62, whereupon they are held in position by means of wing bolts 64 entering the supporting member 62 obliquely to engage the upper surface of the feet 60. In accommodating differences in angularity of the holddown member at the points of location of the feet 60, with differently constructed shoes, the feet may be constructed as shown, in two parts joined at 65 for swiveling relative to each other.

The supporting member 62 is carried by oppositely extending arms 63 formed integrally with a vertically slidable collar 66 encircling a post 68. Terminating the lower end of the post 68 is a toe pad 70 adapted to press against the toe of a shoe in the usual manner, when a downward force is exerted on the post 68 by means of a suitable jack. The bottom portion 72 of such a jack is shown in Fig. 2. Initially the pressures imparted to the holddown feet and to the toe pad are the same owing to the coordinated movement of a pendulum-like cam 74 and the jack, the lower cam surface resting against a projecting shoulder 76 of the collar member 66. Subsequently, however, an additional amount of pres-

sure may be applied to the holddown feet, and hence to the holddown electrode 26 for transmission to the welt strip of the shoe, by applying to the cam 74 a sidewise force which will be multiplied against the shoulder 76 and thereby effect an additional lowering of the supporting member 62 and hence of the holddown feet 60. Details of construction and operation of a suitable jack mechanism and cam, cooperating with a sole attaching pad, may be found in United States Letters Patent No. 2,138,960, issued December 6, 1938, upon an application of Sidney J. Finn, and wherein another form of sole attaching apparatus is disclosed.

With the welt holddown electrode 26 thus appropriately positioned and rigidified by a magnetic field, and with the appropriate sole attaching pressure applied thereto by means of the holddown feet 60, the shoe is now in condition for the activation of the bonding adhesive, which may be accomplished by the passage of a high-frequency electric field vertically through the marginal parts of the shoe. Thus the holddown electrode 26 and the pad cover electrode 20, with the former preferably grounded and the latter at high-voltage, will be connected to the appropriate terminals of a source, such as an oscillator 78 (Fig. 2), of high-frequency energy, over leads 80, resulting in the production of the desired high-frequency electric field passing vertically through the layer of adhesive. Inasmuch as the magnetized balls are in firm contact with one another, they form a continuous electrical conductor or electrode 26. The electrical resistance of this electrode 26 may be further reduced by copper coating the balls 30. The useful portion of the field will thus extend between the lower surface of the inner wedge-shaped portion of the electrode 26 and the general underlying surface of the pad electrode 20. If desired, a suitable timer may be employed in maintaining the oscillator circuit in operation for the desired interval of time thus removing the human factor in determining the heating period. For the purpose described, any suitable high-frequency oscillator may be employed, designed to operate at a frequency, for example, in the order of several megacycles per second and higher, a particularly desirable frequency being in the order of fifty megacycles per second.

Following the activation of the adhesive it will usually be desirable to maintain pressure against the shoe parts for an interval of time required for the adhesive to set. However, this interval may be relatively short in view of the quick setting time of many available thermoactive adhesives. For instance, it is contemplated that the entire process of placing a shoe in the apparatus, applying the holddown member to the welt crease, activating the cement under pressure and allowing it to set will require but a fraction of a minute and will thus effect a considerable saving of time over former methods of sole attaching.

In accordance with an alternative embodiment of the invention, a flexible electrode of the type herein described may be employed in a stray-field electrode pad designed for use in sole attaching following a somewhat different procedure than the foregoing. By way of example, there is shown in Figs. 5 and 6 an electrode pad 82 of the type disclosed in United States Letters Patent No. 2,412,982, issued December 24, 1946, upon an application of George T. Hart, embodying loop electrodes 84 of graduated sizes. Here, the electrodes also comprise metallic particles usually of copper or other good conductor, encased in a flexible medium such as a pad cover 86 formed preferably of a flexible low-loss rubber-like material. A flexible stray-field electrode system is thereby provided which may be conformed uniformly to the bottom surface of a shoe 88 for attaching an outsole 90. In this illustrated instance, the pad is pneumatically operated, and with the shoe 88 placed under the pressure of welt holddown members 92. After the pad has been inflated under pressure, a layer of adhesive between welt and sole of the shoe may be activated by means of a stray field extending upwardly through the shoe parts when high-frequency electrical energy is supplied to the electrodes from a source 94. Suitable leads extending from the source 94 into the pad for connection to the electrodes 84 may comprise insulated flexible braided conductors 96 and 98, the insulation preferably being of a rubber-like material which may be vulcanized readily to the lower surface of the pad cover layers and to the side walls of the pad through which the conductors pass, thereby simplifying the problem of making the pad airtight. The conductor 98 may form contact with the metallic particles of the electrodes in any suitable way, such as by separating the strands of the lead conductors for extension into the mass of particles in the vicinity of the connecting point 100 between the conductor 98 and the middle electrode loop, while the conductor 96 is similarly joined to the inner and outer loops.

Because of the durability of an electrode of the type described, the pad may be used repeatedly under the conditions attending sole attaching, for example, of pressure and flexure, without noticeable wear of the electrodes or of the pad.

Conveniently, the pad may be readily constructed by a molding technique in which a pad cover may first be molded with a series of electrode grooves of a predetermined cross-sectional shape suited to producing the desired field pattern, and into which the metallic particles will be poured, after the conductors 96 and 98 have been suitably secured to the pad and the electrical contact means provided extending into the grooves. A suitable resilient covering layer may then be placed over the whole for vulcanization to the pad cover 86.

Other features of the structure which are illustrated and described herein are not claimed since they form the subject-matter of a divisional application in my named Serial No. 112,097, filed August 24, 1949.

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

1. In high-frequency electric heating apparatus, a conformable electrode member comprising a flexible casing filled with a substantially non-resilient mass of mutually contacting conductive metallic particles, and means for establishing an external electrical contact with said particles as a conductive body for the purpose of supplying a high-frequency voltage thereto.

2. In high-frequency electric heating apparatus, a flexible electrode member comprising an elongated flexible casing a substantially non-resilient conductive mass of mutually contacting metallic spheres, and means for establishing an electrical contact with said particles as a group for the conduction of high-frequency voltage thereto.

MERWIN F. ASHLEY.

(References on following page)

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,220,269	Patzold et al.	Nov. 5, 1940
2,222,615	Hart	Nov. 26, 1940
2,228,136	Hart	Jan. 7, 1941
2,275,430	Hart et al.	Mar. 10, 1942
2,379,059	Ashley et al.	June 26, 1945
2,426,267	Hart	Aug. 26, 1947
2,450,956	Hart	Oct. 12, 1948
2,474,977	Hart	July 5, 1949

FOREIGN PATENTS

Number	Country	Date
342,419	Great Britain	Feb. 5, 1931