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RADIATOR FOR SHORT-WAVE DEVICES

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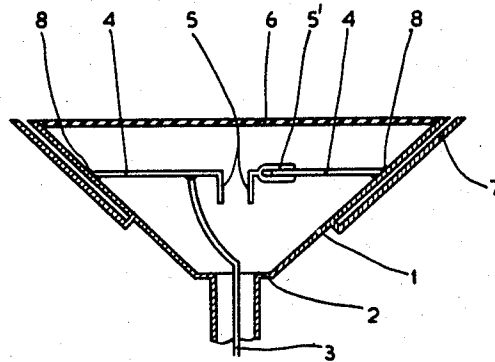


FIG. 1

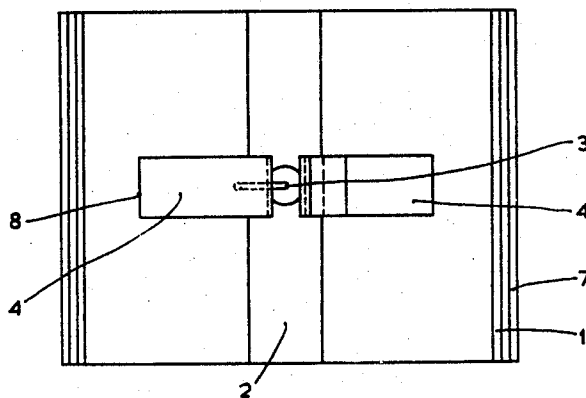


FIG. 2

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RADIATOR FOR SHORT-WAVE DEVICES

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Claims priority, application Germany June 15, 1956

6 Claims. (Cl. 343—749)

The present invention relates to a short-wave radiator. More particularly, the invention relates to the heating of objects and more particularly biological tissues by electromagnetic radiation in the range of decimeter waves, and it relates especially to radiators for this wavelength.

Two wavelength ranges are at present permissible for radiation therapy and other heating purposes, that is, the range of about 2400 megacycles per second, and more recently also the range of about 450 megacycles per second. The high frequencies permit the use of ordinary radiators, the geometric size of which corresponds to the dimensions of the surface to be irradiated. At the low frequencies the radiator of ordinary type becomes much too large in size with proportional variation in its dimensions. Furthermore, it is necessary to work in the vicinity of the core of the field to transfer the energy of the generator to the object with a proper efficiency.

The object of the invention is to provide radiators, the dimensions of which are artificially reduced and which permit working in the core of the radiation field. According to the invention, a radiator of funnel-like section, the aperture of which is approximately equal to the half effective wavelength, or the half apparent wavelength of the energy in the radiator, is loaded and tuned by means of a series-combination of inductive and capacitive reactances which is arranged transversely over the aperture.

According to the invention, an attractive embodiment of very simple construction has transversely directed projections which extend in the central surface of the radiator, parallel to the electric field vector, and the foot points of which are connected to opposing walls of the radiator with a spacing of less than half the effective wavelength. The projections terminate at the center of the radiator with opposing ends bent-over rectangulary. The supply line is connected to the projections symmetrically or asymmetrically.

In such a funnel-like radiator, it is preferable for the surface currents along the wall to be suppressed by the use of a known quarter wavelength choke or a resistance layer.

In order that the invention may be more readily carried into effect, it will now be described more fully with reference to the accompanying drawing, in which:

Fig. 1 is a schematic section of an embodiment of a radiator of the present invention; and

Fig. 2 shows a plan view of the embodiment of Fig. 1.

The radiator comprises a V-shaped plate 1, having at the top a plane portion 2, through which a supply line 3 extends. The dimensions are so chosen that the width of the aperture, which is preferably covered by a plate 6 of low loss dielectric material, approximately corresponds to half the effective wavelength for an opening angle of about 90°. It is not necessary for the radiator to be closed at its ends by means of walls.

In the surface situated midway between the ends, two metal projections 4 are connected to the wall, which pro-

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jections are directed towards each other and have their bent extremities 5 opposite each other. The spacing between the foot points is less than half the wavelength. The limbs of the projections 4, which are parallel to the plane of the aperture, constitute inductive reactances. A capacitive reactance is produced between the bent extremities 5. The radiator is tuned by means of the two inductive reactances and the capacitive reactance. The supply line 3 for the high frequencies is asymmetrically connected to one of the projections 4 at a point such that matching is obtained. Tuning and matching vary during the operation of the radiator, since in front of the aperture, in the field present there, a body of variable electrical properties is arranged. The radiator can thus be tuned and matched only for a mean irradiation distance. Tuning is effected in a simple manner by moving the bent extremities 5 of the projections 4 towards each other or apart from each other by means of a suitable instrument made of dielectric material. The length of one projection may also be variable, for example if a slidable shoe 5' is provided on this part.

By means of spacers (not shown), the detuning or reflection on the surface to be irradiated may be prevented from becoming unduly great.

In order to avoid surface currents along the outer wall of the radiator, $\lambda/4$ wavelength chokes 7 of known type are arranged in parallel with the inclined surfaces.

The invention is also advantageously applicable to radiators having a circular aperture, such as spherical or parabolic radiators.

There is a transition range between the transfer of energy to objects by means of radiation and the methods by which the object is placed either between electrodes in the condenser field or in the induction field produced by a coil. The condenser field may be highly homogeneous, so that the electric lines of force penetrate the various tissue layers substantially at right angles. Fatter layers offer the highest resistance to this penetration and are thus heated strongest. During the inductive treatment, the electric field coupled to the induction lines is directed substantially in parallel to the tissue layers. Since the field is non-homogeneous in this case, the skin tissue is strongly loaded. The radiation obtained by means of a short-wave radiator may be made homogeneous by means of effective beaming. The electric field lines then also extend in parallel with the tissue layers, so that this application permits the obtaining of optimum results in therapy.

While the invention has been described by means of a specific example and in a specific embodiment, I do not wish to be limited thereto, for obvious modifications will occur to those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, and means for loading and tuning said radiator affixed to opposing sides of said section and extending substantially transversely across said aperture.

2. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, and means for loading and tuning said radiator, said last-mentioned means comprising a series combination of inductive and capacitive reactances

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affixed to opposing sides of said section and extending substantially transversely across said aperture.

3. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, means for loading and tuning said radiator, said last-mentioned means comprising a pair of projections affixed to opposing sides of said section and extending substantially transversely across said aperture, the side ends of said projections being separated from each other by a distance less than the half wavelength of energy in said radiator and the inner ends of said projections being bent to form substantially parallel arms in relatively close proximity to each other, said projections extending substantially parallel to the electric field vector of said radiator, and means for applying input electrical energy to at least one of said projections.

4. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, means for loading and tuning said radiator, said last-mentioned means comprising a pair of projections affixed to opposing sides of said section and extending substantially transversely across said aperture, the side ends of said projections being separated from each other by a distance less than the half wavelength of energy in said radiator and the inner ends of said projections being bent to form substantially parallel arms in relatively close proximity to each other, said projections extending substantially parallel to the electric field vector of said radiator, means for varying the separation between said arms, and means for applying input electrical energy to at least one of said projections.

5. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, means for loading and tuning

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said radiator, said last-mentioned means comprising a pair of projections affixed to opposing sides of said section and extending substantially transversely across said aperture, the side ends of said projections being separated from each other by a distance less than the half wavelength of energy in said radiator and the inner ends of said projections being bent to form substantially parallel arms in relatively close proximity to each other, said projections extending substantially parallel to the electric field vector of said radiator, means for varying the separation between said arms, means for applying input electrical energy to at least one of said projections, and means for damping surface currents on the outer surfaces of said sides.

6. A radiator for short-wave devices, comprising a funnel-like section having sides forming a relatively small cross-section at one end and a relatively large cross-section aperture at the other end, said aperture having a width substantially equal to the half wavelength of energy in said radiator, means for loading and tuning said radiator, said last-mentioned means comprising a pair of projections affixed to and in electrically conductive connection with opposing sides of said section and extending substantially transversely across said aperture, the side ends of said projections being separated from each other by a distance less than the half wavelength of energy in said radiator and the inner ends of said projections being bent to form substantially parallel arms in relatively close proximity to each other, said projections extending substantially parallel to the electric field vector of said radiator, and means for applying input electrical energy to at least one of said projections.

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