

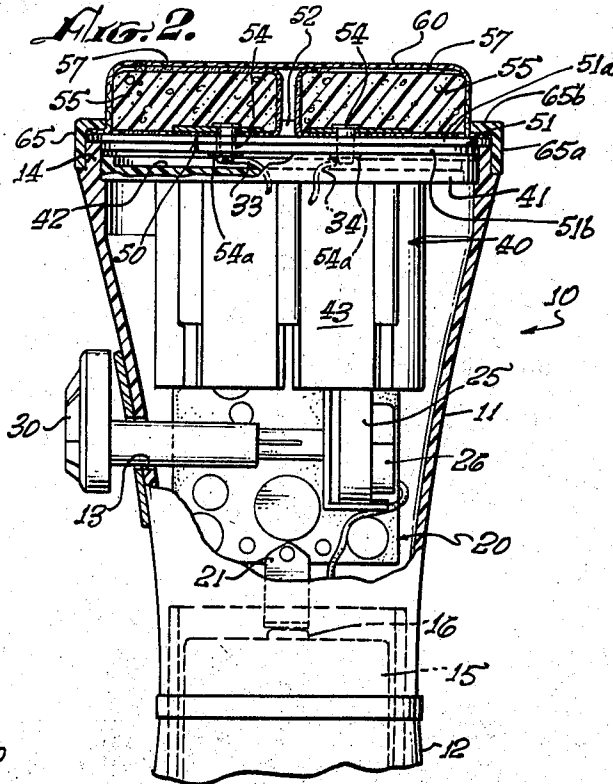
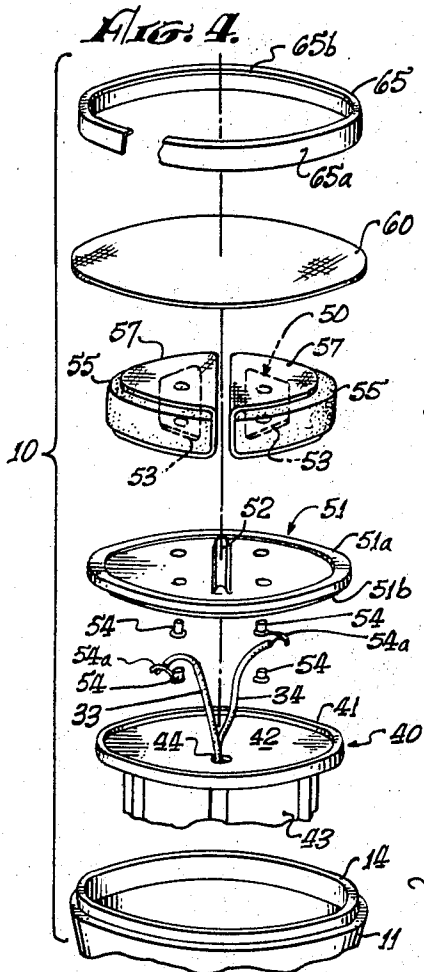
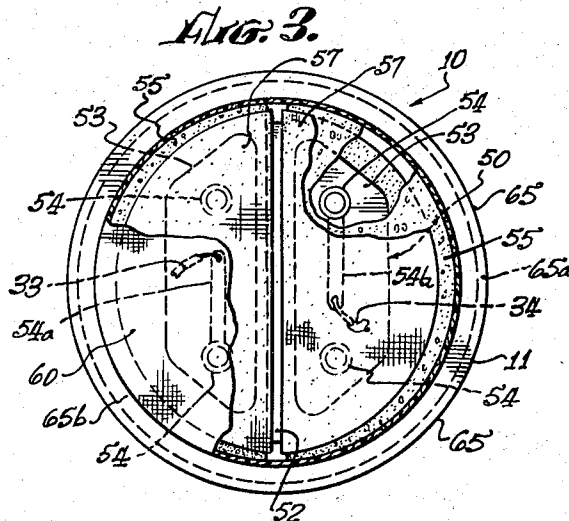
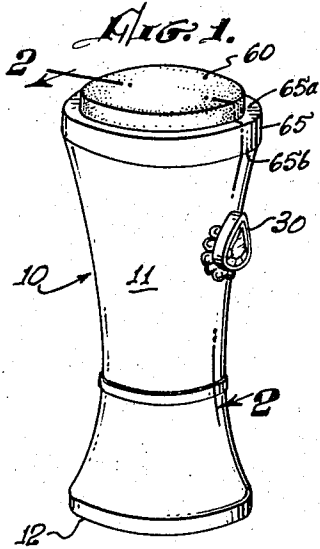
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ELECTRONIC MUSCLE STIMULATOR AND ELECTRODES THEREFOR

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3,424,165

## ELECTRONIC MUSCLE STIMULATOR AND ELECTRODES THEREFOR

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9 Claims

This invention relates to electrical signal generating apparatus for stimulating muscle activity and more particularly to an electrode configuration therefor.

It has been found that certain types of electrical impulses may be utilized for stimulating muscle action to achieve and maintain muscle tone and to eliminate soft, flabby body tissue. Apparatus using transistorized circuits for generating such muscle stimulating electrical signals are now well known in the art, the electrical output of the generator being fed to a pair of electrodes disposed near opposite ends of a particular muscle to be stimulated. The electrodes are typically covered with a pad which is moistened to facilitate electrical contact with the skin of the user, the pads being placed on the skin in areas where the muscles and nerve endings are close to the surface, the electrodes being connected to the signal generator by means of connecting cords.

The present invention is directed toward an electronic muscle stimulator apparatus for stimulating facial muscles, wherein small electrodes spaced closely together are preferred. The present invention resulted from development of a novel electrode configuration, thereby rendering feasible a compact and unitary apparatus wherein the electrodes, facial pads, signal generator and power supply are all contained in a hand-held casing.

Accordingly, a principal object of the present invention is to provide an improved electronic apparatus for muscle stimulation.

Another object of the present invention is to provide a device of the character described which is compact, hand-held, and completely self-contained.

It is also an object of the present invention to provide a novel electrode structure for a device of the character described.

It is a further object of the present invention to provide a novel electrode configuration for a device of the character described, the electrode configuration being particularly suitable for application to the face of the user.

It is another object of the present invention to provide improved electronic apparatus for stimulating facial muscles.

The present invention utilizes electro-conductive sheet material for the electrodes to provide a pair of adjacent, substantially semicircular, facial contact areas in one end of a tubular casing. The sheet material is cut in circular form and each resulting flexible disc is folded about the chordal edge of a substantially semicircular support pad, the support pads being disposed in co-planar alignment with their chordal edges parallel and spaced sufficiently apart to prevent short-circuiting of the adjacent electrodes. Electrical connection is made to those portions of the electrodes beneath the support pads, those portions of the electrodes above the support pads defining the facial contact area.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages thereof will be better understood from the following description considered in connection with the accompanying drawing in which a presently preferred embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description

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only, and is not intended as a definition of the limits of the invention.

In the drawing:

FIGURE 1 is a perspective view of a compact electronic muscle stimulator embodiment;

FIGURE 2 is a partly sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a plan view, partly cut away, of the device of FIGURE 2; and

FIGURE 4 is an exploded perspective view of the upper portion of the device.

Turning now to the drawing, in FIGURE 1 there is shown a perspective view of a presently preferred embodiment of a compact, self-contained electronic muscle stimulator device in accordance with the present invention, the device being generally indicated by the reference numeral 10. The device housing is in the form of a tubular casing 11 of plastic or other suitable insulating material, typically having an overall length of about four inches and a maximum diameter of about two inches, tapering to a minimum diameter of about one and one-quarter inches, so that the device may be conveniently hand-held. At the bottom of the casing is a removable cap 12 to permit access to a battery 15 (shown in FIGURE 2) used as the source of operating potential for the device. The cap 12 can be used for the dual purpose of retaining the battery 15 and establishing electrical contact to one of the battery terminals in a manner similar to that in common usage in flashlights.

As shown in the partially cut away view of FIGURE 2 the other battery terminal 16 is urged against a metallic contact 21 mounted on a circuit board containing the electrical components for the muscle stimulating signal generator, the circuit board being generally indicated by the reference numeral 20. The use of transistors, miniaturized components, printed and integrated circuitry, etc., enables the fabrication of a suitable electronic generator on a circuit board of such compactness so that it will easily fit within the casing 11. For example, a circuit board 20 having dimensions on the order of 1" x 2" was used with the aforementioned typically dimensioned casing 11.

Various circuits for the generation of electrical signals suitable for muscle stimulation are well known in the art, and such particular circuitry is not a part of the present invention. A typical example of suitable circuitry can be found in U.S. Patent No. 3,180,338, entitled "Electronic Muscle Stimulator," issued April 27, 1965, the transistorized circuitry therein presented being presently preferred for use in the present invention device.

In the illustrated embodiment, the signal generator circuitry is provided with a potentiometer 25 incorporating a switch 26, the potentiometer functioning to control the amplitude of the muscle stimulating pulses while the switch 26 is a power switch which turns the device on and off. The potentiometer shaft is provided with an extension projecting through a hole 13 in the casing 11 and terminating in an external knob 30 which can be conveniently rotated by thumb pressure so that the device may be held and operated with only one hand.

Referring now to FIGURES 3 and 4 of the drawing, the open upper end of the casing 11 defines a circular flange 14 into which is fitted a plastic plug generally indicated by the reference numeral 40. The plug 40 has a disc shaped top 41 defining a circular depression 42 in its upper surface, and a downwardly extending portion 43 of arcuate cross-section adapted to retentively engage a portion of the circuit board 20 and encompass the components mounted thereon. The plug 40 is provided with a hole 44 in its top portion 41 for the passage of electrical connecting leads 33 and 34 from the signal generator out-

put to an electrode assembly generally indicated by the reference numeral 50.

The electrode assembly 50 comprises a circular support plate 51, a pair of electro-conductive contact plates 53, a pair of support pads 55, and a pair of electroconductive flexible discs 57. The support plate 51 is fabricated of plastic or other suitable electrical insulating material, and defines a larger diameter upper portion 51a and a smaller diameter lower portion 51b, the outer diameter of the upper portion 51a corresponding to the outer diameter of the circular flange 14 on the casing 11, and the outer diameter of the lower portion 51b being almost substantially equal to the inner diameter of the circular flange 14 for a press fit. The upper surface of the larger diameter portion 51a defines a circular depression bisected by a projecting rib 52.

The contact plates 53 are metal plates of generally trapezoidal shape and are secured to the upper surface of the support plate 51, on either side of the rib 52, by rivets 54. One of the rivets 54 on either side of the rib 52 includes a projecting lug 54a to which is soldered a different one of the electrical leads 33 and 34. The pair of support pads 55 are fabricated of a sponge like material such as flexible polyurethane foam for example, and are of substantially semi-circular configuration to fit within the depression in the upper surface of the support plate on either side of the rib 52.

The pair of discs 57 are fabricated of an electro-conductive sheet material, such as the electro-conductive rubber compound commonly used for body electrodes in muscle stimulating apparatus. The discs 57 are of a diameter slightly less than the diameter of the circular depression in the upper surface of the support plate 51, each of the flexible electro-conductive discs 57 being folded around the chordal edge of a different one of the support pads 55 to thereby form a pair of substantially semicircular electrodes. These electrodes are disposed within the circular depression in the upper surface of the support plate 51 on either side of the rib 52 with the portion of each disc 57 beneath its associated support pad being in electrical contact with the underlying contact plate 53.

In the illustrated embodiment the electrode assembly is fabricated by placing one of the electro-conductive discs 57 into position atop the support plate 51 and then placing one of the contact plates 53 atop the flexible disc and riveting it into place, whereby the disc 57 is secured to the support plate 51 and in electrical contact with the plate 53. Next, the associated support pad is positioned atop the contact plate 53 and the free portion of the electro-conductive disc folded around the chordal edge of the support pad, the support pad being secured to the underlying contact plate and to the electro-conductive disc 57 by means of a suitable adhesive substance or material. Then, the remaining contact plate and electrode is assembled in a similar manner on the other side of the rib 52.

A replaceable facial pad 60, comprising a circular disc of moisture-retentive material such as cotton felt, for example, is secured over the electrode assembly 50 by means of a mounting ring 65. The mounting ring 65 comprises a main body portion 65a having an inner diameter slightly greater than the outer diameter of the circular flange 14 at the top of the casing 11, and an uppermost inwardly directed flange portion 65b of sufficient inner diameter to clear the support pads of the electrode assembly 50. The facial pad 60 is of sufficiently large diameter so that when it is placed in position centered atop the electrode assembly 50 and the mounting ring 65 then pushed downward into position, the outermost portion of the facial pad will be forced downwardly about the periphery of the electrode assembly and then outwardly beneath the inwardly directed flange portion 65b of the mounting ring. Thus, the mounting ring will circumferentially clamp the facial pad 60 between the flange 65b of the mounting ring and the upper surface 51a of the

support plate, the facial pad being stretched rather tightly over the electrode assembly.

In use, the facial pad 60 is moistened and the device rendered operative by rotation of the knob 30, electrical current flowing between the upper surfaces of the electroconductive discs 57 through the skin of the face of the user. The facial pad may be replaced by merely removing the mounting ring 65, compression of the material of the facial pad holding the mounting ring in place during use.

Thus, there has been described a unitary, completely self-contained, hand-held apparatus for electronically stimulating facial muscles, the apparatus employing a novel electrode structure which facilitates extreme device compactness. Although the invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. In an electronic muscle stimulator including a tubular casing containing a source of electrical energy and signal generating means powered therefrom for generating electrical signals for muscle stimulation, and an electrode assembly mounted to an open end of said casing, said electrode assembly comprising:

- (a) a support plate of electrical insulating material transversely disposed across said open end of said casing;
- (b) a pair of substantially semicircular support pads defining a chordal edge extending between the ends of an arcuate edge; and
- (c) a pair of circular discs of flexible electro-conductive sheet material, each of said discs being folded around the chordal edge of a different one of said support pads so that portions of the disc are above and beneath the support pad to thereby form a substantially semicircular electrode, said electrodes being secured to said support plate with their chordal edges in spaced apart parallel alignment, said electrodes being connected to the output of said signal generating means.

2. An electrode assembly in an electronic muscle stimulator as defined in claim 1, further including a pair of electro-conductive contact plates mounted in spaced apart relationship on the exposed face of said support plate, said contact plates being electrically connected to the output of said signal generating means, said electrodes being secured with the portion of each disc beneath the associated support pad in electrical contact with a different one of said contact plates.

3. An electrode assembly in an electronic muscle stimulator as defined in claim 2, wherein each of said contact plates is secured to said support plate with a portion of the associated electro-conductive disc compressed therebetween.

4. An electrode assembly in an electronic muscle stimulator as defined in claim 1, wherein the exposed face of said support plate is bisected by a projecting rib, said electrodes being disposed on either side of said rib with their chordal edges in parallel alignment therewith.

5. An electrode assembly in an electronic muscle stimulator as defined in claim 1, wherein said support plate is detachably secured to said casing.

6. An electronic apparatus for stimulating facial muscles comprising, in combination:

- (a) a tubular casing sized to be held in one hand and containing a source of electrical energy and signal generating means powered therefrom for generating electrical signals for muscle stimulation, said casing having an open end;
- (b) a support plate of electrical insulating material transversely disposed across said open end of said casing;

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- (c) a pair of substantially semicircular support pads of foam like material defining a chordal edge extending between the ends of an arcuate edge;
- (d) a pair of circular discs of flexible electro-conductive sheet material, each of said discs being folded around the chordal edge of a different one of said support pads so that portions of the disc are above and beneath the support pad to thereby form a substantially semicircular electrode, said electrodes being secured to said support plate with their chordal edges in spaced apart parallel alignment, said electrodes being connected to the output of said signal generating means;
- (e) a facial pad of flexible moisture-retentive material covering said electrodes; and,
- (f) a mounting ring detachably secured to the open end of said casing and circumferentially securing said facial pad.
7. An electronic apparatus for stimulating facial muscles as defined in claim 6, further including a pair of electro-conductive contact plates mounted in spaced apart relationship on the exposed face of said support plate, said contact plates being electrically connected to the output of said signal generating means, said electrodes being se-

cured with the portion of each disc beneath the associated support pad in electrical contact with a different one of said contact plates.

8. An electronic apparatus for stimulating facial muscles as defined in claim 7, wherein each of said contact plates is secured to said support plate with a portion of the associated electro-conductive disc compressed therebetween.

9. An electronic apparatus for stimulating facial muscles as defined in claim 6, wherein the exposed face of said support plate is bisected by a projecting rib, said electrodes being disposed on either side of said rib with their chordal edges in parallel alignment therewith.

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