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Deering et al.

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[54] **SURFACE ELECTRODE ADAPTED FOR USE WITH RHEOGRAPHIC APPARATUS**

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[52] **U.S. Cl.** ..... **128/2.1 E**, 128/DIG. 4, 128/418, 128/416, 339/261, 128/411

[51] **Int. Cl.** **A61b 5/04**, A61n 1/04

[58] **Field of Search** ..... 128/2.1 E, 2.06 E, DIG. 4, 128/416–418, 410–411, 404, 379, 380, 384–389, 172.1, 1 C, 303.13; 174/5 SB; 317/2 B; 339/260, 261

[56] **References Cited**

UNITED STATES PATENTS

840,915	1/1907	Cove	339/260
910,474	10/1909	Hornung et al.	128/384
1,853,814	4/1932	Huth	128/416
3,543,760	12/1970	Bolduc	128/416

FOREIGN PATENTS OR APPLICATIONS

74,787	1/1917	Switzerland	339/260
732,130	9/1932	France	128/416

OTHER PUBLICATIONS

General Electric Diathermy Electrodes and Accessories, GE X-Ray Corp., 1934, pp. 14, 25, 28.

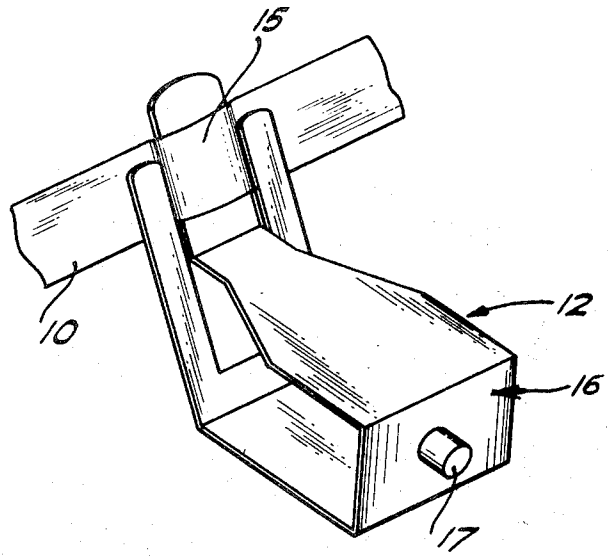
"Electronics and the Aged," Radio Electronics, Vol. 36, No. 6, June 1965, p. 29.

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[57] **ABSTRACT**

A quickly attachable and detachable surface electrode arrangement, especially adapted for connecting rheographic apparatus to the extremity of a subject such as a human subject for making impedance measurements. A broad, flexible conductive band is provided, adapted to loop around an extremity of the subject in conductive contact with the skin. A clamp is provided to firmly secure the conductive band in the loop, with the band in good conductive contact with the skin. The clamp is adapted to be connected to a conductor for providing an excitation signal to the subject from suitable rheographic apparatus or other electrical equipment. The electrode and clamp arrangement is also capable of use as a receiver electrode. The clamp is easily attachable and removable since it comprises two outer tangs joined at one end to a base to form a fork, and otherwise includes an elongate center tang or tongue which is also joined to the base of the fork by a flexible, spring portion. The tongue can be depressed through the fork by pinching action of an operator and, when released, will spring back through the fork to firmly engage and clamp a portion of the band placed therebetween. The extended ends of the fork tangs and the tongue are formed of flat conductive material whereby excellent electrical contact is achieved with the conductive band, when it is clamped.

1 Claim, 5 Drawing Figures



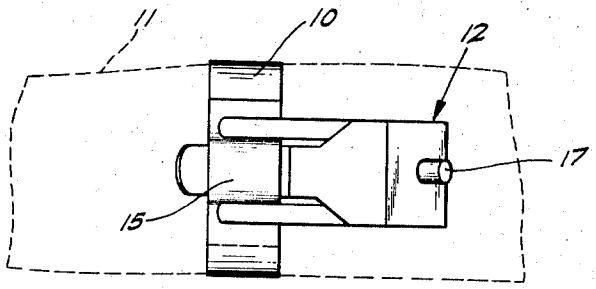


Fig 1

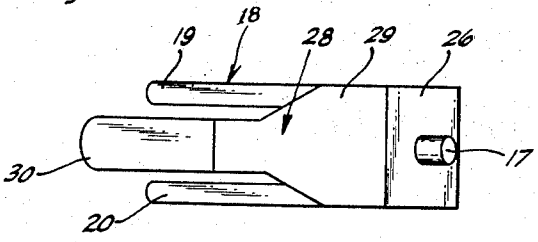


Fig 3

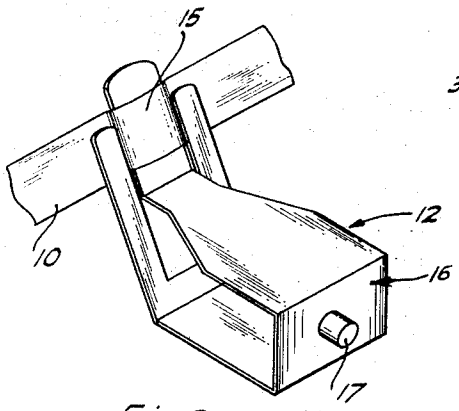


Fig 2

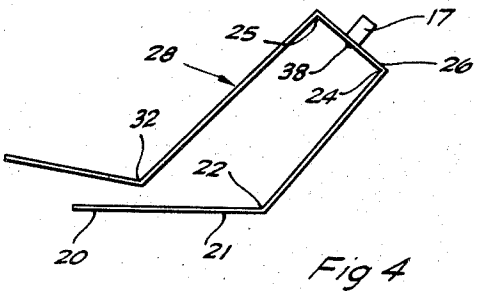


Fig 4

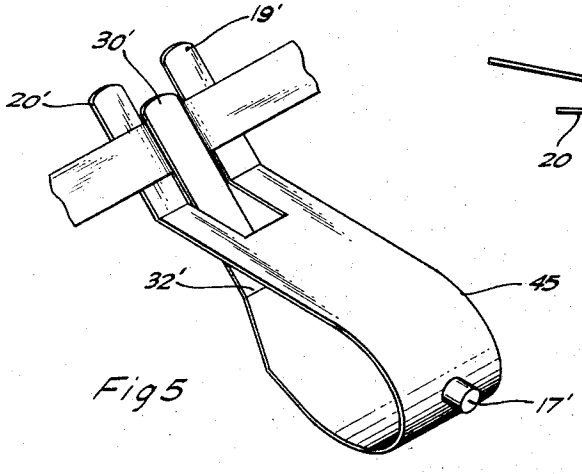


Fig 5

SURFACE ELECTRODE ADAPTED FOR USE WITH RHEOGRAPHIC APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a quickly attachable and detachable surface electrode arrangement. More particularly, the invention concerns a band and clamp arrangement especially adapted for use as an excitation electrode or a receiver electrode for excitation signals to be applied to the extremities of a subject, such as from an associated rheographic apparatus.

Various rheographic systems are utilized in medicine in which an excitation signal of relatively high frequency is applied to a subject, and a resulting signal is sensed from the subject as an indication of the impedance or some other parameter of the subject. In most such cases the excitation signal is applied to the skin of the subject usually at one or more extremities thereof. Also, in the usual case the resultant signal from the patient is picked up by skin electrodes again attached to the extremities of the subject.

Various types of skin electrodes have been utilized for this purpose. Perhaps the most common type are flat discs or cups which are secured to the extremities by straps. These electrodes usually require the use of a conductive jelly to facilitate suitable electrical contact with the skin of the subjects. They may also require the use of straps which are tightly placed upon the extremities of the subject to further facilitate the electrical contact required. Aside from the discomfort to the patient associated with the use of such electrodes, they are cumbersome to use and time consuming since they require special placement and operator attention.

Other electrodes such as subcutaneously placed needles could be utilized, if desired, but obviously would result in more patient discomfort. Consequently a need has developed in conjunction with rheographic apparatus for a quickly attachable and detachable surface electrode that can be employed as an excitation electrode or as a receiver electrode.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide a surface for skin electrode arrangement which overcomes the disadvantages of skin electrodes mentioned above.

It is another object of the invention to provide a quickly attachable and releasable clamp.

It is a further object of the invention to provide a quickly attachable and detachable band and clamp arrangement which can be easily and quickly applied to the extremities of a subject by even an inexperienced operator, in a manner which will provide suitable conductive contact between the subject and an electrical instrument such as a rheographic apparatus.

It is yet another object of the invention to provide such a surface electrode arrangement which is extremely easy to manufacture and assemble whereby the electrode is economical to use.

It is yet a further object of the invention to provide a band and clamp arrangement wherein the clamp includes two fixed elements and a movable element adapted to pass therebetween whereby a section of a looped band clamped therebetween will be placed under tension.

These and other objects of the invention are attained with an electrode and clamp arrangement which utilizes a wide, flat flexible conductive band adapted to surround an extremity of the subject and form a skin contacting loop. The arrangement otherwise includes a clamp adapted to slip over the common portion of the looped band for securing the loop around the extremity with suitable tension to provide good electrical contact between the loop and the subject. The clamp is adapted to be connected to a conductor associated with suitable rheographic apparatus. Preferably, the clamp is fabricated such that one or more flat members are placed in clamping relationship with the band whereby good conductive contact is established between the clamp and the band. The clamp is designed such that it can be manufactured from a single strip of conductive material. Consequently the band and clamp are especially economical to manufacture and use.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and advantages of the invention will become apparent from the following detailed description of the invention taken in conjunction with the accompanying drawings wherein:

FIG. **1** is a diagrammatic view of one preferred embodiment of the invention associated with an extremity of a subject illustrated in dotted outline;

FIG. **2** is an enlarged perspective view of one preferred embodiment of a clamp associated with a portion of a flexible conductive band;

FIG. **3** is a top plan view of the clamp embodiment illustrated in FIG. **2**;

FIG. **4** is a side view of the clamp arrangement illustrated in FIGS. **2** and **3**; and

FIG. **5** is a perspective view of an alternative embodiment of a clamp suitable for use with the conductive band illustrated in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings one preferred embodiment of the invention is illustrated including a band **10** adapted to form a loop about an extremity **11** of a subject, such as that illustrated in dotted outline in FIG. **1**. Band **10** preferably comprises a wide flexible solid strip of conductive material such as aluminum or aluminum foil. However, a band of woven conductive wire or a flexible cable could be utilized, if desired. Band **10** is sufficiently long to form a loop about the extremity to which the electrode is to be secured, with sufficient material overlapping to provide a common clamping area as indicated by numeral **15**. With the band associated with the extremity and suitably clamped in position, the band exerts relatively light pressure upon the skin of the subject and provides good electrical contact therewith without the use of conductive cream, although such could be utilized with the band if desired.

Band **10** is adapted to be secured to the extremity, as shown, by a clamp **12** secured in clamping area **15**. In the preferred embodiment, clamp **12** is fabricated of a conductive material and is disposed in good conductive relationship with band **10**. Clamp **12** generally comprises a body portion formed of a single elongate strip of conductive material and an electrode receptor **17** secured to the body, in a manner described hereinafter, to receive an electrical conductor, not illustrated. Since the clamp is adapted for use in medical applications it

should be fabricated of a material which is noncorrosible and can be sterilized.

As shown, the body of the clamp includes a fork **18** comprising elongate extended tangs **19, 20** joined at one end to a base **21.** Base **21** is formed with an angular bend therein along a line **22** extending transversely of the length of tangs **19, 20,** whereby a major portion of base **21** is angularly offset with respect to the tangs at an angle of about 130°. The body is otherwise bent at about a 90° angle along a line **24,** and at about a 90° angle along a line **25** whereby a connector platform **26** is provided between base **21** and a clip portion **28.**

Clip portion **28** includes a wide segment **29** of the clamp body adjacent platform **26,** and a tongue **30** of reduced width extending outwardly therefrom. As shown, a bend is formed in clip portion **28** along a line **32** extending transversely of the length of tongue **30.** Furthermore, tongue **30** is of sufficient length that it extends somewhat beyond the ends of tangs **19, 21.** The combined effect of the bends formed adjacent platform **26** and the bend along line **32** are such that the extended end of tongue **30** is offset upwardly with respect to the tangs by approximately a 10° angle as shown in FIG. **4.** Furthermore, the end of tongue **30** is of sufficiently reduced width that clearance is provided between the side of tongue **30** and the inner edges of tangs **19, 20** whereby tongue **30** can pass back and forth through the fork formed by the tangs when the clamp is pinched and released by an operator. To facilitate this movement, the body of clamp **12** is preferably formed of flexible spring material such as tempered steel, or a tempered alloy of conductive material.

An opening preferably of circular configuration is formed in the center of platform **26.** A connector **17** is secured within the opening by suitable means. In the embodiment illustrated, connector **17** comprises a female type connector having a reduced cylindrical portion on one end adapted to fit within the opening in the platform. An end **38** of the cylindrical portion is swaged to secure the connector to body **16.** Other suitable means of securing the connector to the body, such as soldering, could be utilized if desired. Likewise, other types of connectors could be utilized in connection with the clamp without departing from the scope of the invention. It should also be noted that the tangs and tongue of the clamp are fabricated from thin stock and are formed with relatively wide dimensions. Accordingly the contact between the tongue and tangs of the clamp and the clamping area of band **10,** when the clamp is located in a clamping position, is of sufficient area to ensure good electrical contact between the clamp and bands.

In use of the clamp and band assembly described herein, the band is placed around the extremities of a subject by an operator and drawn to a looped position. The clamp is then deformed by pinching action such that the tongue is oriented between the tangs and these members are located, respectively, on opposite sides of the common portion of the loop. The clamp is then released and, due to the spring action of the material it is fabricated of, as well as the offset in the tangs and the tongue, the tongue moves or springs back through the tangs and firmly clamps the band without pinching the skin of the subject or uprooting hair. The connector **17** can be connected with a suitable electrode either before or after the clamping action is accomplished.

Since the normal position of the tongue of the clamp is slightly away from the tangs, the tongue exerts significant force upon the band when clamped therein. Consequently, the loop formed by the band is effectively shortened and the band is placed under slight tension around the subject. This enhances the desired electrical contact and tends to hold both the band and the clamp in place.

An alternative embodiment of the invention is illustrated in FIG. **5** wherein like elements are identified by like primed numerals. In this embodiment, the tongue and tangs are reversed. Also this embodiment of the invention utilizes a body **45** formed with a curved outline to provide suitable offset between the tongue and tangs. It should be apparent that the function of the clamp illustrated in FIG. **5** is similar but reversed to that illustrated in FIGS. **1** to **4.**

The clamp and band arrangement described herein comprises a surface electrode which is extremely easy to utilize in that an operator can quickly apply or remove the band from the extremity of the subject. Furthermore, the arrangement provides excellent conductive contact with the skin of the subject without the use of conductive creams and without noticeable subject discomfort. Electrical contact is greatly facilitated by the use of a wide conductive band, as well as by the use of tongue and tang members which are flat, and sufficiently wide to contact a signifcant area of the band. Since the tongue over-extends the tangs, the clamp can be easily guided into the clamping position by an operator without injuring the subject. Furthermore the clamp is susceptible of sterilization and is especially adapted to place tightening force on the looped band, when clamped therein.

It should be apparent that, if desired, the clamp described herein could be used for clamping other objects. Thus, the clamp has utility for purposes of clamping nonconductive members, and in that event could be fabricated of nonconductive material, or without connector **17.**

What is claimed is:

1. A surface electrode especially adapted for use as an excitation electrode for applying electrical signals from an electrical apparatus to an extremity of a subject, comprising

a broad flexible conductive band of sufficient length to form a loop around the extremity of a subject, the ends of the band overextending each other forming a common clamping area adapted to be adjacent to the extremity,

clamping means formed of a conductive material and adapted to be associated with an electrical apparatus for engaging said band at said clamping area to confine and tighten the looped band in firm conductive engagement with said extremity, said clamping means including a body formed of a thin strip of resilient material, said body having a fork formed at one end thereof by two extending, straight, spaced-apart tangs,

said body having a tongue formed at the other end thereof having a width less than the gap between said spaced-apart tangs,

said body being formed in a doubled shape so that the tangs and the tongue extend in generally the same direction, with the tongue centered between the tangs and parallel thereto, said tongue and said tangs being flat, the end of the tongue being pressed through the gap between the tangs and firmly engaging said conductive band at said clamping area with the tangs and tongue being positioned on opposite sides of the clamping area for engaging the extremity in a tight relationship.

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