June 6, 1967 R. F. SALTER 3,323,516

ELECTROCARDIOGRAPHIC CONTACT DEVICE

Filed June 22, 1964

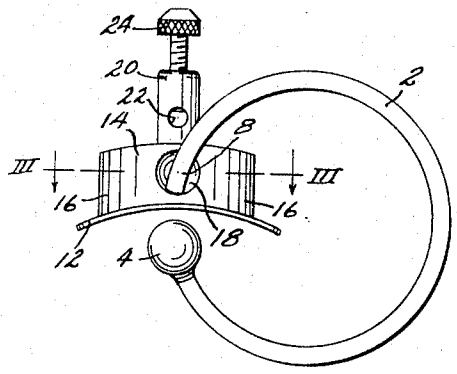


Fig. 1

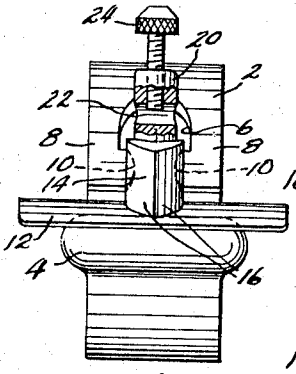


Fig. 2

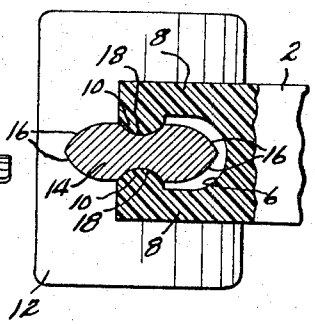


Fig. 3

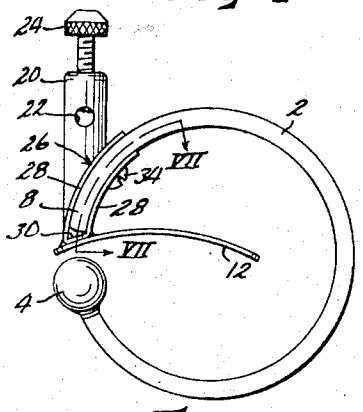


Fig. 5

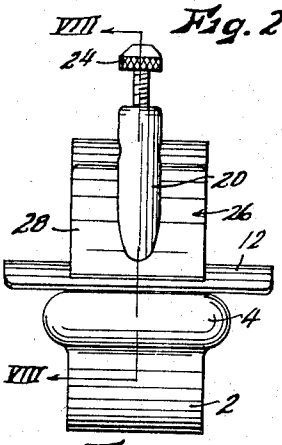


Fig. 6

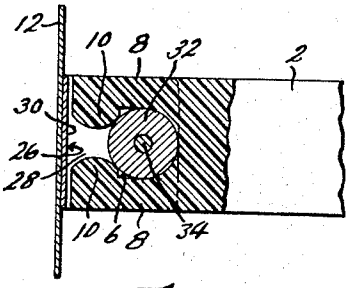


Fig. 7

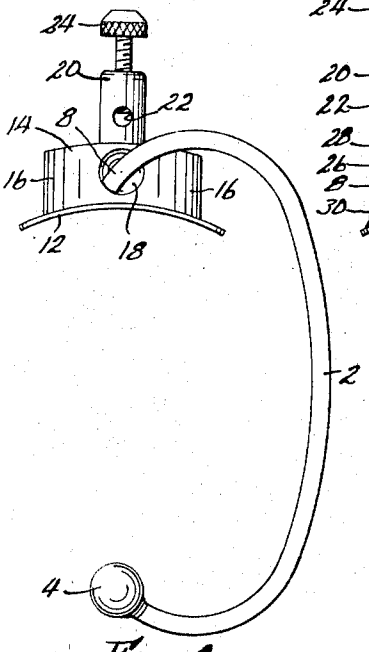


Fig. 4

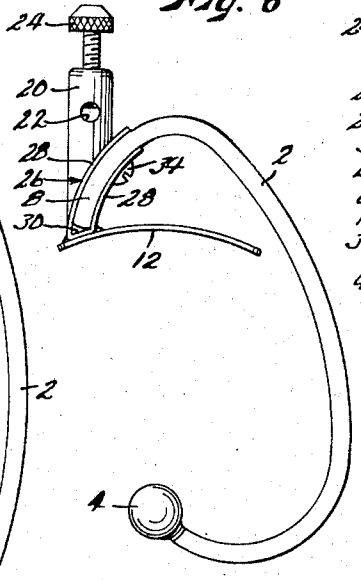


Fig. 9

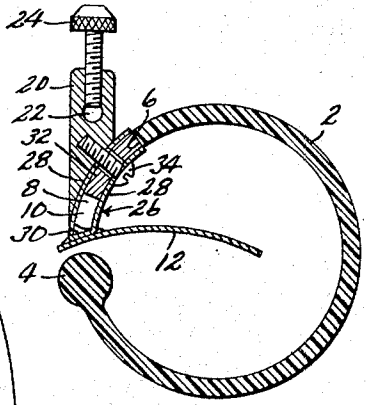


Fig. 8

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United States Patent Office 3,323,516 Patented June 6, 1967

3,323,516

ELECTROCARDIOGRAPHIC CONTACT DEVICE

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Filed June 22, 1964, Ser. No. 376,816
5 Claims. (Cl. 128—2.06)

This invention relates to new and useful improvements in electrocardiographic equipment, and has particular reference to the contact plates customarily placed against the patient's body and connected by electric conductors to an electrocardiograph for measuring and recording electrical potential and other characteristics in the preparation of an electrocardiogram, as is common and well understood in the art, and to the means of securing said contact plates to the patient's body.

Heretofore, the commonest means of securing such a contact plate has been a rubber strap secured snugly about the patient's arm or leg, with the contact plate held firmly between the strap and the skin. It is also customary to coat the plate, or the skin area to be contacted thereby, with a saline or other "contact paste" to insure good electrical contact between the plate and the skin. However, such straps are tedious and time-consuming to apply, are often smeared with the contact paste so as to require cleaning, and are often so cumbersome and bulky as to worry or frighten a patient, when as is well known the making of a reliable electrocardiagram requires as near perfect tranquility of the patient as possible. Previous attempts to produce contact plate attaching means solving these difficulties have, within my knowledge, generally resulted in structures which are relatively complicated and expensive, and which as a consequence have not enjoyed extensive acceptance.

The principal object of the present invention is, therefore the provision of an electrocardiographic contact device which is extremely simple in both operation and appearance, which may be applied easily and instantly to the patient's body without operation of "fasteners" of any kind, and which will insure a full and efficient contact of the entire area of the plate with the patient's skin.

Generally, this object is accomplished by the use of a simple C-clamp formed of resilient material adapted to be spread apart to engage a limb of the patient between the ends thereof with a gentle pressure, one end thereof having a contact plate attached thereto so as to be pressed against the skin by the resilience of the clamp. In one form the contact plate is pivoted to the clamp so as to accommodate itself to the patient's limb to lie flat thereagainst, and in another form the contact plate is rigidly secured to the clamp but in such relationship thereto that the resilience of said clamp permits and causes the plate to accommodate itself to the patient's limb. The same clamp may be used interchangeably in either type of mounting, and in both mountings may be instantly connected to or disconnected from the contact plate, without operation of screws, snaps, bolts or the like, for greater facility of handling and manipulation and to permit convenient cleaning of either of the parts. The use of a resilient plastic in the C-clamp also has certain advantages over the use of spring steel or the like, first in that it is more "universally" elastic than steel and permits the contact plate to tilt universally to contact the patient's skin more efficiently, and second in that it is slower and gentler in its recovery from deformation so that it is less likely to "snap" or slap painfully against the patient's body as it is being applied.

Other objects are simplicity and economy of construction, efficiency and dependability of operation, and adaptability for uses other than in electrocardiography wherever electrical contacting of a person's skin may be desired.

With these objects in view as well as other objects which will appear in the course of the specification, reference will be had to the accompanying drawing, wherein:

FIG. 1 is a side elevational view of an electrocardiographic contact device embodying the present invention, with the C-clamp shown in its relaxed position,

FIG. 2 is a front elevational view of the device as shown in FIG. 1,

FIG. 3 is a fragmentary sectional view taken on line III—III of FIG. 1, with the C-clamp rotated somewhat relative to the contact plate,

FIG. 4 is a view similar to FIG. 1, showing the C-clamp expanded for application to a person's limb,

FIG. 5 is a view similar to FIG. 1, showing a modification of structure,

FIG. 6 is a front elevational view of the form of the device shown in FIG. 5,

FIG. 7 is a fragmentary laid-out sectional view taken on line VII—VII of FIG. 5,

FIG. 8 is a sectional view taken on line VIII—VIII of FIG. 6, with parts left in elevation, and

FIG. 9 is a view similar to FIG. 5, but showing the C-clamp expanded for application to a person's limb.

Like reference numerals apply to similar parts throughout the several views, and the numeral **2** applies to a C-clamp consisting of a flat strip of resilient plastic molded in a C-shape as best shown in FIG. 1. It is of such resilience that when it is expanded as shown in FIG. 4, or even completely straightened, it will when released return to its normal shape. Its recovery, however, will be slow and gentle as compared, for example, to a spring steel clamp. Plastics having these properties are common and well known. One end of the clamp is provided with an integral cylindrical enlargement **4** extending parallel to the clamp axis said enlargement being smoothly rounded and serving as a pad for engaging a person's skin gently and comfortably. The other end of the clamp strip has a slot **6** formed longitudinally therein, the inner end of said slot being semi-circular in form. The strip material at opposite sides of said slot constitute a pair of fingers **8**. At their free ends, each of said fingers is provided with an integral ear **10** at the side thereof adjacent the other finger, the ears therefore being coaxial on an axis parallel to the clamp axis. The inner or confronting ends of said ears are arcuately convex as shown. For a purpose which will presently appear, the convex inner ends of said ears are tangent to the curvature of the semi-circular inner end of slot **6**. The sloted end of C-clamp **2** carries a contact plate **12** of a size, material and configuration recommended by electrocardiographic specialists. As shown, it is formed of stainless steel, is of about 1½ by 2 inches rectangular form, and is arcuately curved about its major axis. It is mounted between the ends of C-clamp **2** with its axis of curvature parallel to the clamp axis, and with its convex side facing pad **4**.

In FIGS 1–4, contact plate **12** is connected to the C-clamp by means including a boss **14** of conducting material welded or otherwise affixed to the convex side of the plate, centrally thereof. Said boss is elongated transversely of the plate, and the ends thereof are tapered to a thin edge as indicated at **16**. The opposite sides of said boss, which rises vertically from plate **12**, have concave sockets **18** formed therein, said sockets being coaxial on an axis parallel to the axis of curvature of the plate, and being adapted to receive the ears **10** of the C-clamp therein as shown, whereby the contact plate is pivotally connected to the C-clamp. In attaching the clamp, the ears **10** are rested against the tapered surfaces **16** at one end of the boss, and pressed toward sockets **18**, whereby fingers **8** of the clamp are resiliently spread apart by the boss to allow the ears to enter the sockets. The ar-

cuate curvature of the ears provides a camming action which also spreads the clamp fingers to allow detachment of the clamp on application of considerable force transverse to the pivot. The strength of the clamp fingers is sufficient, however, to hold the contact plate in assembly therewith with a security fully adequate for all practical purposes.

Provision is made for attachment to the contact plate of a lead wire from an electrocardiograph. As shown, this means includes a terminal post **20** of conducting material affixed to or integral with boss **14** and having a hole **22** formed transversely therethrough for receiving an end of said lead wire, and a clamp screw **24** threaded in said post and adapted to clamp said wire in hole **22**. The clamp ring material, plastic as described, is of course electrically non-conductive to prevent possible interference with test results by contacting something other than the patient's body. Also, as previously described, said plastic is gentler and slower in recovery from deformation than a steel spring, and therefore is more comfortable to the patient. Another advantage of the plastic over steel is that it has a more "universal" flexibility. That is, if for example the contour of a patient's body at the point of contact is desired is such that when the clamp is first applied one end or corner of the contact plate is elevated out of contact with the skin, the plastic appears to "adjust" or "flow" so that with the continued pressure of the clamp the entire plate area soon engages the skin. Full area contact of the plate with the skin is important to uniform and accurate test results.

In FIGS. 5–9, C-clamp **2** is connected non-adjustably to contact plate **12** by means including a U-shaped bracket **26** of conducting material consisting of spaced apart side walls **28** joined by a connecting wall **30**, said connecting wall being welded or otherwise affixed to the convex side of plate **12**, along one of the longer edges thereof, so that the major portion of said plate is disposed within the curvature of the C-clamp. Side walls **26** of the bracket are spaced apart a distance equal to the thickness of the clamp strip, and are arcuately curved to the normal curvature of said strip, so that the slotted end of said strip may be inserted therebetween as shown. A circular washer **32** is disposed between walls **26**, and secured therebetween by a screw **34** passing through walls **26** and said washer, and threaded in a terminal post **20** abutting said bracket, said terminal post being similar in all functional aspects to that shown in FIGS. 1–4. The washer diameter is equal to the diameter of curvature of the inner end of slot **6** so as to seat firmly in said slot when the clamp strip is pressed firmly into the bracket to spread fingers **8** of the strip resiliently apart to allow ears **10** of the fingers to pass around the washer. When the fingers snap into their normal positions, ears **10** thereof are tangent to the washer, so that the connection is firm and free of lost motion.

In the FIGS. 5–9 form of my invention, it will be seen that since nearly the entire width of the contact plate is disposed at one side of its line of attachment to the clamp, and within the clamp curvature, and since the plate is normally so disposed relative to the clamp, approximately radial to the clamp when the latter is relaxed, that the edge thereof opposite bracket **26** normally engages the patient's body first, that the pressure of the clamp will force the entire area of the plate into contact with the skin. The plate acts as a lever applying a bending stress to the clamp strip, tending to sharpen and increase the curvature of said strip immediately adjacent bracket **26**, as clearly shown in FIG. 9. While the FIG. 5 species is perhaps not quite as efficient as the FIG. 1 species in insuring full area contact of plate **12**, particularly where the clamp must be expanded to an extreme degree, it is completely satisfactory in the great majority of applications, and has the advantage that it has no loose pivotal joints as in FIG. 1. The FIG. 1

pivot, while of course virtually guaranteeing full area contact of plate **12**, does require that the plate be pivoted to the correct position before applying the clamp. This may require the use of both of the operator's hands, while the FIG. 5 species can nearly always be applied with one hand.

While I have shown and described certain specific embodiments of my invention, it will be readily apparent that many minor changes of structure and operation could be made without departing from the spirit of the invention as defined by the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. An electrocardiographic contact device comprising:

(a) a C-clamp constituting a flat strip of resilient material formed in a normally generally circular curvature about a geometric axis extending at right angles to the plane of said curvature, the free ends of said strip being adapted to be spread apart to encompass a portion of a patient's anatomy clampingly therebetween, one end portion of said strip having a longitudinally extending slot formed therein and opening through the adjacent end of said strip, the strip material at opposite sides of said slot forming fingers adapted by the resilience of said strip material to be spread yieldably apart from each other in the plane of said strip, said fingers having opposed ears formed on the confronting sides thereof,

(b) a contact plate having its plane generally parallel to the axis of said C-clamp, and disposed between the ends of said strip,

(c) means attaching said contact plate to the slotted end of said C-clamp strip, said means including a boss affixed to the outer surface of said contact plate and having opposite faces rising vertically from said plate surface, each of said boss faces having a socket formed therein in axial alignment with the socket of the other face, and having one of said ears of said C-clamp fingers engaged in said socket for pivotal movement about the axis of said sockets, whereby said contact plate is urged against the patient's body and will accommodate itself by said pivotal connection to provide full area contact with the patient's body, and

(d) means for attaching an electrocardiograph lead wire to said contact plate.

2. An electrocardiographic contact device as recited in claim **1** wherein said sockets are arcuately concave, and wherein the opposed ends of said clamp fingers are correspondingly convex, whereby said C-clamp may be detached from said boss by a substantial force exerted thereon transversely to the axis of said sockets.

3. An electrocardiographic contact device as recited in claim **1** whereby said boss is elongated in a direction parallel to the general plane of said contact plate and at right angles to the axis of said sockets, the socketed faces of said boss converging toward the ends of said boss, whereby to serve as cams for engaging said ears and forcing said clamp fingers apart when attaching said clamp to said boss.

4. An electrocardiographic contact device comprising:

(a) a normally generally cylindrically curved flat strip of resilient material, the free ends thereof being adapted to be spread apart to encompass a portion of a patient's body therebetween, said strip having a longitudinally disposed slot formed therein and opening through one end thereof, the strip material at opposite sides of said slot forming fingers adapted by the resilience of the strip material to be yieldable away from each other in the plane of said strip, said fingers having opposed ears formed on the confronting sides thereof,

(b) a contact plate formed of conducting material and disposed between the ends of said strip with its

plane generally parallel to the axis of curvature of said strip,

(c) a U-shaped bracket having a connecting portion affixed to the outer surface of said contact plate closely adjacent one edge thereof and side walls extending outwardly from said plate, said side walls being curved toward the opposite edge of said plate with a curvature corresponding to the normal curvature of said strip and spaced apart a distance equal to the thickness of said strip, the slotted end of said strip being inserted between the side walls of said bracket,

(d) a rigid retainer member affixed between the side walls of said bracket, the dimension of said retainer member, in a direction parallel to the clamp axis, being equal to or less than the width of said slot, but greater than the spacing between said ears, and

(e) means for attaching an electrocardiograph lead wire to said contact plate.

5. An electrocardiographic contact device as recited in claim 4 wherein said retainer member constitutes a circular washer with its axis normal to said bracket side

walls, the inner end of said clamp slot having a semicircular curvature equal to that of said washer, and said clamp ears normally being tangent to said washer.

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