

[54] **ELECTRICALLY CONDUCTIVE WRIST STRAP**

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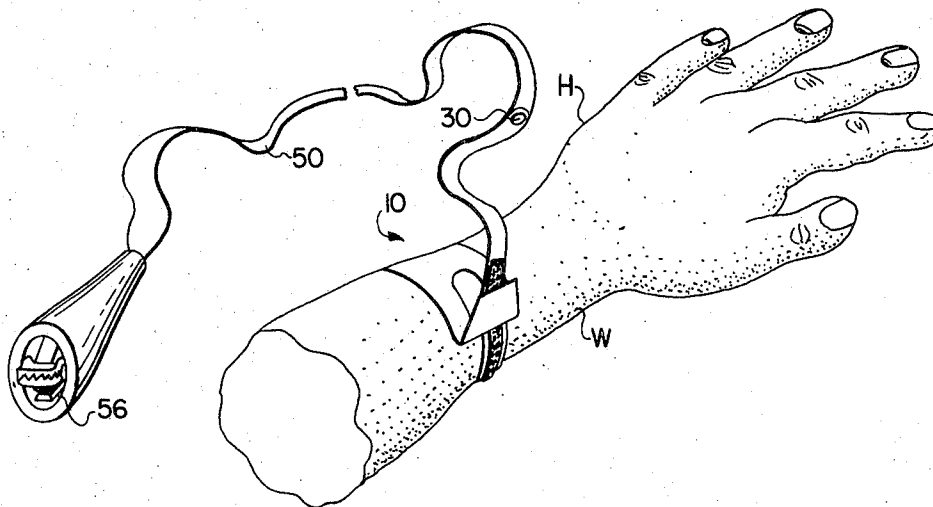
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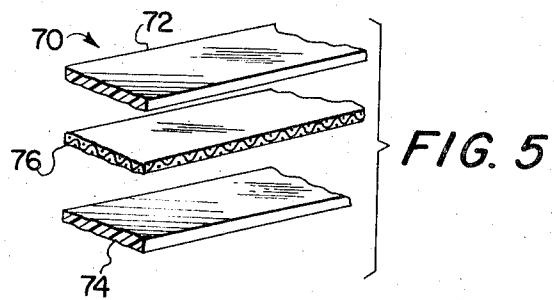
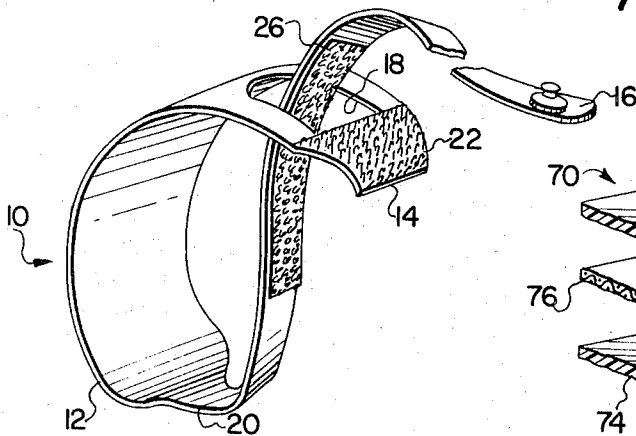
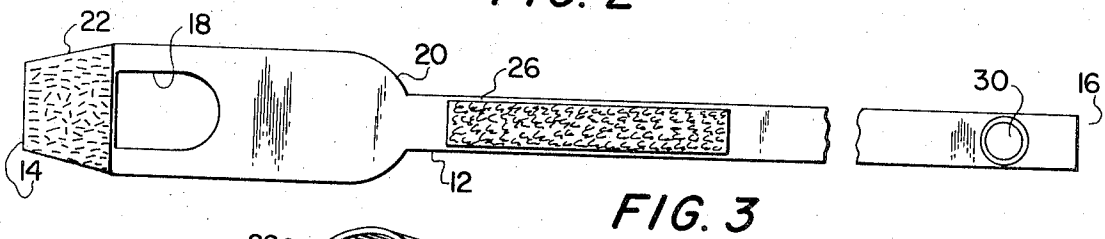
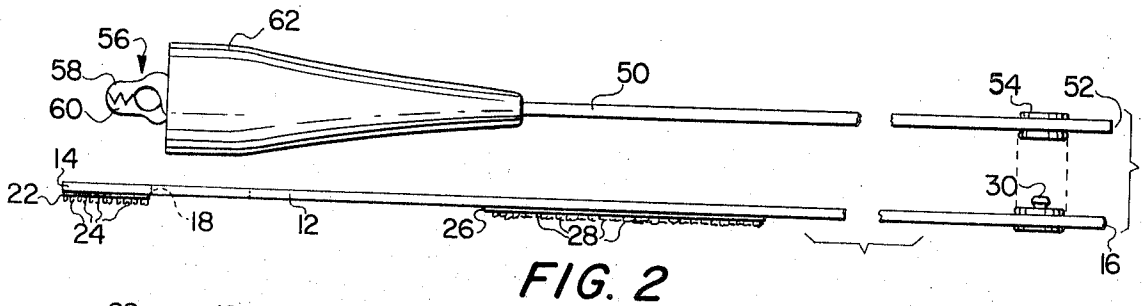
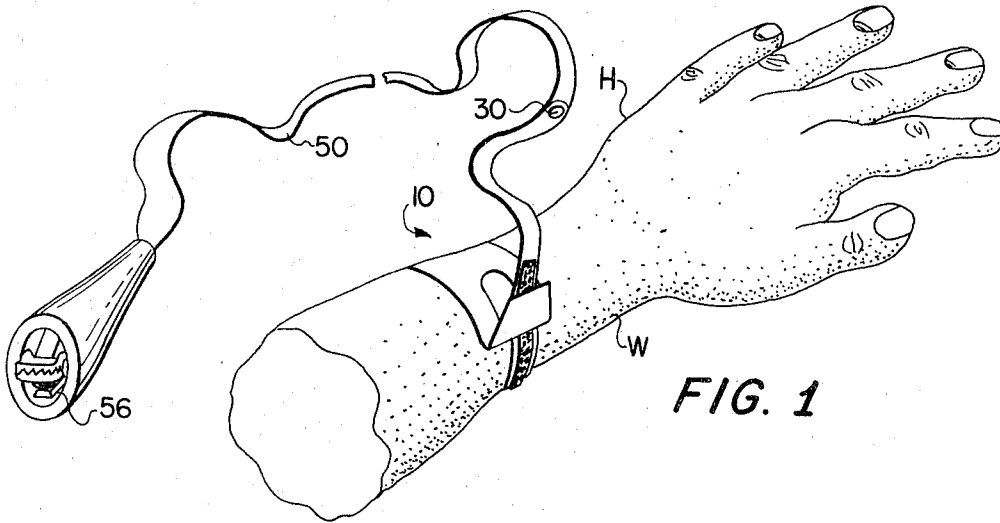
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[57] **ABSTRACT**

An electrically conductive wrist strap comprises a strip of conductive plastic material having an opening spaced from one end, outwardly of which is a pad of Velcro hooks. Intermediate its ends, there is a pad of Velcro loops of conductive material. The other end of the strap passes through the opening to form an adjustable loop, and a conductive terminal is carried by the other end for connection with a grounding conductor having a cooperating fastener at one end and a bull-dog clamp at the opposite end. The strap has a breaking strength permitting it to be broken by a strong pull, as in an emergency. A laminated electrically conductive material of predetermined tensile strength comprising an intermediate layer of Nylon scrim between and bonded to two outer layers of conductive polyolefin.

12 Claims, 5 Drawing Figures





ELECTRICALLY CONDUCTIVE WRIST STRAP**BACKGROUND OF THE INVENTION**

The present invention relates to an electrically conductive strap to be worn on the body, for grounding a human body to prevent the build up of static electricity.

It has been recognized that in a number of occupations, it is highly desirable to connect the workmen to ground. One such occupation in particular is the assembly of or working on devices which are sensitive to static electricity charges, and in such operations, the assembly workers must be electrically connected to earth, i.e., grounded, so that static electricity charges which may be built up by movement of the workmen, such as hand movements, are quickly discharged through the electrical connection to earth or ground. This is necessary in order that there be no build up of static electricity charges on the workmen which could be transferred to the products being worked upon, to their detriment. Further, electrically conductive body-worn grounding devices have proven useful in other occupations, such as where there is danger where the workman is in an electrostatic field, or in an explosive atmosphere.

A number of prior art devices are known which are intended to be placed upon one part or another of a workman, and which are electrically connected to earth or ground in order to drain off electrostatic charges. One such device, commonly used where workmen are assembling devices which are sensitive to static electricity charges comprises a wrist strap made of electrically conductive plastic material having secured to it at one end a strip of Velcro hook material facing in one direction, and at the other end a strip of Velcro loop material facing in the opposite direction. A terminal clip is provided of spring construction for engaging a pin which is at one end of a linearly extending conductor, the other end of the conductor having a suitable connector such as a releasable clamp for engaging a structure connected to earth or ground; this may be, for example, a water pipe.

While the prior art wrist strap above described was entirely suitable for conducting charges of static electricity from the body of an assembly worker, it suffered from certain deficiencies. One deficiency was the inconvenience of the device, since one wrist had to be placed on the strap, and the other hand used to bring the two Velcro strips into engagement, so as to secure the strap about the wrist. The Velcro strips being of conducting material, could generate a spark discharged between them when being separated to remove the strap, and this is an undesirable characteristic. Further, should an emergency arise requiring the worker to leave the work station without delay, an impediment was provided to such action in that the strap was securely engaged about the wrist of the worker and was connected to a structure connected to earth or ground, thus inhibiting the rapid departure of the worker from the work station.

In another prior art device of this type, there is provided a coil spring having its ends secured to an insulator block, with a cord threaded through the coil spring. Thus, an endless loop or band was provided which was expanded to be passed over, for example, the foot of a worker, thereafter resting upon the ankle of the worker. While this construction was convenient to put

on, if the coil spring was made sufficiently strong to provide good engagement with the skin at the ankle of the workman, it would tend to grip so strongly so as to be uncomfortable, due to the fact that there was at each point of engagement of the wire coil with the skin a very small area of contact, so that the workman could be somewhat discomforted. If the coil spring was not as strong, then there would be less contact and therefore less effective conducting of electricity. Further, since the sizes of various workmen vary significantly, the noted construction, in order to be comfortable, would likely be provided in different sizes, so as to provide a reasonable degree of comfort.

Another suggestion was the provision of a structure similar to a bicycle clip, being a metallic band of spring material, such as spring steel, open at one end and of generally circular formation, so as to be placed upon the leg of a wearer by spreading apart the ends of the clip. This construction suffers from many of the same defects noted above in connection with the device made of a coil spring.

Yet another construction known in the prior art was in the form of a conventional garter, made electrically conductive, and fastened by conventional hook members. This construction, like those noted above, could not readily be disconnected in an emergency, so that a rapid departure from a work-site would be prevented or inhibited, and like the first-mentioned prior art, was not convenient to put on because of the necessity for fastening the hook members placed at either end of the garter-like device.

Among the objects of the present invention are to provide a body encircling strap, such as a wrist strap, which is electrically conductive and convenient to put on. Another object of the present invention is the provision of an electrically conductive wrist strap which is conveniently formed, and which is adjustable in size. A further object of the present invention is to provide an electrically conductive wrist strap which will remain in loop form, and which can be worn with effective electrical contact and with comfort by workmen of various sizes.

A further object of the present invention is to provide an electrically conductive wrist strap which will not inhibit the rapid departure from the work-site of a workman, as in an emergency. A further object of the present invention is the provision of an electrically conductive wrist strap having a breaking strength permitting it to be broken in an emergency by manual strength, while at the same time being sturdy enough for conventional usage over an extended period of time.

Yet another object of the present invention is to provide an electrically conductive wrist strap which is convenient, adjustable in size, and which is not subject to discharging a spark when fastener elements of this strap are separated.

SUMMARY OF THE INVENTION

The electrically conductive wrist strap comprises a strip of electrically conductive material of a length in excess of the normal circumference of a human wrist, or ankle. An opening is provided in the conductive strip adjacent to but spaced from one end thereof, the opening being sufficiently large to permit passage of the opposite end of the strip through it, and the strip is further provided with two cooperating sheets of Velcro material. One sheet is adjacent the opening, between the

opening and the adjacent end of the conductive strip, so that it thereby not only serves as a fastening element, but also strengthens the end of the conductive strip. At an intermediate portion of the strip, there is a second Velcro sheet, the first Velcro sheet preferably having hooks and the second mentioned sheet having loops, and only one of the Velcro sheets is conductive. When the strap is in the flat condition, before passage of one end through the opening, both of the Velcro sheets are on the same side. At its opposite end, the electrically conductive strip forming the wrist strap is provided with a conductive terminal, preferably in the form of a snap fastener, and a conductor is provided having a cooperating snap fastener portion, so that it may be connected to the strap in a releasable manner, and yet there is flexibility of the connection between the conductor and the wrist strap, the construction thereby providing for both electrical conductivity and flexibility of the fastening. At its opposite end, the conductor is provided with a connector device, preferably in the form of a spring-urged clamp, for connection to a structure which is in turn connected to earth or ground, such as a pipe or the like. The conductive strip of which the strap is made has a breaking strength yieldable to a strong or sudden force within the strength range of even the weakest workers, so that in an emergency the strap may be broken, the workman not being required to disengage connections or the like. The electrically conductive strip is made of a laminated material having outer layers of electrically conductive olefin, and an inner layer of nylon scrim. There is also disclosed a sheet material having an intermediate layer of nylon scrim and outer layers of electrically conductive olefin, the three layers being bonded together.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a wrist strap and conductor in position on a wrist.

FIG. 2 is an exploded, elevational view, with parts broken away, of the wrist strap of the present invention and conductor.

FIG. 3 is plan view of the wrist strap shown in FIG. 2, with parts broken away.

FIG. 4 is an enlarged perspective view of the wrist strap, in endless band or loop form.

FIG. 5 is an exploded perspective view showing the laminated construction of the material of which the wrist strap is made.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, wherein like or corresponding parts are designated by like or corresponding reference numerals throughout the several views, there is shown in FIG. 1 a portion of a human arm, including the wrist W and the hand H. Encircling the wrist W is an electrically conductive wrist strap 10 in accordance with the present invention, having a linearly extending conductor 50 connected to it. As will be understood, the conductor 50 is of convenient linear extent, and in practice this is preferably about 4 feet.

Referring now to FIGS. 2 and 3, the wrist strap 10 comprises an electrically conductive strip 12 having ends 14 and 16. Adjacent to and spaced from the end 14 is an opening 18 which is of adequate size so as to readily receive therethrough the end 16. Preferably, the conductive strip 12 is of a relatively large width

from the end 14, past the location of the opening 18, and to a necked down portion 20, and from the portion 20 to end 16, the strip 12 is relatively narrow. Hence, the end 16 is narrow in comparison to the end 14.

Two sheets of Velcro material are provided for adjustable fastening of the wrist strap 10. A first sheet 22 is adhered to the conductive strip 12, on the bottom face thereof as shown in FIG. 2, and has a large number of hook elements 24 of flexible resilient material projecting therefrom. A second sheet 26 is secured to the same face of the conductive strip 12, having a substantial linear extent as shown in FIGS. 2 and 3, which is greater than the linear extent of the sheet 22, and has a large number of loop elements 28 of flexible resilient material projecting therefrom. As will be understood, when placed in face-to-face relationship, the two sheets 22 and 26 cooperate by action of the hooks 24 interlocking with the loops 28, the hooks 24 hooking into some of the loops 28, so as to bind the sheets 22 and 26 securely together. A pulling action separating the sheets 22 and 26 will effect the release of this engagement.

The sheet 26 and loop elements 28 are conductive, and are in electrically conducting relationship to the strip 12, while the sheet 22 and hook elements 24 are non-conductive. As will be understood, the sheet 26 and loop elements 28 may be made non-conductive, and the sheet 22 and hook elements 24 may be made conductive.

Adjacent the end 16 of conductive strip 12 is a terminal 30, preferably in the form of a post-element of a snap fastener, secured to the strip 12, terminal 30 being electrically conductive, and electrically connected to strip 12.

The conductor 50 is provided adjacent one end 52 with a female-element 54, of a size to cooperate in conventional snap-fastener manner with the terminal 30, so as to provide for connection of the conductor 50 with the wrist strap 10. This connection is electrically conductive, is releasable, and provides for rotational movement of the conductor 50 relative to the wrist strap 10. At its opposite end, the conductor 50 is provided with a spring-urged clamp 56 having jaws 58 and 60, the clamp 56 being partially within a flexible shroud 62 of suitable material. Hence, by grasping the shroud between the thumb and finger, the jaws 58 and 60 of the clamp 56 may be opened, against the force of the spring therein (not shown) and caused to engage a structure connected to earth or ground, such as a water pipe or the like. The conductor 50 may be made of the same material as the strip 10, having a suitable width.

The conductive strip 12 is made of a material, and has dimensions, which together provide it with a breaking strength which will permit to be broken by manual force, so that in an emergency, a workman wearing the wrist strap 10, having the conductor 50 secured to it, will be able to leave the work area rapidly and without hindrance, by moving his arm with sufficient force so as to break the strip 12, even if the other hand of the workman cannot be used for disconnecting clamp 56, or for separating the conductor 50 from the wrist strap 10, or for manipulating the strap so as to separate the Velcro sheets. This is achieved by providing the conductive strip, in the preferred embodiment, with a tensile strength of between 4,000 and 5,000 pounds per square inch, and a cross-sectional area at the smallest

dimension of the conductive strip 12 of about 0.0084 square inches, the strap being 0.015 inches thick and 0.526 inches wide, in practice.

Referring now to FIG. 5, there is shown in exploded perspective a sheet 70 of the material from which the strip 12, and also the conductor 50, is made. There are provided two outer layers 72 and 74 of conductive polyolefin film, having a thickness of 0.006 inches each. An intermediate layer 76 is of nylon scrim, and has a thickness of 0.005 inches. These layers are pressed together in known fashion, so that they become bonded and form a unitary sheet of material, which then may be cut into strips of the desired sizes and configurations. This material can therefore be closely controlled as to its width and thickness dimensions, therefore the above noted cross-sectional area of the smallest part of the wrist strap conductive strip 12 can be obtained, with consequent obtaining of the desired tensile strength of the material and breaking the strength of the completed wrist strap.

In use, and referring to FIG. 4, there is shown the wrist strap 10, with the end 16 of the conductive strip 12 having been passed through the opening 18, with the Velcro sheet 26 in facing relationship to the Velcro sheet 22, and ready to be placed in face-to-face contact for securement of the wrist strap 10 about the wrist of a person. The wrist strap 10 can remain, over many uses of it, in the convenient loop form shown in FIG. 4. To place the wrist strap 10 upon the wrist, the person simply passes his hand through the loop formed by the wrist strap 10, and grasps the conductive strip 12, as between the end 16 and the Velcro sheet 26, drawing the wrist strap 10 into snug but comfortable engagement with his wrist, and then moving the free hand so as to place the Velcro sheets in face-to-face cooperative, interlocking engagement. Due to the positioning of the sheet 22, with its edge adjacent the opening 18, the sheet 22 will serve as a bearing for the intermediate portion of the conductive strip 12 inwardly of the end 16 to slide it over, and the sheet 22 will also provide stiffness for the portion of the conductive strip 12 inwardly of the end 14. Due to the linear extent of the sheet 26, it is not necessary to provide different sizes of the wrist strap 10 for individuals of different sizes since the length of the sheet 26 will permit engagement of the wrist strap 10 in secure, comfortable fashion about the wrists of both large and small workmen.

As will be understood, due to the above reference breaking strength of the wrist strap 10, in an emergency, it may be broken as hereinabove mentioned, so as to permit the rapid departure of the workman from the work station. The conductor 50 while being in secure, electrically conductive relationship to a structure connected to earth or ground, provides for flexibility between the conductor 50 and wrist strap 10 by the snap fastener arrangement including the elements 30 and 54, thereby providing for satisfactory maneuverability of the hand of the workman wearing the wrist strap 10. When the wrist strap 10 is to be removed, it is only necessary to separate the Velcro sheets 22 and 26 in normal manner, as by "peeling" action, and due to the fact that one of the Velcro sheets is conductive and the other is non-conductive, there will be no danger of a spark discharge during or immediately after this separation of the Velcro sheets.

The material 70 will be understood to have good conductive properties, together with not only desirable

strength characteristics, but strength characteristics which can be predetermined to lie within desired limits.

There has been provided an electrically conductive wrist strap which is extremely convenient to use, which can be used with safety, and which can be used by workmen of different sizes. The wrist strap may be connected and disconnected without danger of spark discharge from the fastening elements used, specifically Velcro sheets, and the construction of the wrist strap is sufficiently sturdy for normal use, while permitting breaking of the wrist strap when desired, as during an emergency.

There has also been provided a material having controllable tensile strength properties, while being electrically conductive, and economical to manufacture.

It will be obvious to those skilled in the art that various changes may be made without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawings and described in the specification but only as indicated in the appended claims.

I claim:

1. An electrically conductive wrist strap comprising:
 - a. an electrically conductive flexible strip having first and second ends,
 - b. means comprising an opening in said strip spaced from and adjacent to the first end for permitting passage therethrough of the second end of said strip;
 - c. first cooperating fastening means on said strip between said opening and said first end and second cooperating fastening means on said strip between said opening and said second end for adjustably fastening an intermediate portion of said strip to said strip at the first end thereof, and
 - d. conductive terminal means on said strip, whereby a person wearing said strap may be connected to ground.
2. The electrically conductive wrist strap of claim 1, said cooperating fastening means each comprising a sheet of Velcro-type material.
3. The electrically conductive wrist strap of claim 2, wherein only one of said sheets of Velcro-type material is electrically conductive.
4. The electrically conductive wrist strap of claim 3, wherein a said Velcro-type sheet containing loop elements is electrically conductive.
5. The electrically conductive wrist strap of claim 2, wherein said second sheet is of greater length along said strip than said first sheet.
6. The electrically conductive wrist strap of claim 1, wherein only one of said adjustable fastening means is electrically conductive.
7. The electrically conductive wrist strap of claim 1, said strip comprising means having a breaking strength permitting breaking of said strip by manual force.
8. The electrically conductive wrist strap of claim 7, said strip having a tensile strength between about 4,000 and 5,000 pounds per square inch and a cross-sectional area of about 0.0084 square inches.
9. The structure of claim 1, and further comprising a linearly extending conductor having structure engaging means at one end and means at the other end engaging said terminal.

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10. The structure of claim 9, said last mentioned means comprising means releasably and rotatably engaging said terminal.

11. The electrically conductive wrist strap of claim 1, wherein said strip is a laminated material comprising an intermediate layer of scrim between two outer layers of

conductive polyolefin material, said layers being in adjacent bonded relationship.

12. The electrically conductive wrist strap of claim 11, said intermediate layer being nylon scrim.

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