

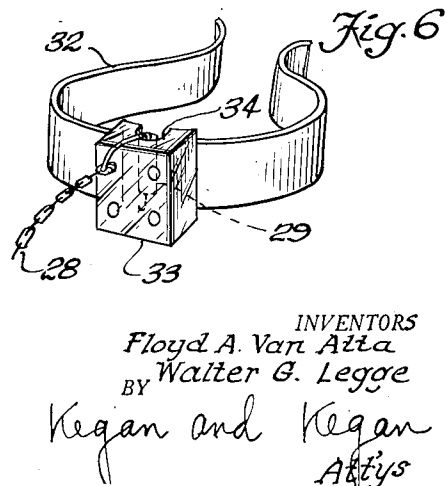
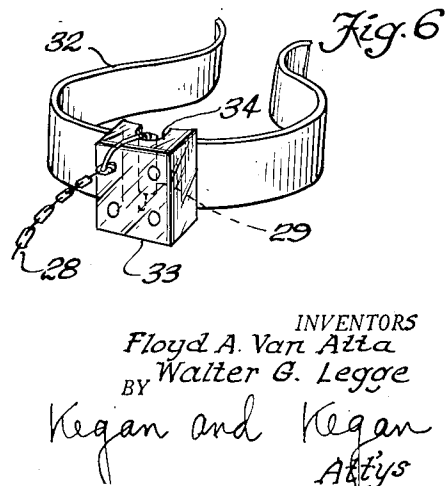
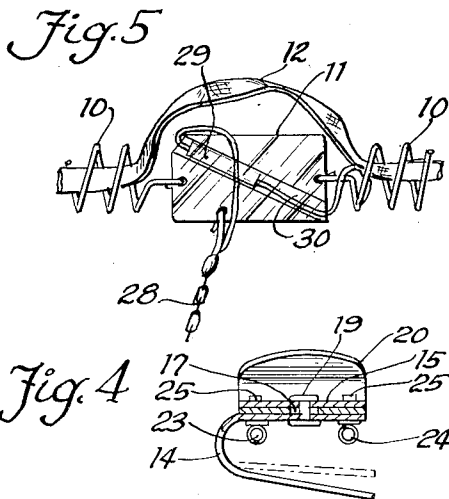
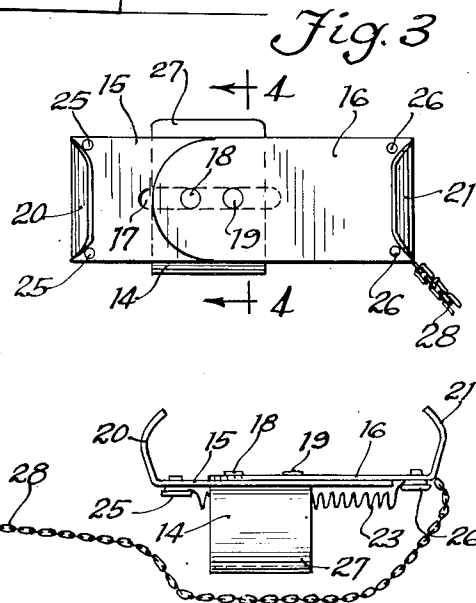
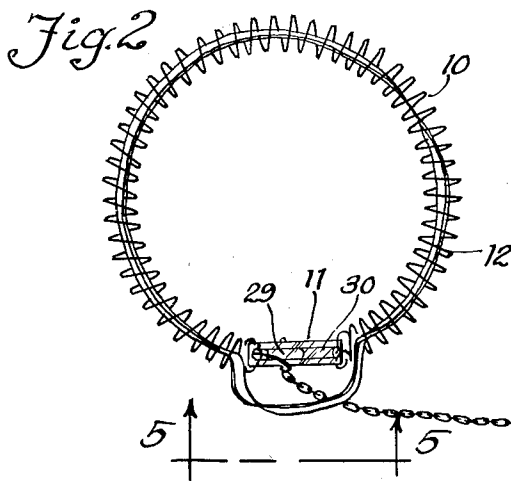
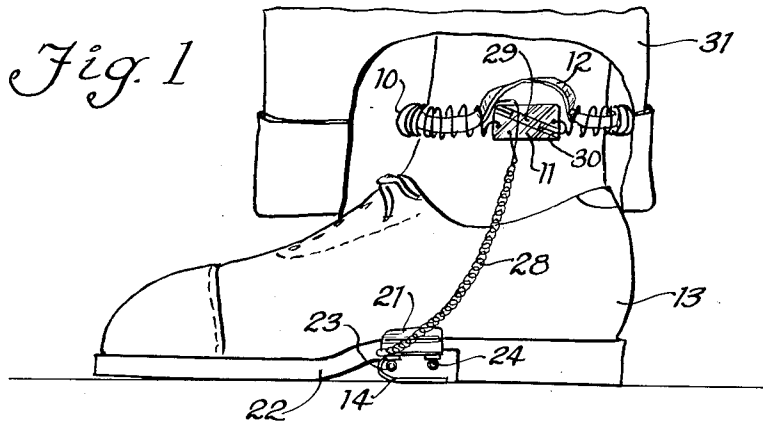
Feb. 19, 1952

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2,586,747

DETACHABLE BODY GROUNDING DEVICE

Filed May 10, 1949



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UNITED STATES PATENT OFFICE

2,586,747

DETACHABLE BODY GROUNDING DEVICE

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Application May 10, 1949, Serial No. 92,366

6 Claims. (Cl. 175-264)

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Our invention relates to a detachable body grounding device. More particularly, our invention relates to improvements in body grounding devices whereby electrostatic charges are continuously drained from the body of a person who may be working, for example, in or near explosive gas mixtures or the like.

It is a matter of common knowledge that electrostatic charges may accumulate on a person's body to the point where it discharges as a spark or arc when the body is temporarily grounded. This tendency is especially noticeable when the relative humidity of the air is low. If the person is working in or near explosive gas mixtures or the like, this spark or arc may ignite the explosive mixture. As an illustration of a practical application of the utility of body grounding devices, mention may be made of its use by surgeons and operating room attendants where the patient is being anesthetized with a flammable anesthetic agent, as for example ether, ethylene, cyclopropane, or mixtures thereof. When the patient exhales an explosive mixture of the anesthetic and air there is danger of explosive from an arc discharge of static electricity unless the same has been drained from the bodies of the persons grouped about the patient. In the past such mishaps have occurred, and have resulted in death to the patient.

Several types of body grounding devices have been suggested, but to date these prior art devices have proved unsatisfactory. For example, it has been suggested that shoes be fabricated from conductive materials such as graphitized rubber; however, this raises serious problems in foot comfort since shoes fabricated from such material become uncomfortably warm if worn for considerable periods of time. In addition, this plan requires that each individual be specially fitted with his or her own pair of shoes. Another unsuccessful attempt at providing a practical body grounding device involved permanently securing a metallic plate to the bottom of the shoe and connecting this conductor to another conductor placed about the ankle in contact with the skin. The major drawback inherent in this device grew out of the fact that the heavy metal plate was positioned directly beneath the ball of the foot to insure contact with the ground, and this resulted in discomfort to the wearer when walking and even when standing still. And since the plates were attached to the shoes by nails or screws the shoes could not conveniently be used for general wear.

It is a principal object of our invention to pro-

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vide a body grounding device which may be quickly and easily detached, which fits all persons irrespective of shoe size, and which neither interferes with the comfort of the wearer nor requires any alterations or disfigurement of the wearer's shoe.

Another object of our invention is to provide a detachable body grounding device which can be electrically dimensioned to within very close limits so as to provide optimum electrical characteristics.

Another object of our invention is to provide a body grounding device which is light in weight, durable in use, and inexpensive to manufacture.

In its broad aspect, our invention comprises a conductive member adapted to contact the skin of the wearer, a second conductive member which is adapted to be clamped to shoes of various sizes and to underlie the instep portion of the foot and which is further adapted to press against the surface on which the person is standing, and a conductor element electrically coupling together the two conductive members. In preferred embodiments of our invention, the first member is fastened about the ankle, and includes a resistor of predetermined magnitude placed in series with the conductor element so that the person is protected against severe and painful electrical shocks should he or she inadvertently touch a source of high potential current.

In order that our invention may be more fully disclosed, reference is had to the accompanying drawing which illustrates one form of apparatus embodying the foregoing and such other principles, advantages or capabilities as may be pointed out as this description proceeds, or as are inherent in the present invention. For purposes of clarity in exposition, the following description is explicit, and the accompanying drawing is detailed, but it is distinctly to be understood that said exposition is illustrative only, and that our invention is not restricted to the particular details recited in the specification or shown in the drawing.

In the drawing:

Figure 1 illustrates a preferred embodiment of our invention as it appears when attached to the ankle and shoe of a person;

Figure 2 is a front elevational view of the embodiment of Figure 1 as it appears when detached from the wearer;

Figure 3 is a plan elevational view of a portion of the embodiment of Figure 2;

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Figure 4 is a side elevational view taken in section on the line 4—4 of Figure 3;

Figure 5 is a fragmentary plan elevational view as viewed from the line 5—5 of Figure 2; and

Figure 6 is a perspective view of a modified form of the conductive member which contacts the skin of the wearer.

Like reference characters designate like parts in the drawing and in the description thereof following hereafter.

Referring now to the drawing, the conductive member of our invention which is adapted to contact the skin of the wearer, includes a coiled spring 10 the two ends of which are secured, respectively, to opposite edges of the insulating block 11. As shown in Figure 1, the spring 10 is adapted to fit about the ankle or lower portion of the leg. A cord 12 is threaded through the spring 10 so that said spring cannot be stretched excessively and thereby deformed when slipped over the foot or shoe 13.

As best shown in Figures 1 and 2, the conductive member which is adapted to be removably secured to the shoe 13 includes a spring clip 14 which lies beneath the overlapping plates 15 and 16. The plate 15 is provided with a slot 17 through which extends the two pins 18 and 19 whereby the plate 16 is pinned to the spring clip 14. Sufficient clearance is provided between the clip 14 and the plate 16 so that the plate 15 is slidable relative thereto. The outer end portions 20 and 21 of the plates 15 and 16, respectively, are bent or otherwise formed into substantially hook-shaped configuration. It is these portions 20 and 21 which are adapted to clamp upon the sole 22 of the shoe 13 at the instep portion thereof (Figure 1). The portions 20 and 21 are clamped securely to the sole 22 by the action of the two helical springs 23 and 24 anchored respectively to the rivets 25, 25 on the plate 15, and the rivets 26, 26 on the plate 16. Advantageously, the springs 23 and 24 permit adjustment of the distance between the portions 20 and 21; therefore the spring clip 14 can be secured to shoes of various sizes.

As is best shown in Figure 4, the end 27 of the spring clip 14 may be flexed, the alternate position shown in dotted outline representing the configuration which the clip 14 assumes when attached to the shoe 13 and deflected in the manner shown in Figure 1. Because of the flexible nature of the spring clip 14, our invention automatically compensates for variations in the height of the insteps of different shoes, and at the same time insures a positive connection to ground.

The spring clip 14 is electrically connected to the coiled spring 10 and hence to the ankle of the person wearing the device, through the flexible chain 28. As best shown in Figures 2 and 3, one end of the chain 28 is connected to the plate 16, so that an electrostatic charge draining down the chain 28 passes on to the plate 16 and from there to the clip 14 either through the plate 17 or rivets 18 and 19, or both. The other end of the chain 28 is secured to the insulating block 11. Interposed between and in series with the latter end of the chain 28 and the coiled spring 10, is a resistor 29, which lies within the bore 30, extending through the insulating block 11.

The purposes of the resistor 29 is to protect the wearer of the device from severe and painful electrical shocks should the wearer acci-

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dentally ground a source of high potential current. Thus, for example, surgeons, nurses and other operating room attendants using our device may inadvertently contact the electrical circuit of one of the many electrically operated machines found in modern day operating rooms. While operating room circuits are usually limited to 110 volts, this potential is still capable of severely shocking the person if a path of low resistance connects him to ground. In general, persons can withstand a ten milliamper current coursing through their body without suffering any ill effects. By using a resistor 29 of more than 11,000 ohms, our device will limit the current to less than ten milliamperes (in the case of a 110 volt potential). At the same time a resistor 29 of the order of 11,000 ohms does not interfere in any way with the efficient draining of electrostatic charges from the person wearing the device. Hence persons working in operating rooms, as well as the patient, are safeguarded.

As a matter of fact, the resistor 29, in theory at least, could be as large as 100 megohms before electrostatic charges would begin to accumulate on the person wearing the device. However, in practice, we prefer that the largest resistor 29 be of the order of four or five megohms, so that there is no possibility of any interference with rapid and complete drainage of electrostatic charges from persons wearing our device.

While of course each of the various elements of our device could be electrically dimensioned so that the aggregate resistance would be of proper magnitude, by using the separate resistor 29 the precise degree of protection against electrical shocks which is desired can be provided both quickly and accurately. Thus, for example, in most industrial plants line voltages of 440 volts are used. As mentioned previously, it is desirable to limit the current which will pass through the body to no more than ten milliamperes, should the wearer accidentally touch or grasp a source of high potential current. By dividing ten milliamperes into 440 volts, it is apparent that the minimum safe value of resistance is approximately 44,000 ohms. By inserting a resistor 29 of at least $\frac{1}{20}$ megohms in the bore 30, therefore, the worker is safeguarded.

Advantageously, our device may be attached without removing the shoe 13, since the coiled spring 10 may be stretched sufficiently to allow it to be slipped over the average shoe and on to the ankle of the wearer. At the same time, the spring 10 is sufficiently resilient to fit the ankle snugly, so that a good electrical connection between the spring 10 and the skin of the wearer is assured at all times. After the coil spring 10 is in place about the ankle, the plates 15 and 16 are pulled apart sufficiently to permit slipping the hook-shaped portions 20 and 21 thereof over the sole 22 at the instep portion of the shoe 13. When the plates 15 and 16 are released, the helical springs 23 and 24 cause the plates 15 and 16 to slide toward each other so that the portions 20 and 21 clamp securely to the sole 22. Advantageously, the coiled spring 10 and the insulating block 11 are completely hidden beneath the pant leg 31, while substantially all of the clamping member underlies the instep portion of the sole 22, so that only the flexible chain 28 and the portions 20 and 21 show.

When the wearer stands, or otherwise causes the shoe 13 to be placed against the ground or floor, the spring clip 14 is flexed upwardly, this

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initial tensioning insuring a good contact at all times between the clip 14 and the ground or floor. At the same time, the spring clip 14 does not interfere in any way with walking or standing because of its position beneath the instep portion of the sole 22.

A modification of the conductive member which contacts the skin of the wearer is shown in Figure 6 as including a metallic clip 32 the outer ends of which may be flexed apart to permit slipping the clip 32 over the ankle or other limb. An insulator block 33 is secured to the exterior surface of the clip 32, and is provided with a groove 34 in which the resistor 29 is positioned. One end of the resistor 29 is connected to the clip 32; the other end to the chain 28 which is fastened to the block 33. Advantageously, when the clip 32 is secured in place, it so effectively covers and contacts a large area of skin as to cause said skin to perspire. The excreted moisture in turn provides a superior electrical connection between the skin and the clip 32, so that a highly efficient drainage of static electricity is insured.

Having thus fully disclosed our novel detachable body grounding device, and demonstrated its utility by reference to a specific embodiment thereof, we claim as our invention:

1. A detachable body grounding device, comprising: a stretchable, conductive ankle band adapted to be slipped over the foot; a clamp including two metal strips movable relative to each other, the outer ends of said strips terminating, respectively, in a pair of hooks adapted to clamp upon the sole of a shoe at the instep portion thereof, and spring means connecting said strips and urging said hooks toward each other; a metallic chain linking said clamp and said ankle band; a resistor element in series with said metallic chain; and a spring clip secured to one of said metal strips and extending downwardly therefrom to connect said clamp to ground.

2. A detachable body grounding device, comprising: an ankle band including an insulator block and a coiled metallic spring connected at the two ends thereof to said insulator block and adapted to fit about the ankle in contact with the skin; a detachable, conductive clamp adapted to clamp upon the sole of a shoe to underlie the instep portion thereof; a resistor element one end of which is electrically connected to said coiled spring, said resistor element carried by said insulator block, a flexible conductor connecting the other end of said resistor element to said clamp, and a conductive spring clip secured to said clamp and extending downwardly therefrom to ground said clamp.

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3. A detachable body grounding device, comprising: a detachable, conductive ankle band, a detachable, conductive clamp adapted to clamp upon the sole of a shoe to underlie the instep portion thereof, a conductor connecting said ankle band to said clamp, a resistor in series with said conductor, and a conductive spring clip secured to said clamp and extending downwardly therefrom to connect said clamp to ground.

4. A detachable body grounding device, comprising: a conductive member adapted to be secured about a limb, a deflectable conductive spring adapted to underlie only the instep portion of a shoe, means for detachably securing said spring to said shoe, electrical conductor means connecting said member to said spring, and an electrical resistor in series with said conductor means limiting the current flow to less than about ten milliamperes.

5. A detachable body grounding device, comprising: a first conductive member, means for removably securing said member to a limb of the wearer in contact with the skin, a deflectable conductive spring member adapted to underlie the instep portion only of a shoe, detachable clamp means on said deflectable member for clamping said deflectable member to said shoe, and electrical conductor means connecting said first member to said deflectable member.

6. A detachable body grounding device, comprising: a metallic ankle clip, an insulator block secured to said ankle clip, a resistor element one end of which is electrically connected to said ankle clip, said resistor element carried by said insulator block, a detachable, conductive clamp adapted to clamp upon the sole of a shoe to underlie the instep portion thereof, a flexible connector connecting the other end of said resistor element to said clamp, and a conductive spring clip secured to said clamp and extending downwardly therefrom to ground said clamp.

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