US 20070291431A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0291431 A1**

Takayanagi (43) **Pub. Date: Dec. 20, 2007**

(54) **STATIC ELIMINATOR WITH SELF-DISCHARGED WHISKERS**

(76) Inventor: **Makoto Takayanagi**, Hamamatsu-City (JP)

Correspondence Address:
Leighton K. Chong
133 Kaai Street
Honolulu, HI 96821 (US)

(21) Appl. No.: **11/781,622**

(22) Filed: **Jul. 23, 2007**

Related U.S. Application Data

(62) Division of application No. 10/764,027, filed on Jan. 23, 2004, now Pat. No. 7,248,454.

(30) **Foreign Application Priority Data**

Jul. 22, 2003 (JP) 277239/2003
Jan. 5, 2004 (JP) 000040/2004

Publication Classification

(51) **Int. Cl.**
H02H 9/00 (2006.01)

(52) **U.S. Cl.** **361/91.1**

(57) **ABSTRACT**

There is provided a static eliminator which comprises an ion generating portion in the form of tape. There is also provided a self-discharged static eliminator comprising an conductor provided with discharge whiskers in which the conductor is applied with a predetermined voltage. There is also provided a DC type of self-discharged fiber-like static eliminator which comprises plus fiber electrodes applied with plus voltage, minus fiber electrodes applied with minus voltage; a support disposed between the plus and minus electrodes for supporting the plus and minus electrodes and provided with insulation reserving member for preventing the spark discharge or short due to the access of the plus and minus electrodes.

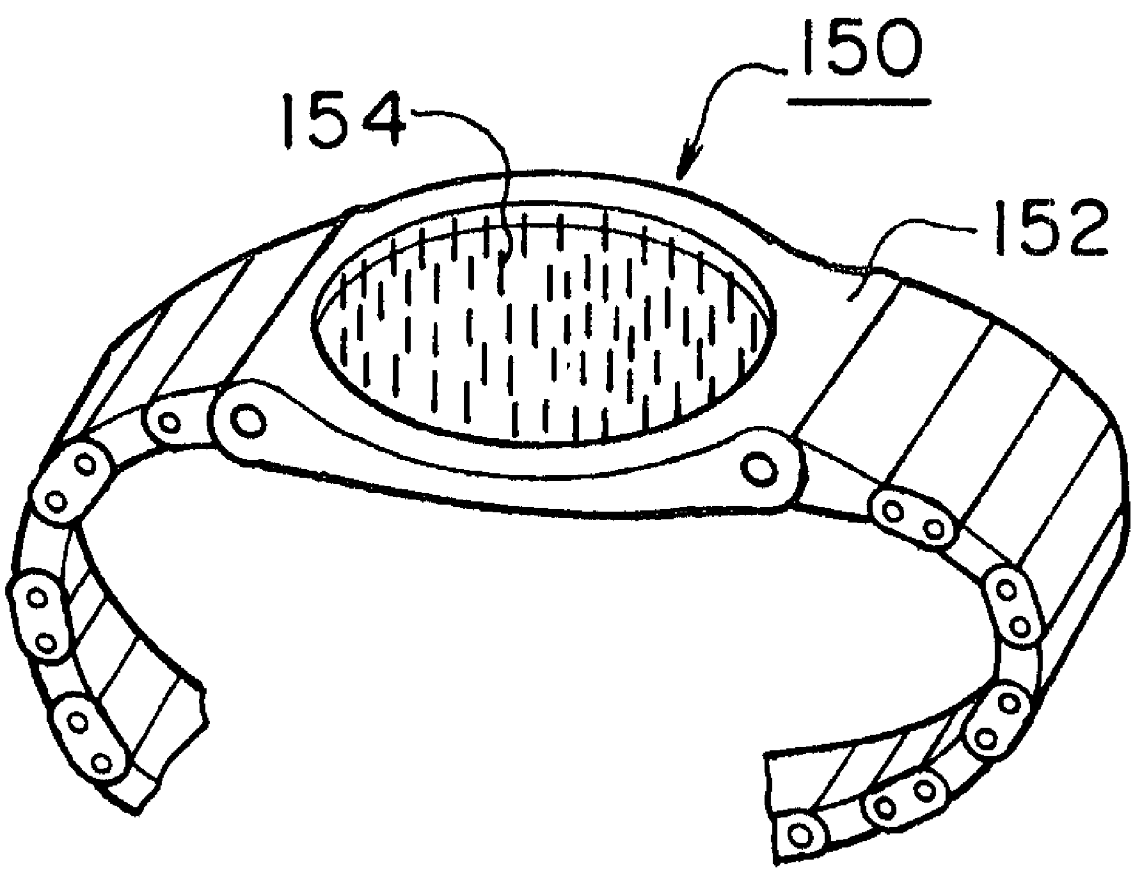


FIG. 1(a)

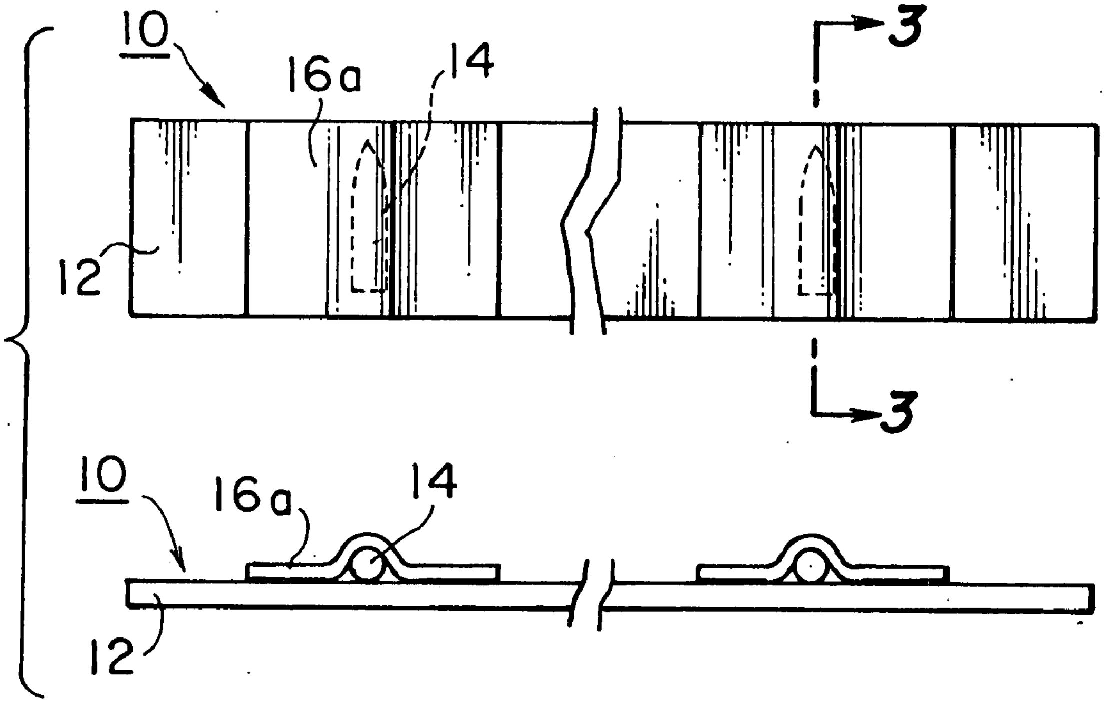


FIG. 1(b)

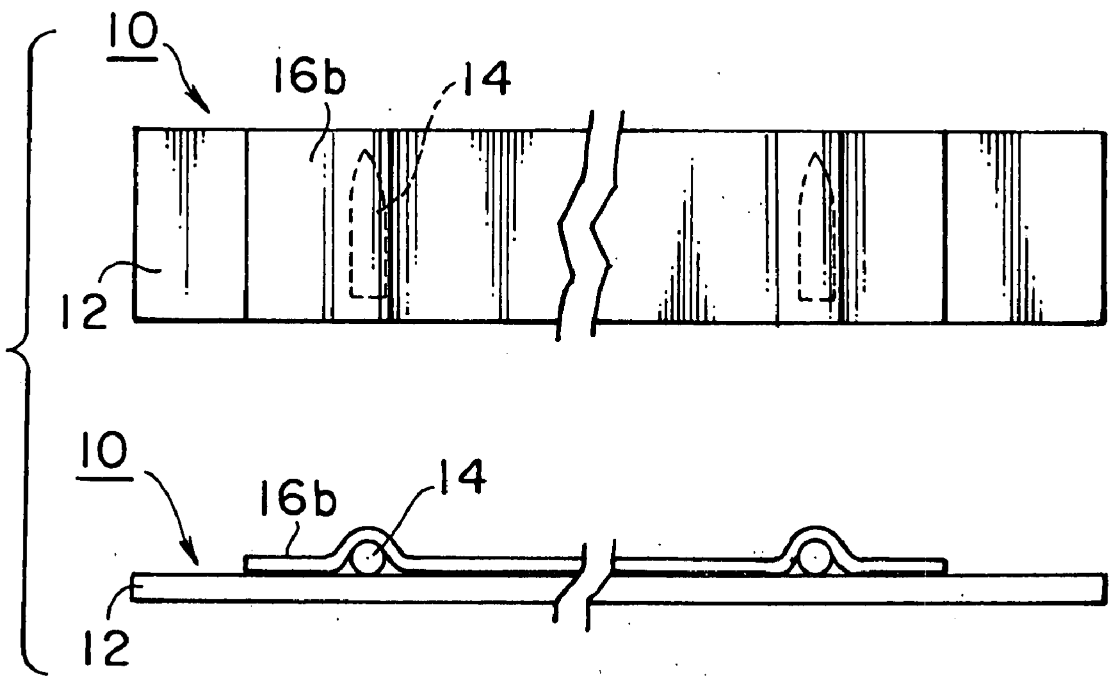


FIG. 2

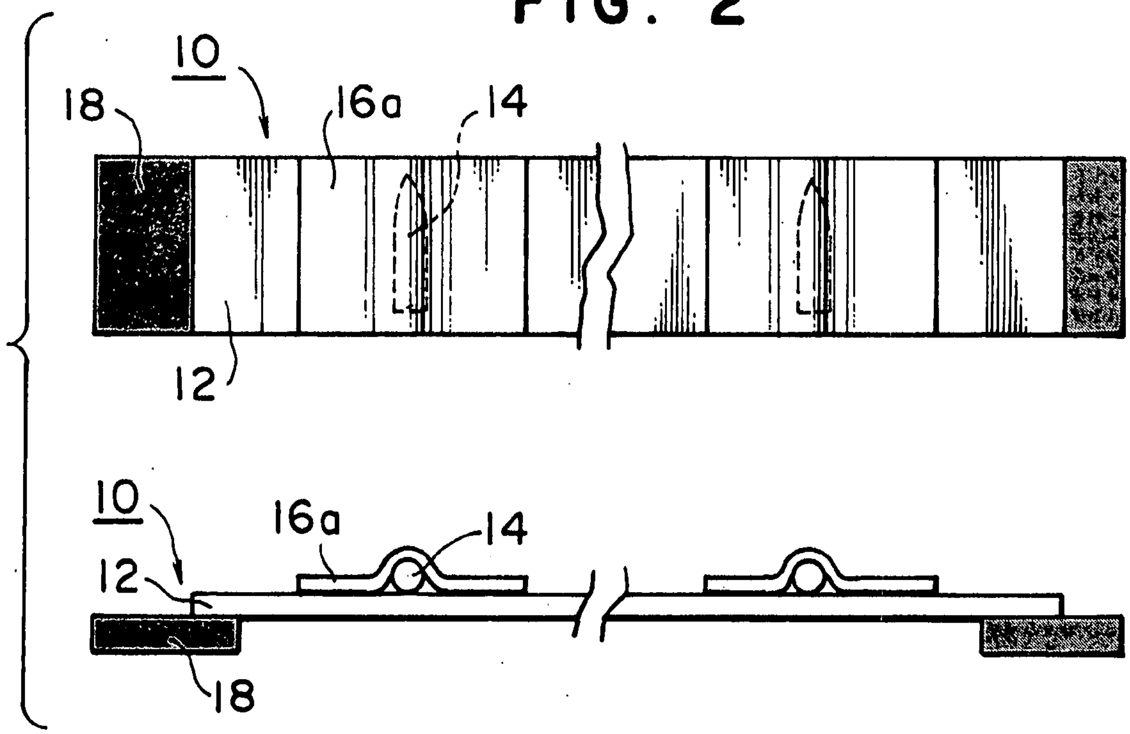


FIG. 3(a)

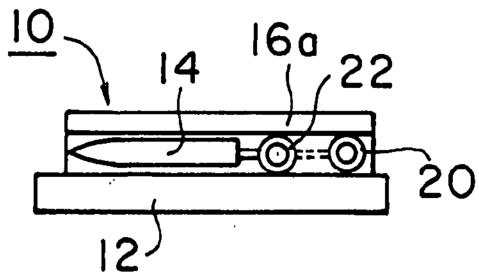


FIG. 3(b)

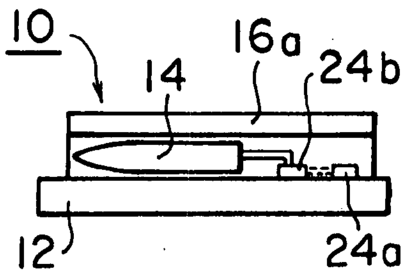


FIG. 4

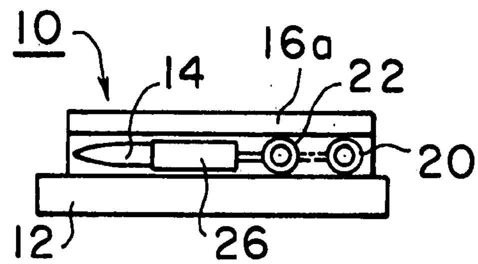


FIG. 5

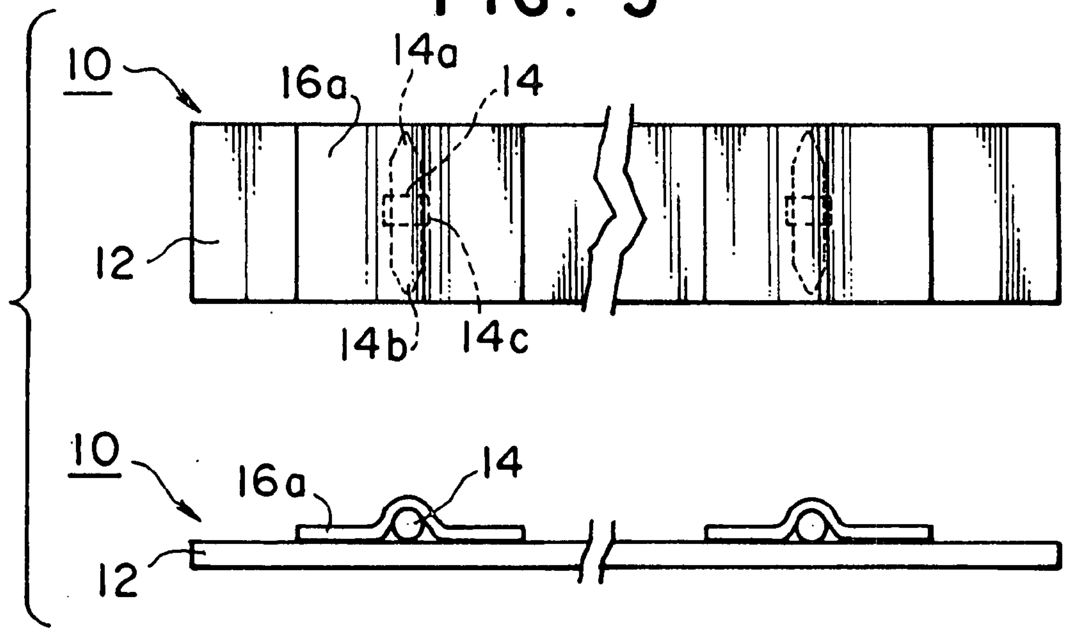


FIG. 6

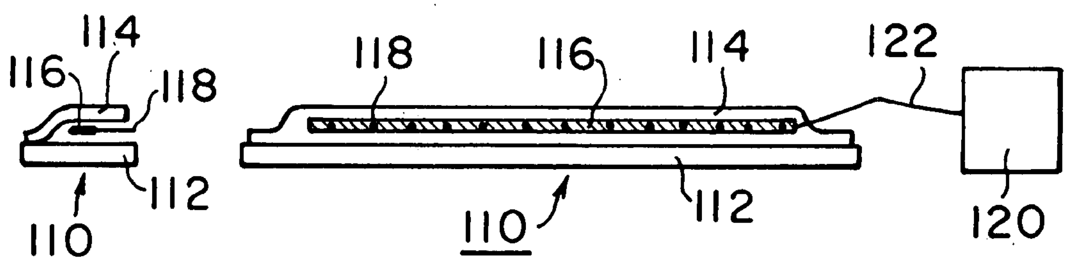


FIG. 7

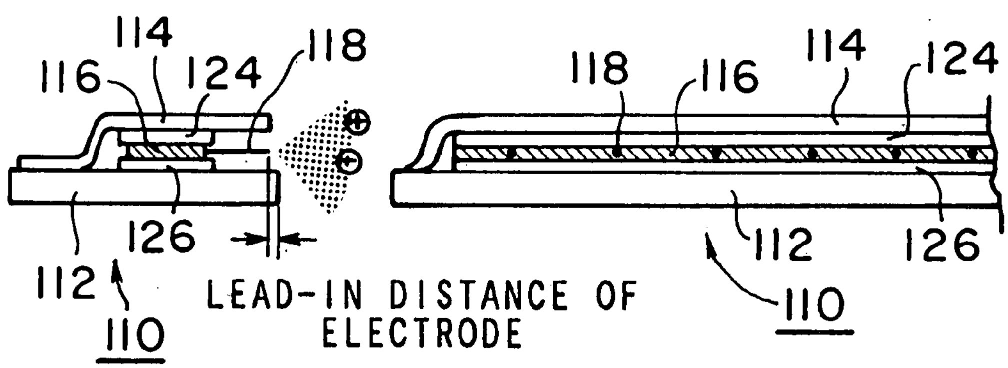


FIG. 8

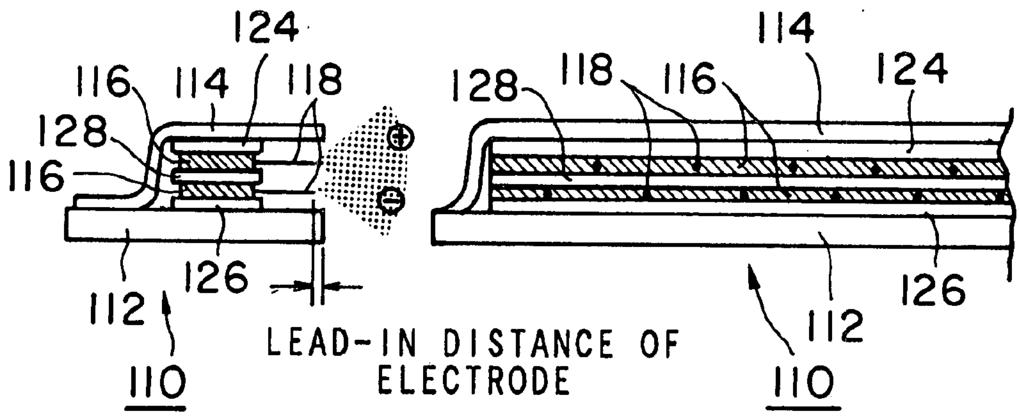

124
116
114
118
128
116
112
126
110
LEAD-IN DISTANCE OF ELECTRODE
128
118
116
114
124
126
112
110

FIG. 9

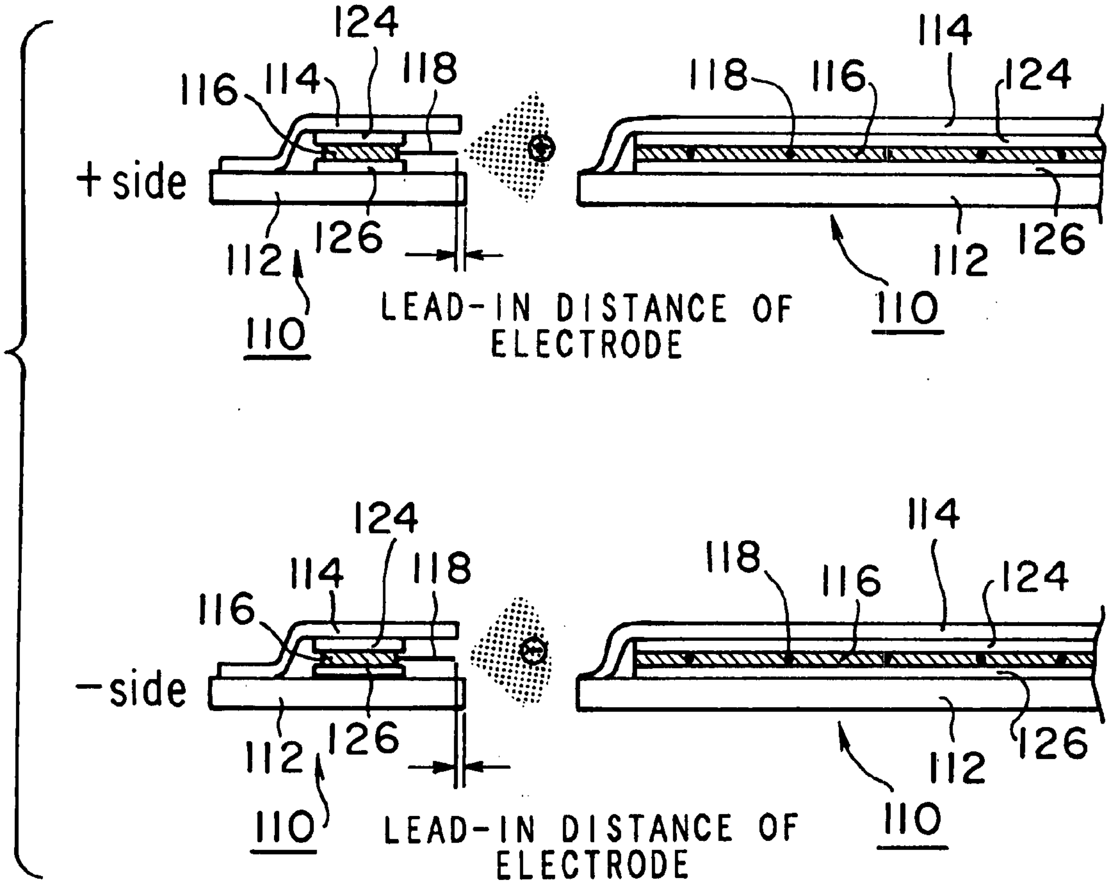

+side
124
116
114
118
112
126
110
LEAD-IN DISTANCE OF ELECTRODE
118
116
114
124
126
112
110
−side
124
116
114
118
112
126
110
LEAD-IN DISTANCE OF ELECTRODE
118
116
114
124
126
112
110

FIG. 10

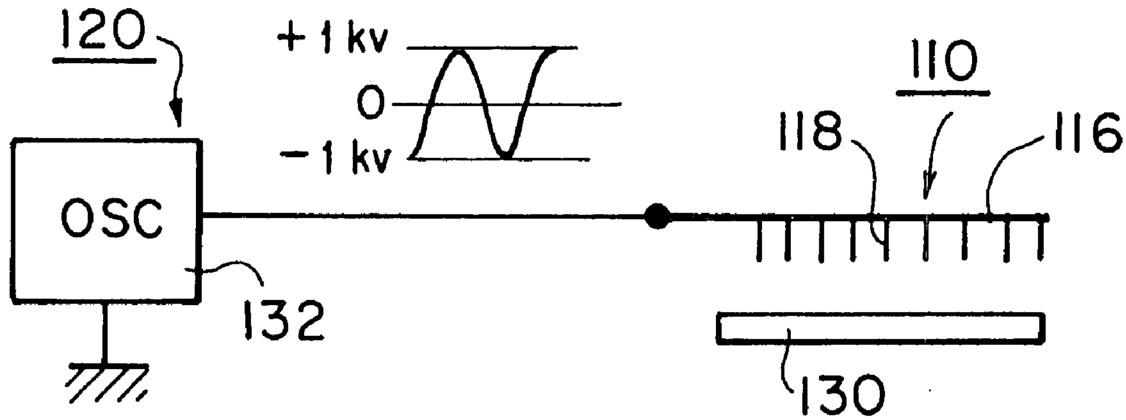

120
+1 kv
0
-1 kv
OSC
132
110
118
116
130

FIG. 11

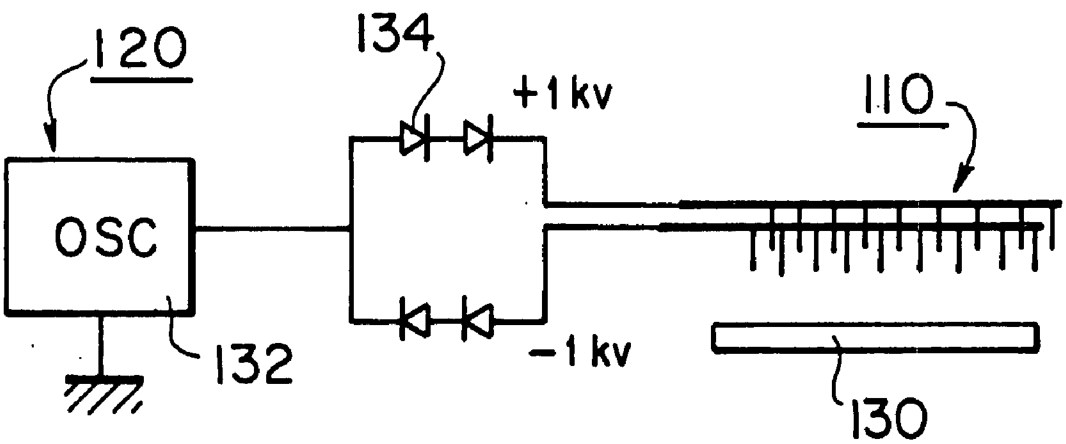

120
134
+1 kv
OSC
132
-1 kv
110
130

FIG. 12

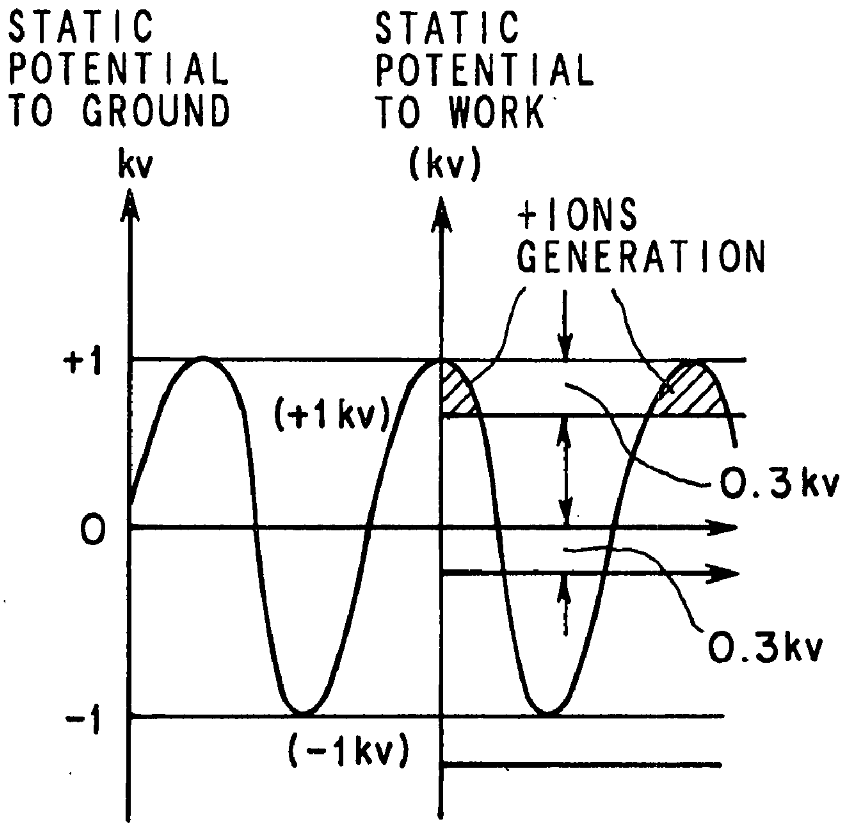

STATIC
POTENTIAL
TO GROUND
kv
STATIC
POTENTIAL
TO WORK
(kv)
+IONS
GENERATION
+1
(+1 kv)
0.3kv
0
0.3kv
-1
(-1kv)

FIG. 13

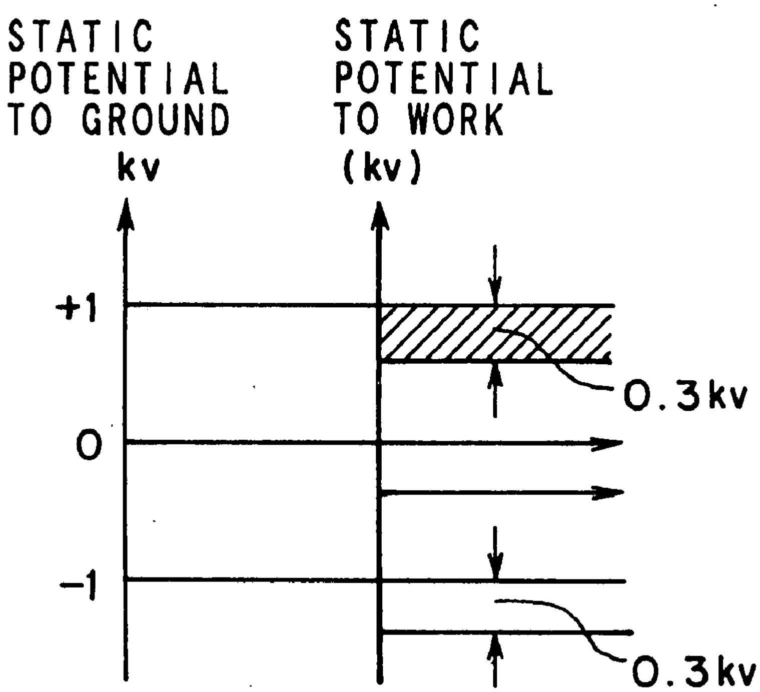

STATIC
POTENTIAL
TO GROUND
kv
STATIC
POTENTIAL
TO WORK
(kv)
+1
0.3kv
0
-1
0.3kv

FIG. 14

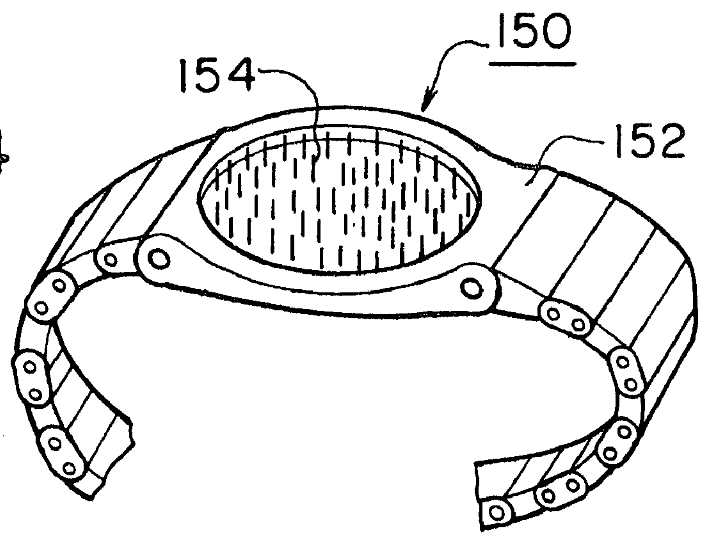


FIG. 15

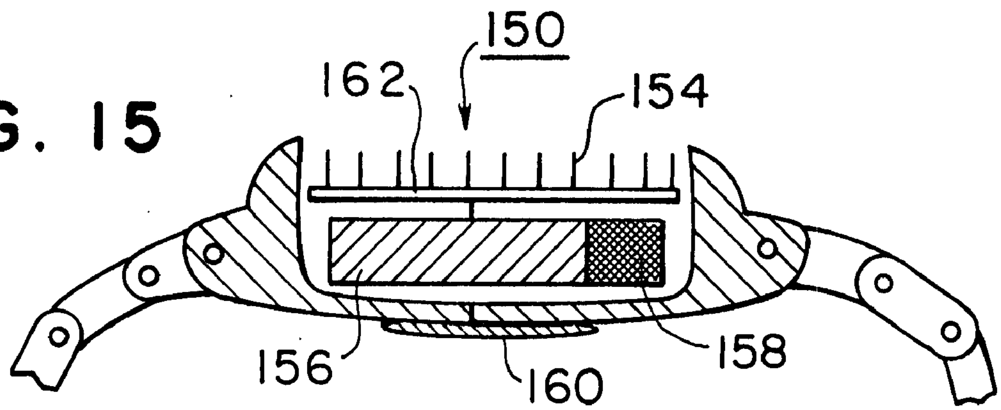


FIG. 16

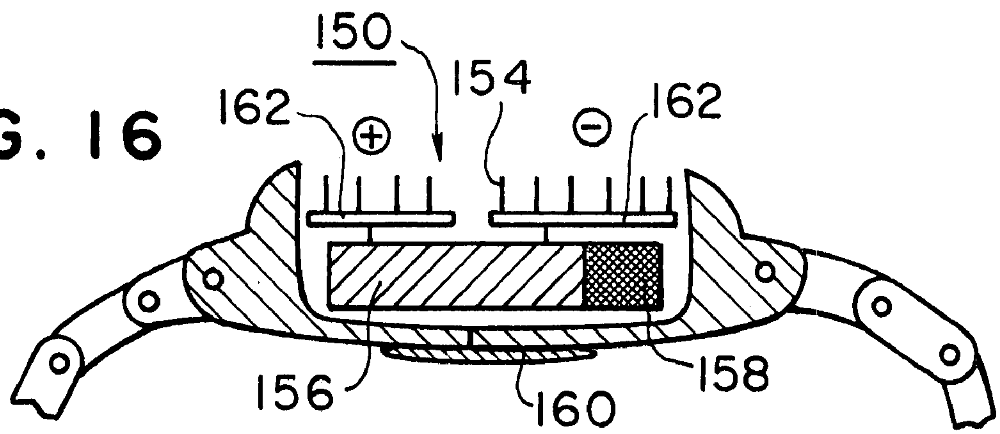


FIG. 17

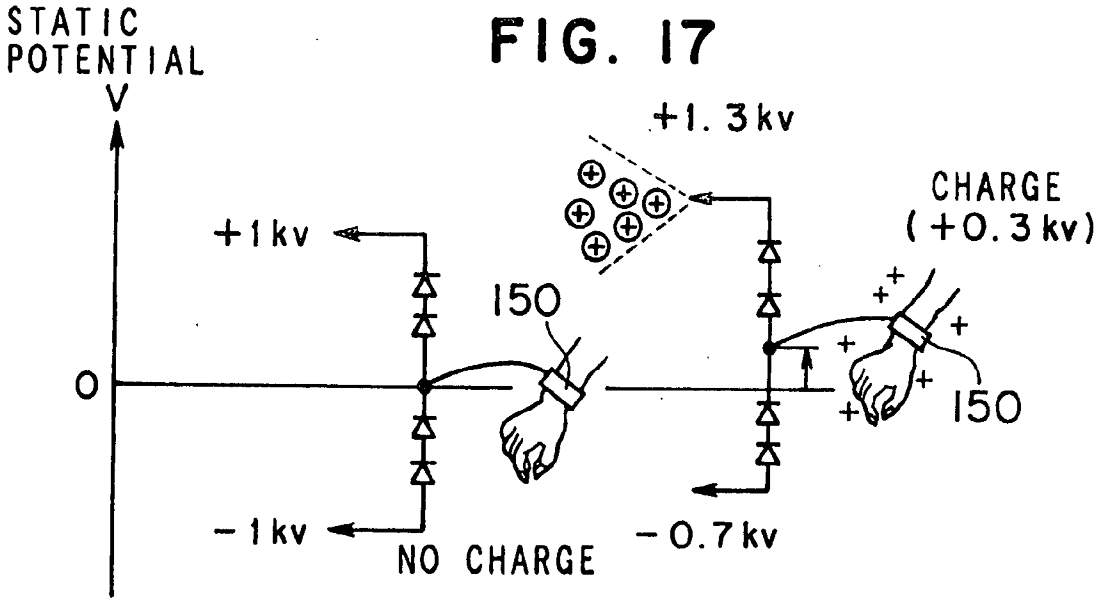


FIG. 18
PRIOR ART

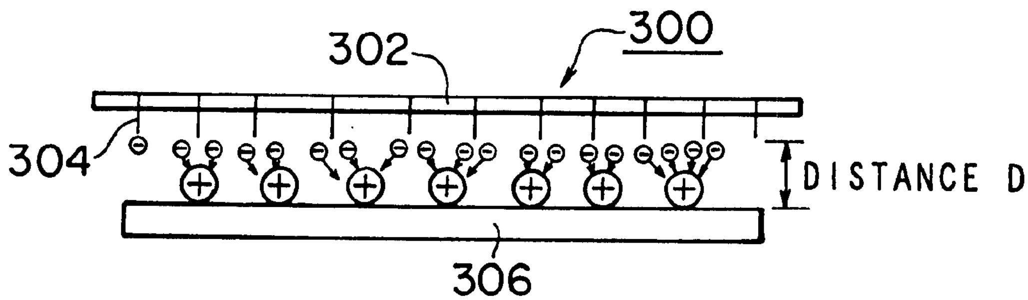


FIG. 19

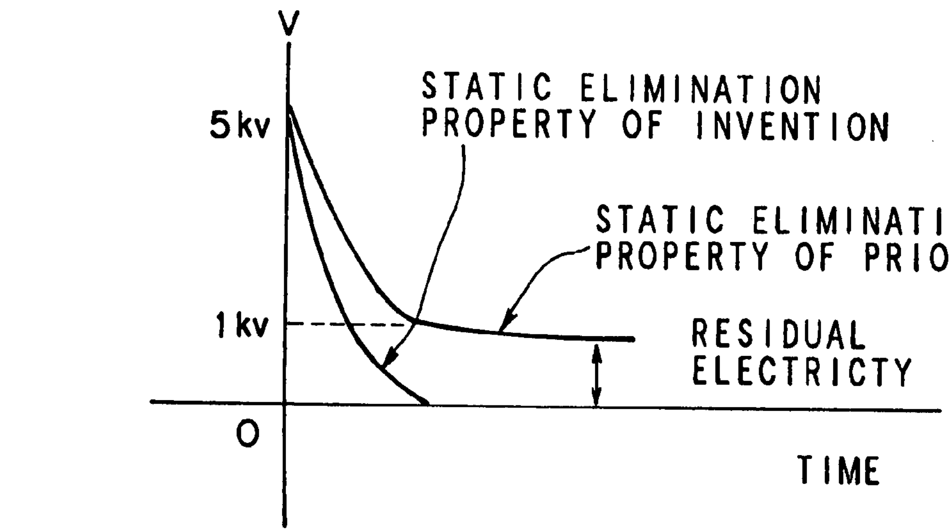


FIG. 20

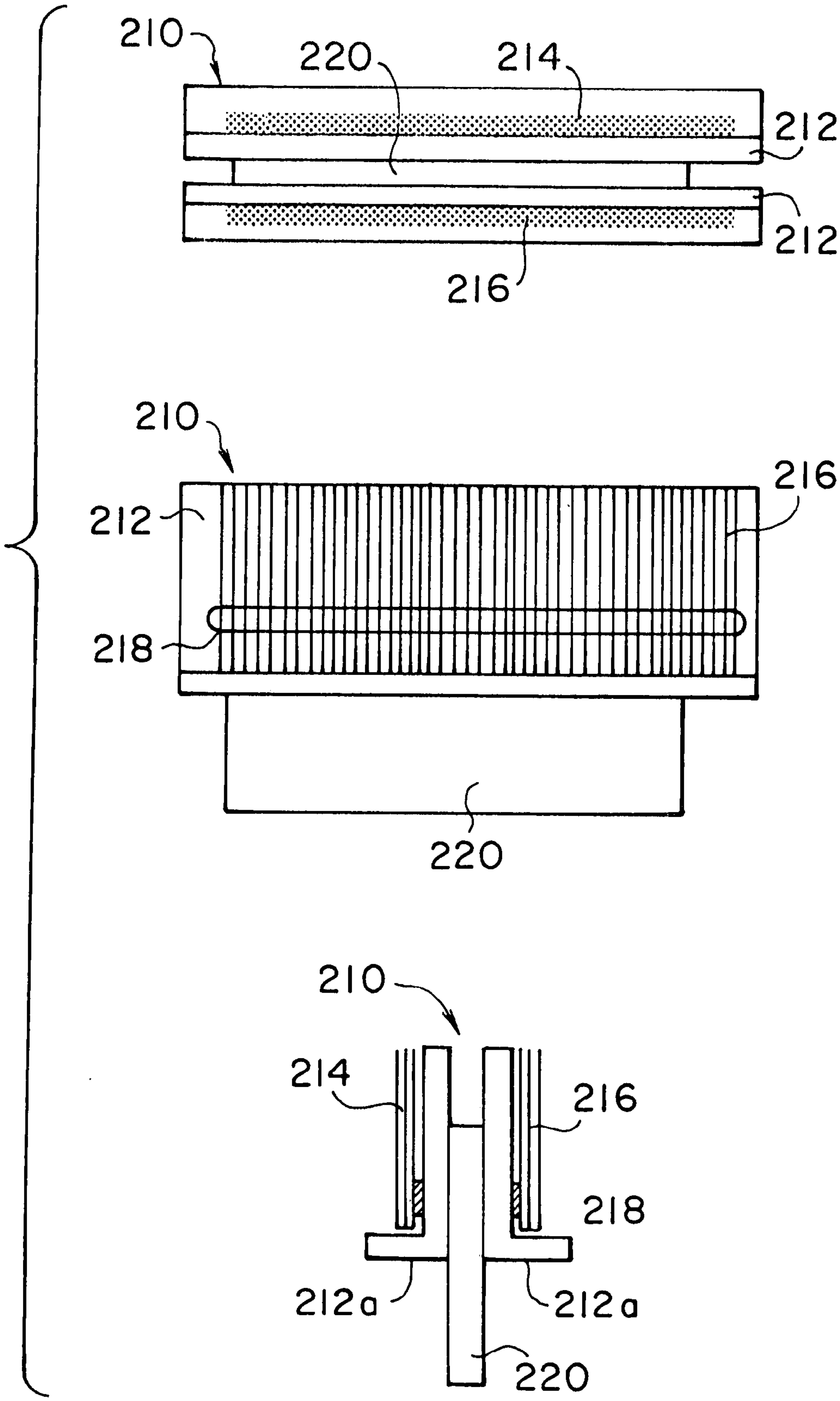

210
220
214
212
212
216
210
216
212
218
220
210
214
216
218
212a
212a
220

FIG. 21

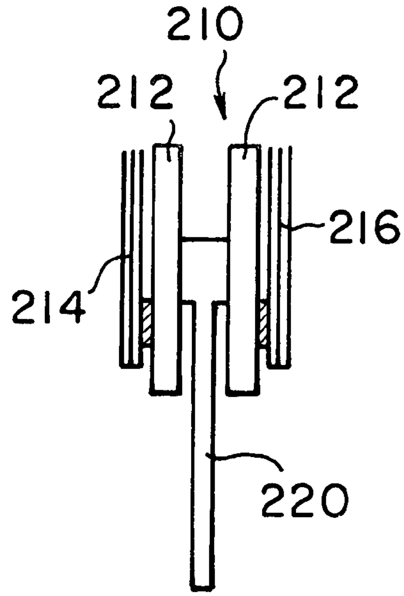


FIG. 22(a)

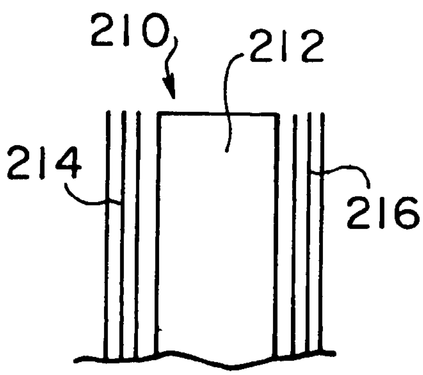


FIG. 22(b)

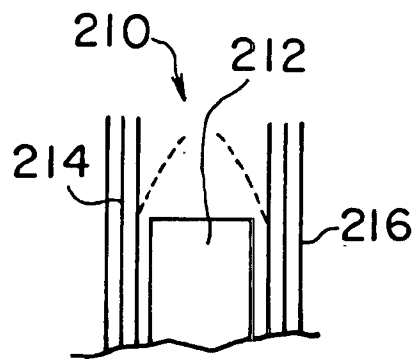


FIG. 23

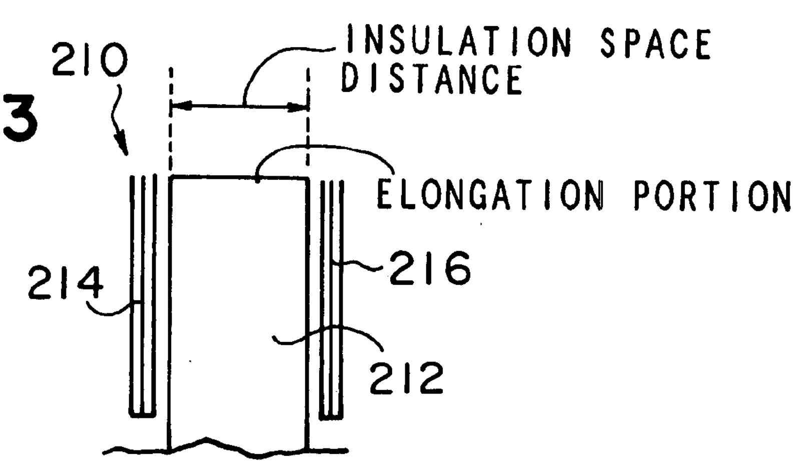


FIG. 24

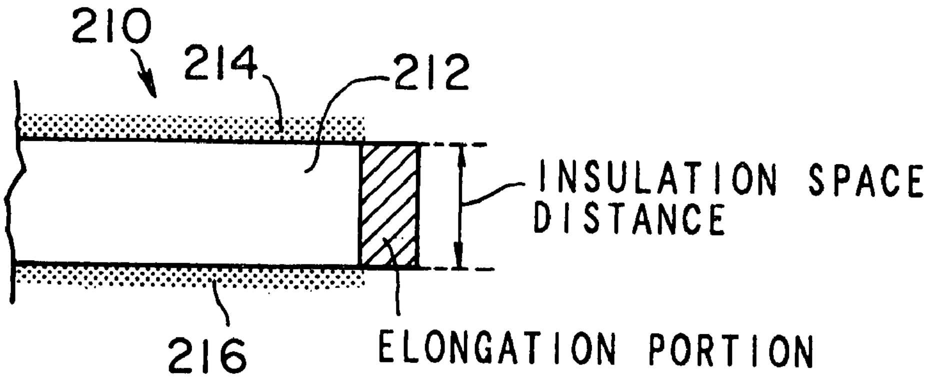


FIG. 25

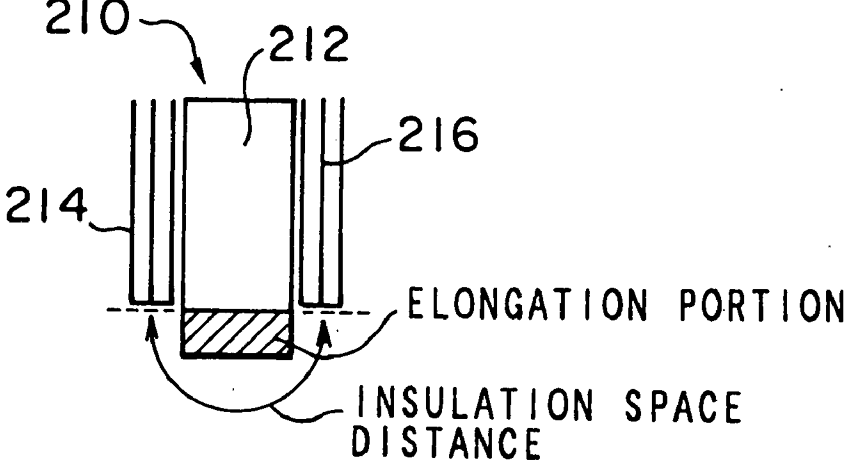


FIG. 26

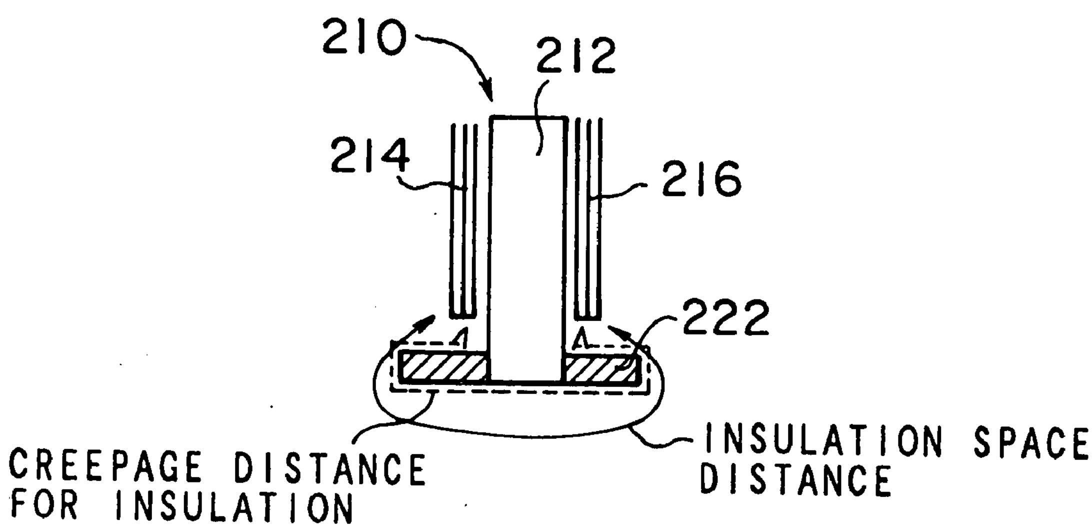


FIG. 27

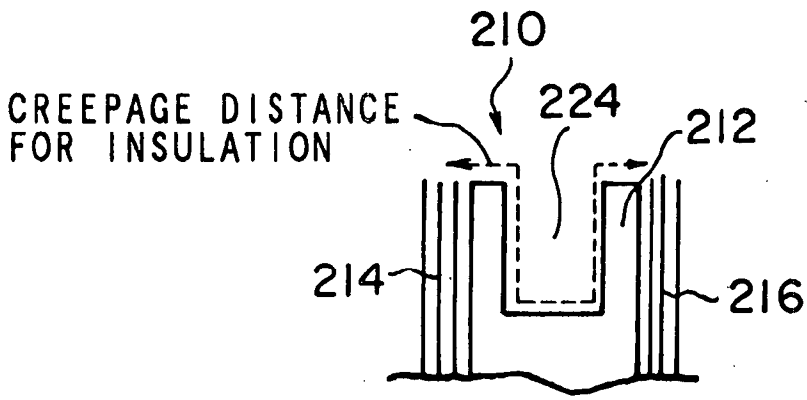


FIG. 28

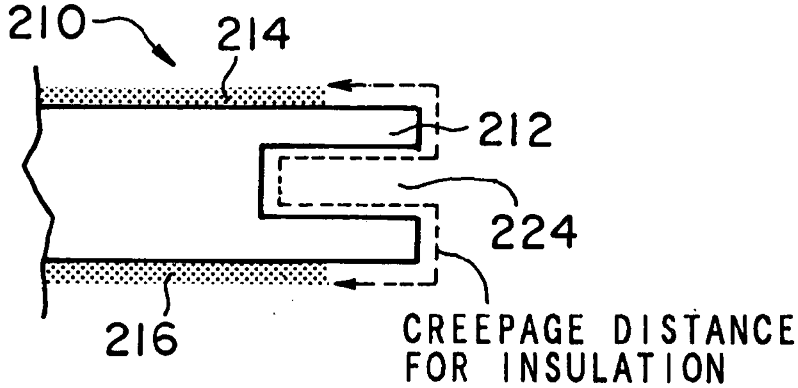


FIG. 29

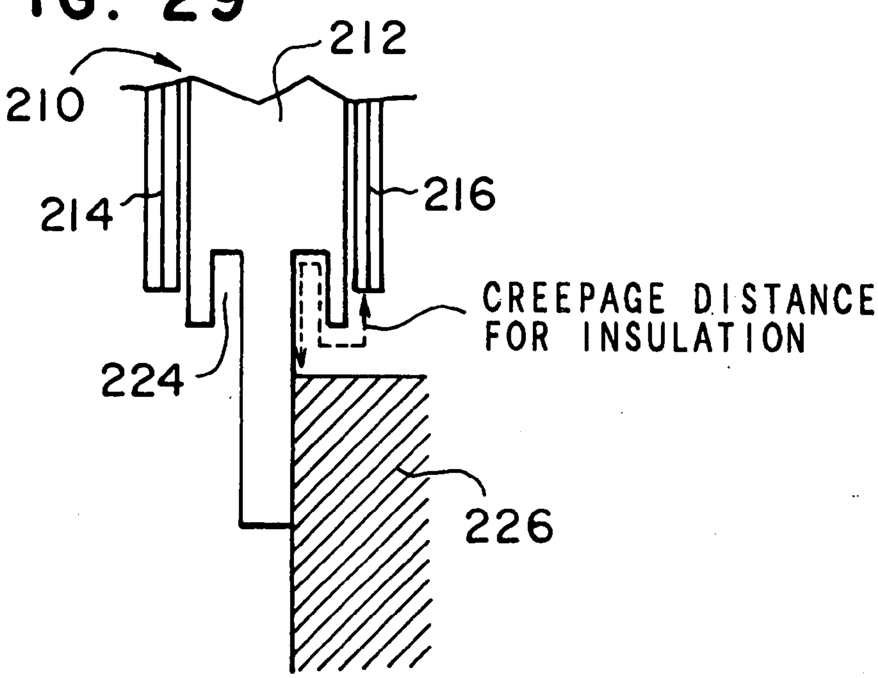


FIG. 30(a)

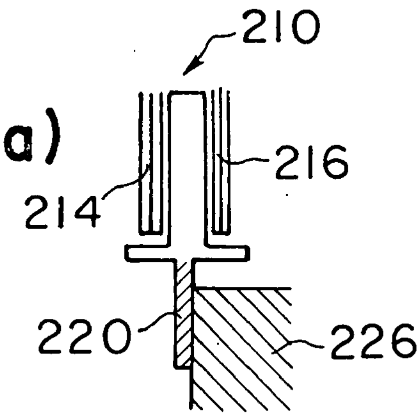


FIG. 30(b)

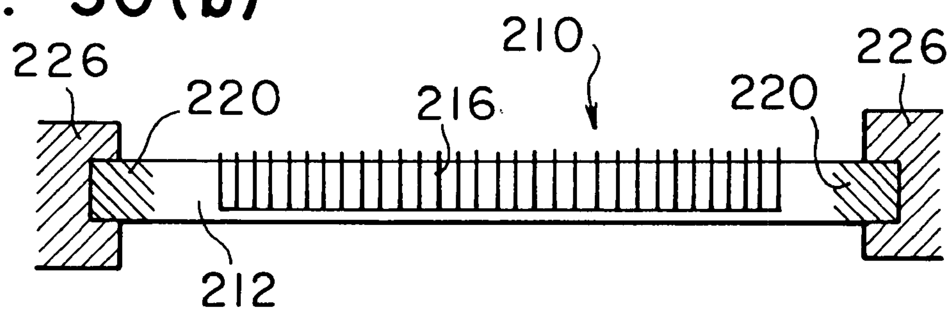
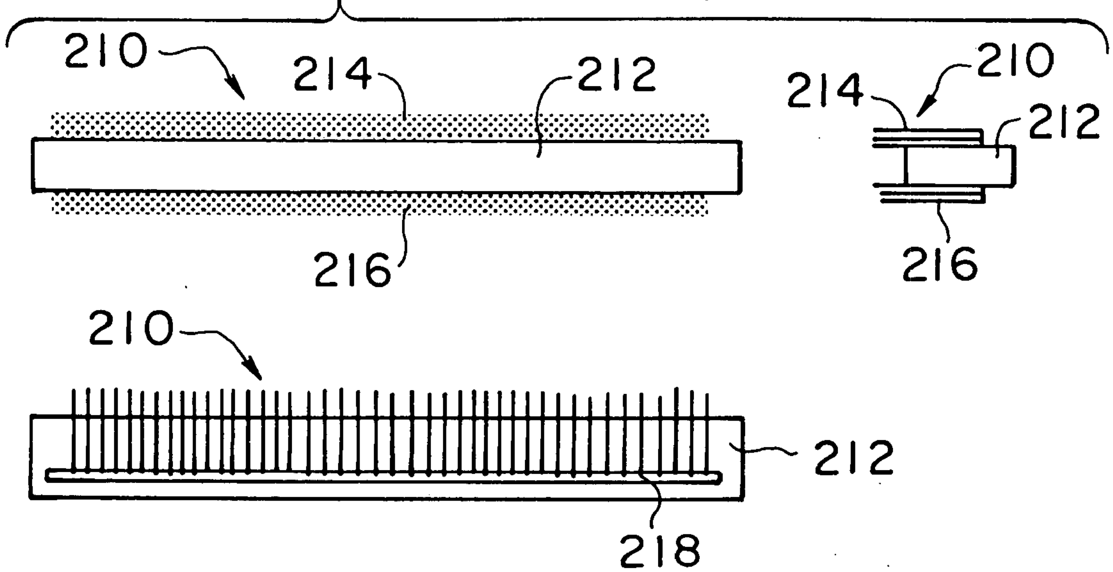


FIG. 31
PRIOR ART



STATIC ELIMINATOR WITH SELF-DISCHARGED WHISKERS

TECHNICAL FIELD

[0001] This invention generally relates to a static eliminator, and more particularly, to a tape type of static eliminator and a self-discharged static eliminator.

BACKGROUND OF INVENTION

[0002] From the viewpoint of construction, the ion generating portion of the conventional static eliminators are shaped in the form of box or rod.

[0003] From the viewpoint of discharge property, there is a self-discharged static eliminators. The self-discharged static eliminator uses conductive thin fibers. The discharge occurs from the leading ends of the fibers when the difference of static potential between the fibers and the object to be discharged or the fibers themselves rises above a certain value, which results in the cut-down of static electricity of the charged object. The self-discharged static eliminator is used to discharge static electricity of the charged objects by approaching the static eliminator to the charged objects. The operators in the factory wear the self-discharged static eliminators to discharge the static electricity from themselves and cut down the charge.

[0004] Since the ion generation portion of the static eliminator of the former is shaped in the form of box or rod, a large space is required to install it. Therefore, since the static eliminator can not be installed in the machine or in the narrow gap, the static electricity can not be eliminated in the area of static generation.

[0005] With the self-discharged static eliminator of the latter, the self-discharge does not occur until static electricity is accumulated and then static potential difference goes over a certain value, about 700 V, and the self-discharge stops when static potential difference goes below the certain value, about 700 V, and therefore the residual static electricity of about 700 V always remains.

[0006] FIG. **18** shows a conventional self-discharged static eliminator. A self-discharged static eliminator **300** comprises a line-like or rod-like conductor or a plate-like or fiber-like conductor body **302** provided with whisker-like conductors **304**, and is called "eliminator brush" or "arm band". The eliminator brush is not necessary to have electronic device separately and can eliminate static electricity. That is, without application for energy from the outside, the eliminator can discharge static electricity and therefore is called self-discharged static eliminator.

[0007] On the principle of operation, when the eliminator brush is disposed opposite to the objective **306** to be discharged such as a work made of paper, film, or sheet, and then the distance D is shorten, the electric field on the leading ends of whisker conductors become large and then insulation of air can be held. Finally, corona discharge starts and then air ions in the opposite polarity of the work are induced.

[0008] FIG. **19** shows a graph of elimination property of a conventional self-discharged static eliminator. The curve line indicated at "static elimination property of prior art" on the graph shows that when the elimination brush is approached to the work bearing static potential of 5 kV, the corona discharge starts and the static potential gradually decreases. When the static potential decreases to about 1 kv, the electric field on the leading ends of whiskers of static eliminator is weaken and finally the corona discharge stops. Since at that time static elimination ends, the static electricity is not completely eliminated and the residual static electricity of about 1 kV remains.

[0009] It is desirable that static elimination is made enough to eliminate residual static electricity as shown by the curve line indicated at "static elimination property of invention" in FIG. **19**.

[0010] With the fiber-like static eliminator as shown in FIG. **8**, plus electrodes and minus electrodes are arranged in line, respectively. These electrodes are not disposed oppose to each other and are disposed in zigzag. In this case, since, for example, each of minus electrodes is equally applied with sucking force from plus electrodes on both sides, the leading ends of electrodes are not approached, and thus spark discharge or short due to approaching of electrodes does not occur.

[0011] However, with the conventional DC type of fiber-like static eliminator as shown in FIG. **31** in which a multiplicity of fiber electrodes are disposed in parallel on support on its opposite sides, if the discharge electrodes project from the end of support, the leading ends of discharge electrodes approach to each other due to static force, which would result in the spark discharge or short.

[0012] More specifically, referring to FIG. **31**, a fiber-like static eliminator **210** comprises a multiplicity of plus fiber electrodes **214** and a multiplicity of minus fiber electrodes **216** disposed in parallel on support **212** on its opposite sides. Both electrodes **214** and **216** are power supplied from conducting electrodes **218**, and the leading ends of plus and minus electrodes **214** and **216** project from the end of the support **212**.

[0013] Therefore, it is an object of the present invention to provide a tape type of static eliminator which can be installed in a small space or gap and does not generate the stoppage of discharge even when the static potential goes down below about 700 V.

[0014] It is anther object of the present invention to provide a self-discharged static eliminator, hereinafter referred as to "static eliminator" or "eliminator brush" which can eliminate static electricity with ease by small power until the residual static electricity is removed.

[0015] It is a further object of the present invention to provide a DC type of fiber-like static eliminator which prevents spark discharge or short.

SUMMARY OF INVENTION

[0016] To accomplish the objects, there is provided a static eliminator-which comprises ion generating port ion in the form of tape.

[0017] There is also provided a self-discharged static eliminator comprising conductors provided with discharge whiskers in which voltage is applied to conductors.

[0018] There is also provided a DC type of fiber-like self-discharged static eliminator which comprises plus fiber electrodes supplied with plus voltage, minus fiber electrodes supplied with minus voltage, and a support disposed between plus fiber electrodes and minus fiber electrodes for supporting these fiber electrodes and provided with an insulation reserving mean for preventing the spark discharge or the short due to access of electrodes.

[0019] Other objects, features, and advantages of the present invention will be explained in the following detailed description of the invention having reference to the appended drawings:

BRIEF DESCRIPTION OF DRAWINGS

[0020] FIG. **1** shows a tape type of static eliminator in accordance with the first embodiment of the present invention,

[0021] FIG. **2** shows a tape type of static eliminator in accordance with the second embodiment of the present invention,

[0022] FIG. **3** shows a tape type of static eliminator in accordance with the third embodiment of the present invention,

[0023] FIG. **4** shows a tape type of static eliminator in accordance with the 4th embodiment of the present invention,

[0024] FIG. **5** shows a tape type of static eliminator in accordance with the 5th embodiment of the present invention,

[0025] FIG. **6** shows a static eliminator in accordance with the 6th embodiment of the present invention in a plan view and a side view,

[0026] FIG. **7** shows a static eliminator in accordance with the 7th embodiment of the present invention in a plan view and a side view,

[0027] FIG. **8** shows a static eliminator in accordance with the 8th embodiment of the present invention in a plan view and a side view,

[0028] FIG. **9** shows a static eliminator in accordance with the 9th embodiment of the present invention in a plan view and a side view,

[0029] FIG. **10** is a diagrammatic view of an electronic circuit of AC type of static eliminator,

[0030] FIG. **11** is a diagrammatic view of an electronic circuit of DC type of static eliminator,

[0031] FIG. **12** is a graph for explanation of the principle of operation of AC type of static eliminator,

[0032] FIG. **13** is a graph for explanation of the principle of operation of DC type of static eliminator,

[0033] FIG. **14** is a perspective view showing a static eliminator in accordance with the 10th embodiment of the present invention,

[0034] FIG. **15** is a cross sectional view showing an AC type of static eliminator in accordance with 10th embodiment of the present invention,

[0035] FIG. **16** is a cross sectional view showing a DC type of static eliminator in accordance with 10th embodiment of the present invention,

[0036] FIG. **17** is a view for explanation of principle of operation of 10th embodiment of the present invention,

[0037] FIG. **18** is a front view showing a conventional static eliminator,

[0038] FIG. **19** is a graph showing elimination properties of a conventional static eliminator and a static eliminator in accordance with the present invention,

[0039] FIG. **20** is a view showing the whole of a prototype of fiber-like static eliminator in accordance with 11th embodiment of the present invention,

[0040] FIG. **21** shows a fiber-like static eliminator in accordance with the 12th of the present invention,

[0041] FIG. **22** shows a fiber-like static eliminator in accordance with the 13th of the present invention,

[0042] FIG. **23** shows insulation reserving means in accordance with 14th embodiment.

[0043] FIG. **24** shows insulation reserving means in accordance with 14th embodiment.

[0044] FIG. **25** shows insulation reserving means in accordance with 14th embodiment.

[0045] FIG. **26** shows insulation reserving mean in accordance with 14th embodiment.

[0046] FIG. **27** shows insulation reserving means in accordance with 14th embodiment.

[0047] FIG. **28** shows insulation reserving means in accordance with 14th embodiment.

[0048] FIG. **29** shows insulation reserving means in accordance with 14th embodiment.

[0049] FIG. **80** is a view for explanation of attachment portion in accordance with 16th embodiment, and

[0050] FIG. **31** is a view showing the whole of a conventional fiber-like static eliminator.

DETAILED DESCRIPTION OF THE INVENTION

FIRST EMBODIMENT

[0051] FIG. **1** shows a tape type of static eliminator in accordance with the first embodiment of the present invention. In FIG. **1** a tape-type static eliminator, specifically, a tape-type ion generator of the static eliminator **10** includes a plurality of discharge electrodes **14** for generating ions on a narrow thin board tape **12**. Each discharge electrode **14** is disposed in parallel on the board tape **12** and the discharge end of each discharge electrode **14** is oriented in a direction to issue ions from one side of the board tape **12**. Since the discharge electrodes are applied with high voltage such as above several kV, it is preferred that a plurality of short cover tapes **16***a* as shown in FIG. **1***a* or an elongated cover tape as shown in FIG. **1***b* are provided for covering over the discharge electrodes **14**. The discharge electrodes **14** are is power supplied by conductor or electric supply line, not shown in FIG. **1**, through a high voltage generating device, not shown, from a power supply, not shown.

[0052] The board tape **12** is of any proper insulating material and may be rigid or flexible in its stiffness. However, the flexible material is preferable because of usability. The cover tape **16** (**16***a* or **16***b*) is of any flexible insulating material.

[**0053**] This tape type of static eliminator **10** is not required for large space for installation and can be installed in a narrow space since it is narrow and thin. Therefore, the static eliminator can eliminate static electricity on the site of static electricity occurrence within a machine or a device immediately after its occurrence and thus can prevent problems induced from the static electricity.

[**0054**] As another merits, when the board tape **12** of flexible material is used it can be installed in conformity to the three dimensional structure of the object to be discharged since the board tape **12** can be bent freely. Thus, the static eliminator can issue ions from the best position for elimination in accordance with the object to be discharged, and therefore highly effective elimination is possible.

SECOND EMBODIMENT

[**0055**] FIG. **2** shows a tape type of static eliminator in accordance with the second embodiment of the present invention. In case that the ion generating portion is in the form of tape and is flexible, the static eliminator can be suspended on opposite ends by pulling it. In such a case, only holders **18** provided on the opposite ends are required for pulling. Therefore, a support for supporting ion generating portion from its rear side is not necessary. Furthermore, the problem in that the support absorbs ions can be solved. Although the short cover tapes **16***a* is shown in FIG. **2**, the elongated cover tape **16***b* may be used.

THIRD EMBODIMENT

[**0056**] FIG. **3** shows a tape type of static eliminator in accordance with the third embodiment of the present invention. FIG. **3***a* and FIG. **3***b* are cross sectional views along lines **3**-**3** of FIG. **1**. In FIG. **3***a*, conductors **20** and **22** are used for supplying electric power to discharge electrodes **14**. The conductors **20** and **22** generate plus ions and minus ions, respectively, and power supply to each discharge electrode **14** is carried out by connecting its terminal and conductor **20** or **22**. These conductors **20** and **22** are supplied with power from a high voltage generating device, not shown. In FIG. **3***b*, the board tape **12** itself is an electronic circuit board with an electronic-circuit pattern which supplies power to the discharge electrodes. As a circuit pattern, portions **24***a* and **24***b* corresponding to the conductor or power supply line are provided. In this manner, in case that the electronic circuit pattern is provided, FPC or flexible print circuit, or FFC or flexible flat cable may be used.

4th EMBODIMENT

[**0057**] FIG. **4** shows a tape type of static eliminator in accordance with 4th embodiment of the present invention. In this embodiment, discharge electrodes are mounted in sockets **26**. In this case, discharge electrodes are exchangeable and thus their maintenance is easy.

5th EMBODIMENT

[**0058**] FIG. **5** shows a tape type of static eliminator in accordance with 5th embodiment of the present invention. In this embodiment, discharge electrode **14** is formed with discharge leading ends **14***a* and **14***b* at its opposite ends to issue ions from the opposite sides of the board tape **12**. Alternatively, the discharge electrode with discharge leading, end **14***a* and discharge electrode with discharge leading end **14***b* are disposed in, opposite directions. With this, tape type of static eliminator, it can be used to discharge static electricity on the opposite sides in a narrow space.

6th EMBODIMENT

[**0059**] FIG. **6** shows a prototype of static eliminator in accordance with 6th embodiment of the present invention. One of more specific embodiments 7-9 described later is used in response to the property of applied voltage. An eliminator brush **110** comprises a base tape **112**, whisker shaped conductors or whisker electrodes **118**, a conductor **116** provided with the whisker conductors **118** so that the whisker conductors **118** are disposed in parallel to be, orientated in a direction, and a cover for covering the conductor **116** and whisker conductors **118**. The conductor **116** of the eliminator brush **110** is connected with electronic device or body **120** by conductor **122** to, be applied with voltage from the body **120**. The eliminator brush **110** is covered by insulating cover **114**. It is preferable that the applied voltage is near the residual electricity as shown in FIG. **19**. Although the reason will be described in detail later, when the voltage near the residual electricity is applied, in case that the work, not shown, is not charged with static electricity, the eliminator brush does not discharge and ions are not issued. However, the discharge starts just at the moment when the work is charged even if only slightly and the ions in opposite polarity of charged work are issued and the discharge is made.

[**0060**] If the eliminator brush **110** is being applied with the voltage higher than the residual electricity, the full-time discharge continues to be made from the eliminator brush **110**. This is of no use in a sense. However, because of full-time discharge, if charged only slightly, a quantity of discharge is adjusted with high sensitivity and thus a rapid and high accurate operation of discharge can be realized.

7th EMBODIMENT

[**0061**] FIG. **7** shows a static eliminator in accordance with 7th embodiment of the present invention. In FIG. **7** a static eliminator is of AC type. With the AC type of static eliminator, one eliminator brush (conductor **116** and array of discharge whiskers **118**) is held by spacers **124**, **126** and covered by the cover **114** to be insulated from the outside. The eliminator brush is preferably formed on a base tape **112**, which can be easily handled. Since the eliminator brush would touch the work and be charged if the leading ends of whiskers projects from the base tape, it is preferable that the whisker is led in from the base tape and does not touch the work directly. The brush eliminator is applied with, voltage, for example, AC 1 kV relatively lower than the applied voltage such as AC 5 kV-10 kV used in the conventional static eliminator.

8th EMBODIMENT

[**0062**] FIG. **8** shows a static eliminator in accordance with 8th embodiment of the present invention. This eliminator is of a DC type. The eliminator has two eliminator brushes. The brushes are applied with a voltage, for example, DC 1 kV relatively lower than the applied voltage such as DC 5 kV-10 KV used in the conventional static eliminator. One brush is applied with voltage of plus polarity and the other brush is applied with voltage of minus polarity. It is preferable that whiskers of each brush are disposed in zigzag manner. Furthermore, these brushes are isolated and electrically insulated from each other by spacer **128**. These brushes are mounted on the base tape and are insulated by the cover **114**, which can be easily handled. Since the eliminator brush would touch the work and be charged if the leading ends of whiskers projects from the base tape, it is preferable that the whisker is led in from the base tape and does not touch the work directly.

9th EMBODIMENT

[0063] FIG. **9** shows a static eliminator in accordance with 9th embodiment of the present invention. In the embodiment, an eliminator brush **110** of plus polarity and an eliminator brush **110** of minus polarity are separately provided. The eliminator brush is different from that of the 8th of embodiment in that no intermediate spacer **128** is provided, but the other construction is similar to that of the 8th of embodiment.

[0064] FIGS. **10** and **11** diagrammatically shows an electronic circuit according to the present invention. FIG. **10** shows the electronic circuit applied for the AC type of static eliminator and FIG. **11** shows the electronic circuit applied for the DC type of static eliminator.

[0065] With the AC type of static eliminator, an oscillator OSC **132** provided in the electronic device **120** generates an alternate voltage. Although its oscillating frequency may be 50/60 Hz of commercial power, the transformer becomes large. Therefore, it is preferable that several 10 kV of frequency is used for miniaturization. The voltage generated by oscillator is boosted to the order of the above mentioned residual static potential, for example, 1 kV. The work which is discharged by the eliminator **110** is indicated at **130**. With the DC type of static eliminator, an oscillator OSC **132** generates an alternate voltage. The alternate voltage is rectified by a rectification circuit and boosted to generates plus DC and minus voltages on the order of the above-mentioned residual static potential, for example, 1 kV. These voltages are applied to separate static eliminators.

[0066] Now referring to FIGS. **12** and **13**, a principle of operation will be explained. The AC type will be explained with reference to FIG. **12** and the DC type will be explained with reference to FIG. **13**. The static potential is on axis of ordinate of the graph and time is on axis of abscissas of the graph.

[0067] In FIG. **12** the alternate voltage in which its peak voltage is ±1 kV static potential to ground is applied. At the moment when the work charged with 0.3 kV appears near the eliminator brush, during half positive cycle the potential difference between the eliminator brush and the work increases by 0.3 kV to 1.3 kV. Since the potential difference rises beyond the discharge halt voltage of 1 kV, the electric field becomes stronger and thus the discharge of plus ions starts, which leads to neutralization of minus charge of 0.3 kV. In the meantime, during half negative cycle the potential difference between the eliminator brush and the work decreases by 0. 3 kV to 0.7 kV. Since the charge of 0.7 kV is below the discharge halt voltage of 1 kV, the electric field becomes weaker and thus the discharge of minus ions does not occur.

[0068] In FIG. **13** the DC voltages in which ±1 kV static potentials to ground are applied. At the moment when the work charged with 0.3 kV appears near the eliminator brush, the potential difference between the positive eliminator brush and the work increases by 0.3 kV to 1. 3 kV. Since the potential difference rises beyond the discharge halt voltage of 1 kV, the electric field becomes stronger and thus the discharge of plus ions starts, which leads to neutralization of minus charge of 0.3 kV. In the meantime, the potential difference between the negative eliminator brush and the work decreases by 0.3 kV to 0.7 kV. Since the charge of 0.7 kV is below the discharge halt voltage of 1 kV, the electric field becomes weaker and thus the discharge of minus ions does not occur.

[0069] With the conventional eliminator brush, when static electricity goes below 1 kV, the discharge halts, and a further elimination can be not made. Consequently the residual static electricity of 1 kV remains. On the other hand, in the invention since the eliminator brush is applied with the discharge halt voltage such as 1 kV, the discharge starts and neutralizes the static electricity which the work bears just at the moment when the work is charged with static electricity. Of course when the work bears no static electricity no or little discharge occurs. 10th embodiment.

[0070] FIG. **14** is a perspective view showing a static eliminator in accordance with 10th embodiment of the present invention. In FIG. **14** the body of eliminator **150** is accommodated in a small case **152** such as watch band type or ring type and discharge whiskers **154** are disposed so that these whiskers are oriented in a direction of opening of the small case.

[0071] FIG. **15** is a cross-sectional view showing AC type of static eliminator of 10th embodiment. In FIG. **15** the static eliminator **150** comprises an electronic circuit **156** and a power supply **158** accommodated in the case **152**, and a conductor **162** which is provided with electrode whiskers **162** is adapted to be applied with AC voltage through a conductor from the power supply **156**. An object contact electrode **160** for making contact with the object to be discharged such as a human body or the work through a conductor from the electronic circuit **156** is provided on the outer surface of the case on the side opposite to the opening of the case.

[0072] FIG. **16** is a cross-sectional view showing DC type of static eliminator of 10th embodiment. The embodiment is the same as that of the above-mentioned AC type of static eliminator except that the two conductors **162** and **162** provided with discharge whickers are connected to the DC power supply to be applied with plus and minus voltages.

[0073] FIG. **17** is a view for explanation on principle of operation. In FIG. **17** in case that the-object to be discharged such as human body bears no charge, the discharge does not occur. On the other hand when the object to be discharged is charged with, for example, plus 0.3 kV, the discharge occurs from the plus discharge whiskers applied with DC voltage of plus 1 kV to reduce the charge of the human body to substantial zero.

11th EMBODIMENT

[0074] FIG. **20** is views (plan view, front view and side view) showing a prototype of whole fiber shaped static eliminator in accordance with the 11th embodiment of the present invention. A fiber eliminator **210** comprises a support **212** made of insulating material.

[**0075**] In the embodiment the support **212** comprises two support members and a mounting member **220** for mounting two support members at the opposite sides. However, the support **212** may be one piece of member or may be integral with the mounting member **220**. The mounting member is used to be attached on the other member for holding the fiber eliminator, described in detail later.

[**0076**] A plus fiber electrode **214** and a minus fiber electrode **216** are attached to two supports **212**, **212** at the outer sides thereof and are supplied with plus and minus voltages through a conducting electrode **218** from the power supply, not shown. The conducting electrode **218** equally supplies power to all discharge electrodes. The support **212** is formed with an isolation protrusion **212***a*.

[**0077**] As constructed above, the fiber eliminator **210** does not generate short or spark since the distance between the electrodes are maintained even if statically attracting force for attraction are acted between the plus and minus electrodes. That is, as described in detail later, insulation space distance and creepage distance for insulation between plus and minus electrodes **214** and **216** are reserved at any position such, as upper portion (leading end), side portion (side end) and lower portion (bottom end) of the support **212**.

12th EMBODIMENT

[**0078**] FIG. **21** shows a static eliminator in accordance with the 12th embodiment of the present invention. The static eliminator is similar to that of 11th embodiment except that no isolation protrusion **212***a* is provided. In the embodiment, if the mounting member or portion **220** is attached to a metal support, not shown in FIG. **21**, electric leakage would occur since plus and minus electrodes **214** and **216** are near the metal support. Therefore, as shown in FIG. **21**, it is preferable that the mounting member is made to be in the form of T to reserve creepage distance for insulation between the metal support and plus or minus electrode.

13th EMBODIMENT

[**0079**] FIG. **22***a* shows a static eliminator in accordance with the 13th embodiment of the present invention and FIG. **22***b* is a view for explanation on the static eliminator in accordance with the 13th embodiment of the present invention. If, as shown in FIG. **22***b*, the leading end or upper end of support **212** is below the leading ends of discharge electrodes **214** and **216**, the electrodes are attracted to each other by static force and then deformed, which results in spark or short. In order to avoid this, as shown in FIG. **22***a*, the upper end of the support **212** is made to be level with the leading ends of discharge electrodes to prevent deformation of the discharge electrodes.

14th EMBODIMENT

[**0080**] FIGS. **23**-**29** show insulation reservation means for reserving insulation between the discharge electrodes or between the fiber static eliminator and the holder on which the fiber static eliminator is mounted.

[**0081**] As shown in FIG. **23**, the support **212** is provided with isolation portion at its upper end by making the support to be thick and be level with the discharge electrodes for reserving insulation.

[**0082**] As shown in FIG. **24**, the support **212** is made to be thick and is provided at its opposite sides with isolation portion which length is the same as that of discharge electrodes **214** and **216** or longer than that of discharge electrodes **214** and **216** for reserving insulation at its opposite end portions.

[**0083**] As shown in FIG. **25** the support **212** is made to be thick, and to be level with the discharge electrodes or to project from the bottom of the discharge electrodes for providing isolation portion at its bottom portion to reserve insulation.

[**0084**] As shown in FIG. **26** the support **212** is provided with protrusion **222** for isolation to reserve insulation at its bottom portion.

[**0085**] As shown in FIG. **27** the support **212** is formed with a groove **224** at its upper portion to reserve creepage distance for insulation.

[**0086**] As shown in FIG. **28** the support **212** is formed with a groove **224** at its side portions to reserve creepage distance for insulation.

[**0087**] As shown in FIG. **29** the support **212** is formed with a groove **224** at its bottom portion to reserve creepage distance for insulation.

15th EMBODIMENT

[**0088**] Now referring to FIG. **20** again, the conductor electrode will be explained. Since the fiber discharge electrode material has a low resistance value near the conductor, the discharge occur near the conductor easily and thus elimination is effective. However, since the fiber discharge electrode material has a high resistance value away from the conductor, the discharge does not easily occur away from the conductor and thus elimination is not effective. In order to avoid this each discharge electrode is connected to the conductor electrode **218** to reserve elimination performance even at the end conductor electrode.

16th EMBODIMENT

[**0089**] FIG. **30** is a view for explanation on mounting portion of eliminator. The conventional elimination brush is attached to the holder made of metal. Since fundamentally the elimination brush is used so as to be grounded to the earth there is no concept of insulation. The eliminator brush according to the present invention and should be insulated from the environment since the eliminator is supplied with voltage although the voltage is low. Therefore, the mounting portion is necessary at the side portion or bottom portion of the eliminator.

[**0090**] It is understood that many modifications and variations may be devised given the above description of the principles of the invention. It is intended that all such modifications and variations be considered as within the spirit and scope of this invention, as it is defined in the following claims.

1-**35**. (canceled)

36. A self-discharged static eliminator comprising discharge whiskers connected to a conductor in which a predetermined voltage is applied to the conductor.

37. A self-discharged static eliminator according to claim 36 in which the predetermined voltage has a peak value below ±5,000 volts.

38. A self-discharged static eliminator according to claim 36 in which the predetermined voltage is AC or DC.

39. A self-discharged static eliminator according to claim 38 in which, in the case of DC voltage, plus and minus DC voltage is applied to the whiskers.

40. A self-discharged static eliminator according to claim 36 in which the each of the discharge whiskers is covered by insulating material.

41. A self-discharged static eliminator comprising discharge whiskers in parallel, a power supply for applying power to the discharge whiskers, and an insulator covering the discharge whiskers.

* * * * *