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Olson et al.

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[45] **June 25, 1974**

[54] **RADIOACTIVE STATIC ELECTRICITY ELIMINATOR**

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[21] Appl. No.: **174,642**

[52] **U.S. Cl.** ..... **317/2 F,** 317/4

[51] **Int. Cl.** **H05x 3/02**

[58] **Field of Search** ..... 317/2 R, 2 F, 3, 4, 2 A; 250/106 R, 106 S, 44

[56] **References Cited**

UNITED STATES PATENTS

2,479,882	8/1949	Wallhausen et al.	317/2 R
3,531,688	9/1970	Jackson	317/2 F
3,636,408	1/1972	Shuman	317/2 R

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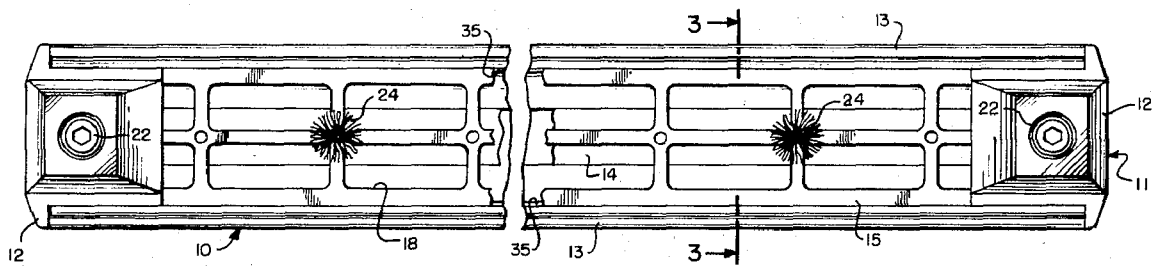
[57] **ABSTRACT**

A radioactive device to remove static electricity charges including a radioactive foil maintained in a grounded housing protected by a grounded metal grid, so located and of such physical dimensions, as to afford maximum protection against physical contact with the active element and minimum physical and electrical shielding of the effective radiations. For applications involving extremely high static charges, or where complete removal of static charges is essential, the grid may also incorporate metal brushes. In the latter version, the radioactive foil creates a region of high density ionization adjacent to the opening in the housing, with maximum density enveloping the points of the brushes, greatly enhancing the normal effectiveness of the brushes and making the device capable of effectively removing a wide range of static electrical charges and finds great use in the elimination of static electricity from moving materials such as paper, plastic, clothing, etc. created during their processing operation.

22 Claims, 6 Drawing Figures



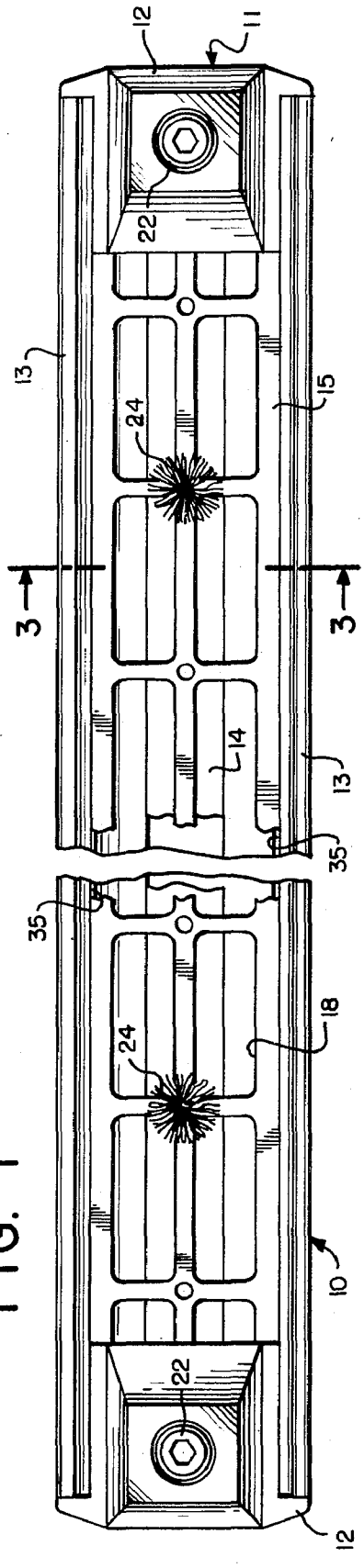


FIG. 1

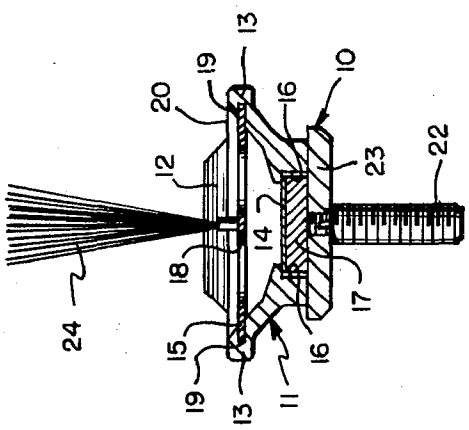


FIG. 3

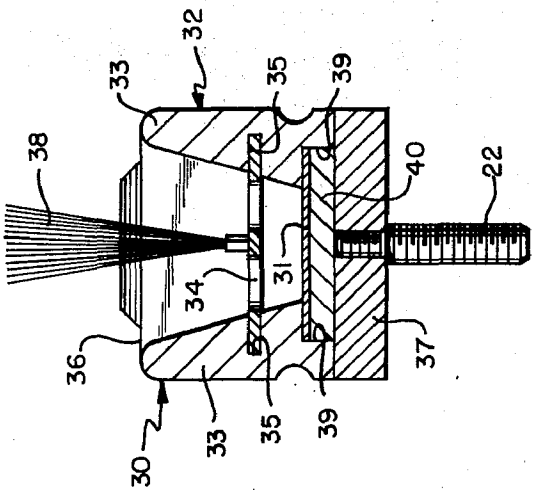


FIG. 5

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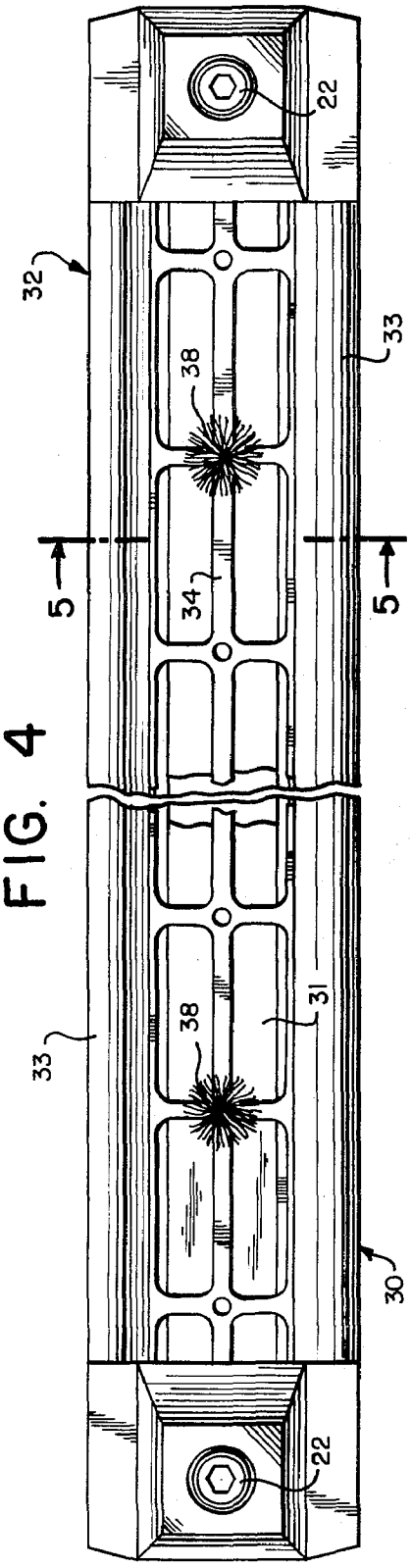

FIG. 4

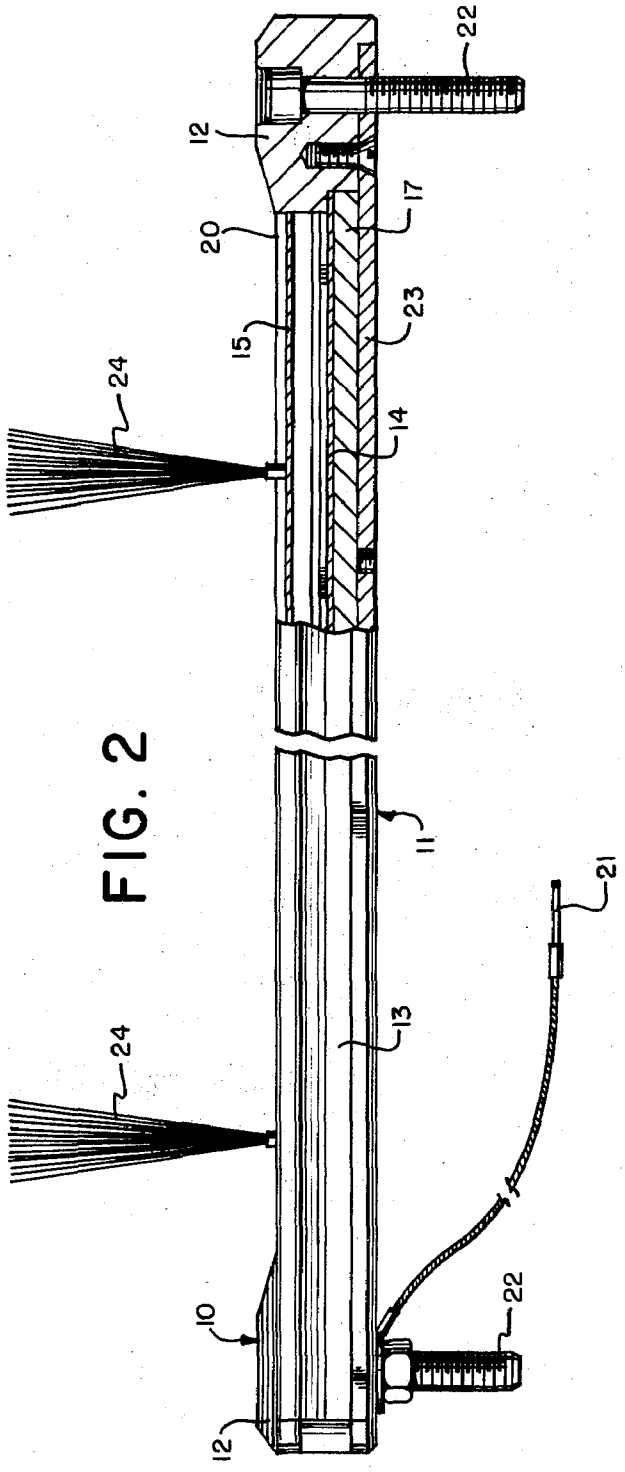

FIG. 2

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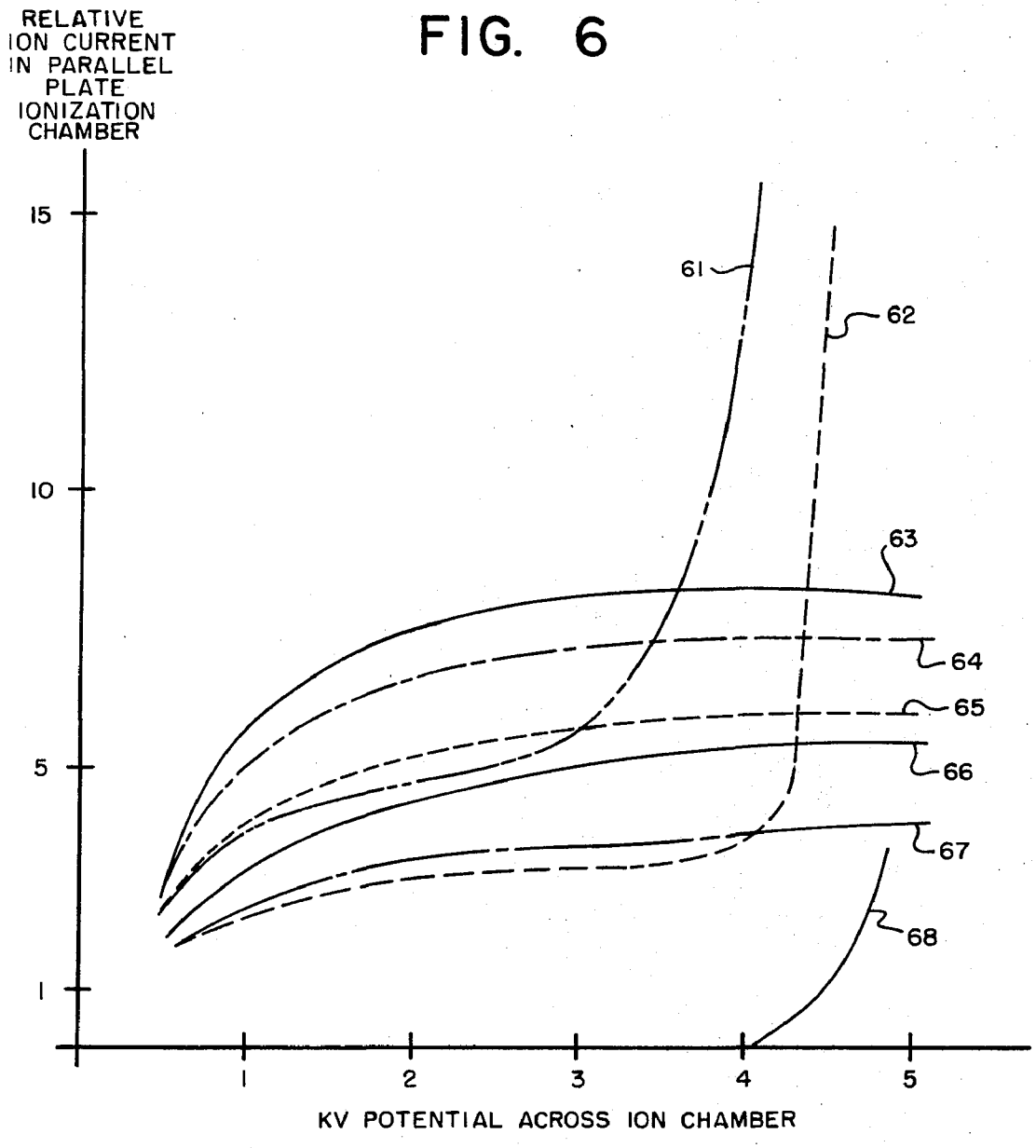
FIG. 6



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RADIOACTIVE STATIC ELECTRICITY ELIMINATOR

BACKGROUND OF THE INVENTION

This invention relates to an improved structure for the removal of static electricity which includes a radioactive source and an assembly utilizing the most effective electrical characteristic of the components of said assembly, and which may also incorporate metal brushes in such manner that a region of high density ionization is created in the effective area of the brushes, in order to efficiently remove a wide range of static electrical charges in and around said region, and more particularly, this invention relates to the removal of static electricity from various articles of manufacture during their manufacture.

Static electric charges are generated on most articles having solid surfaces by friction-creating movement os the articles against one another or by movement of the articles through the atmosphere resulting in electron build-up or loss on their outer surfaces. The handling and processing problems encountered due to this build-up of static electricity are particularly acute in the manufacture of a great number of articles. In addition, in the manufacture of plastic articles there is frequently a danger of fire, explosions and also a hazard of electrical shock to personnel; in the manufacture of paper articles in addition to the danger of fire, there are added problems of dust accumulations and feeding jams; in the textile industry the presence of static electricity often causes undetected process failures resulting in poor quality of the textiles manufactured; etc.

There are a number of devices now in existence for removing static electricity from webs, i.e., charged surfaces, whether moving or stationary, which include: high voltage point discharge units; induction-type units; and radioactive-bar type units. High voltage point discharge units are effective when the magnitude of the static charge is large, but this type of static eliminator increases the probability of an explosion when used in an explosive atmosphere. The induction-type units have been found to be ineffective to discharge articles carrying low electrostatic charges and have proven unreliable where wide variations in magnitude of the charge may occur during processing or where it is essential that a residual charge be at a minimal or nonexistent.

The prior art radioactive-bar type units while utilizing the same principal for discharging static electricity, have been very inefficient due to poor design and failure to recognize the importance of proper attention to the electrical characteristics of the devices. The radiation emitting from the radioactive foil contained in the bar unit ionizes the immediate region adjacent to the open side of the bar, i.e., the alpha, beta and gamma rays emitting from the foil "bombard" the atmosphere in the surrounding region of the opening in the bar, thus creating a density of positive and negative ions resulting in an ionized field capable of discharging the static electrical charges on webs passing through the field. The ionized field is consistently maintained due to the constant "bombardment" from the radioactive foil.

The prior art radioactive-bar type units, as for example 3M's 210 Static Eliminator and those developed and manufactured by U.S. Radium, dissipated many of

the disadvantages encountered with the non-radioactive devices used for reducing static electricity, i.e., they are portable, use no electricity since they are self-powered, have no moving parts, create no heat in their operation, are simple to install, eliminate fire or explosion hazard, etc., but they are designed with primary consideration given to providing a simple holder or support for the radioactive foil, with emphasis to mechanical strength and rigidity, and a minimum emphasis to the electrical characteristics of the assembly, and are consequently of relatively low efficiency.

Prior art radioactive static eliminators are manufactured under the assumption that, within the limits of the amount of radioactive materials permitted by regulations, static elimination can be accomplished by simply providing, in the vicinity of a charged surface, a supply of ions which can neutralize the charged surface. Inherent in prior art designs is also the assumption that conditions within the eliminator and the surrounding area are constant with regard to ion production and availability for neutralization. Another disadvantage of most prior art radioactive static eliminators is that they are usually provided with heavily grated protective grids, frequently insulated, with physical dimensions and properties which reduce radiation and therefore reduce ionization, which in turn greatly dissipates the effective reduction of the static electricity charges. For example, many prior art devices utilizing a heavily grated grid composed of plastic which greatly inhibits ionization by introducing a non-conductive substance within the region of ionization and the heavy grating creates a "masking" effect in that it not only physically blocks radioactive particles from bombarding the surrounding area reducing the ionization of said area, but also develops an electrical field which seriously reduces the intensity of the ion cloud.

Static electricity charges on webs can vary greatly from one web to another and even when dealing with the same web the charges can vary under varying conditions, e.g., temperature, humidity and web speed. On moving webs the nature of the charge to be eliminated can vary in intensity with the number of unit charges per area. A static eliminator to be effective must be capable of eliminating a relatively small number of unit charges under conditions creating a small potential difference between the web and static eliminator, and also be capable of eliminating a large number of unit charges with a large potential difference between the web and static eliminator.

SUMMARY OF THE INVENTION

The present static electricity eliminator includes a substantially rectangular housing provided with an open longitudinal face, including a radioactive foil disposed horizontally therein. The foil emits radioactive particles which ionize the region adjacent to the open face of the housing. The open face in the housing is provided with a protective metal grid which may have metal brushes connected perpendicularly to the open planal face of the grid. When used, the metal brushes are disposed in the adjacent region to the open longitudinal face are in electrical contact with the grounded grid and are of such dimensions that the points are positioned where the radioactive rays emitted from the radioactive foil create the greatest density of ionization. The metal brushes, metal grid and housing are electrically connected to a positively grounded cable of low

resistance such that articles having an electrostatic charge, on passing through or near the ionized region immediately adjacent to the open face of the housing, will be discharged.

The present radioactive static electricity eliminator due to a recognition of the various electrical characteristics of the elements of the device provides high electrical conductivity between the web and the eliminator and therefore affords a wide range of electrostatic charges which may be eliminatd from various type webs or particular webs moving at various speeds.

The present radioactive static electricity eliminator is particularly suitable for use when a continuous type of web is to be continually discharged during its manufacture or processing; however the advantages of the present static eliminator may also be used in a variety of instances whenever static electricity is to be eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fractionalized planar view of the present radioactive static electricity eliminator;

FIG. **2** is a fractionalized side view in partial section of the present radioactive static electricity eliminator;

FIG. **3** is a sectional view taken substantially along line **3—3** of FIG. **1**;

FIG. **4** is a fractionalized planar view of one embodiment of the present radioactive static electricity eliminator;

FIG. **5** is a sectional view taken substantially along line **5—5** of FIG. **4**; and

FIG. **6** is a diagram showing by comparative curves the relation of the present invention to various methods of discharging webs.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1–3**, the radioactive static electricity eliminator **10** of the present invention comprises a housing **11** including end blocks **12**, a backing **23** and side wall **13** which contains a radioactive foil **14** and a protective metal grid **15**.

The housing **11** is provided with sloped side walls **13**, sloped at an angle in the range of about 50° to about 60°.

The radioactive foil **14** may contain a variety of radioactive materials which emit alpha, beta, gamma particles, or X-rays. In the present embodiment, the radioactive foil is rigidly maintained in the housing **11** by placing the foil **14** in the lower slots **16** provided at the base of the sloped side walls **13** of the housing **11** and providing a shim **17** under the foil **14** to secure it in said slots **16**.

The protective metal grid **15** is provided with a large grate **18**, small enough to prevent a person's finger from entering the inner area of the housing, thereby affording excellent mechanical protection for the foil **14** with a minimum of radiation shielding. Experimentation has demonstrated that smaller grates, even when conductive material such as metal is employed, greatly reduced ionization because the emitting radioactive particles are blocked by the grid. The protective metal grid **15** is rigidly maintained in the upper slots **19** in the side walls **13** approximately at or near the open longitudinal face **20** of the housing **11**, 1/4 to 1/2 inch above the radioactive foil **14**. The protective metal grid **15** is provided with metal brushes **24** approximately 1/4 to 1.5 inches in length perpendicularly connected to the open planar face of the protective metal grid **15**. The brushes **24**, protective metal grid **15**, side walls **13** and end block **12** are mechanically and electrically connected to a low resistance and positive grounding cable **21** connected to one of the mounting bolts **22** so that all components of the unit have equally positive grounding. The metal brushes **24** may also be independently electrically connected to the grounding cable **21**. It has been found that the best results are obtained when the brushes **20** are made of small-diameter metal wire in the range of about 0.010 to about 0.001 inches.

Referring to FIGS. **4–5**, there is shown another embodiment of the housing **32** of a radioactive static electricity eliminator **30** when the radioactive foil **31** being employed is one that emits radioactive particles of significant penetrating radiation so that the substantially sloped side walls **13** of the "open" type housing **11** depicted in FIGS. **1–3** may not be desirable. The radioactive foil **31** is rigidly maintained in slots **39** at the base of the side walls **33** and provided with a shim **40** under said foil to secure it in said slots **39**. The side walls **33** and backing **37** are substantially thick and the protective metal grid **34** is rigidly maintained in the upper slots **35** of the side walls **33**, approximately 1/4 to 1/2 inch from the foil, which upper slots **35** are located approximately 1/4 to 1.0 inch below the mouth of the open longitudinal face **36** of the housing **32**. The metal brushes **38** are approximately 1/4 to 1.5 inches long. This particular embodiment causes a screening effect, i.e., the side walls **33** being only slightly sloped at angles of approximately 10° to 20° significantly restricts the area of atmosphere that will be ionized whereas the "open" type housing depicted to FIGS. **1–3** substantially reduces the screening effect.

The present invention offers the widest range of difference in potential to afford a complete simultaneous discharge of relatively low or high charges on webs moving at a variety of speeds. It should be noted in utilizing the present invention that the preferred location of the tips of brushes **24, 38** is approximately 1/4 to 1.0 inch from the charged surface of the webs to afford the most efficient method for discharging the electrostatic charges thereon. It should also be noted that cover plates (not shown in drawing) of aluminum may be used when storing or transporting the radioactive static electricity eliminators which are removed as the last step of installation.

It is to be noted the present invention also contemplates utilization of the devices **10, 30** as depicted in FIGS. **1–5** without metal brushes **24, 38.**

The curves in FIG. **6** demonstrate the increased efficiency obtained by comparing the present invention **10** and alternate embodiment **30** utilizing all their inventive features lines **61** and **62** respectively with: a radioactive foil along line **63**; a radioactive foil in a housing, without grid or brushes, line **64**; the present invention **10** without the brushes **24**, line **65**; the alternate embodiment **30** without the brushes **38**, or protective metal grid **34**, line **66**; the alternate embodiment **30** without the brushes **38**, line **67**; and either the present invention **10** or the alternate embodiment **30**, without radioactive foil, with the protective metal grids **15, 34** and brushes **20, 38** along line **68**. The measurements were conducted utilizing a stationary charged non-

conductive plate as the web. Lines **61** and **62** graphically demonstrate that the present radioactive static-electricity eliminators provide for discharge from a very low potential different to those substantially higher. It can be seen from line **63** that the ability to discharge by the radioactive foil alone is totally ineffective for higher charges and its effectiveness would be almost completely dissipated if the web were moving at a significant speed. The housing with brushes and grids along line **68** demonstrate an inability to discharge at low potential difference. From a simple comparison of the various lines **61–68** it can readily be seen that the present invention and alternate embodiment lines **61** and **62** possess the most effective means for continually removing the widest range of electrostatic charge from stationary webs or webs moving at a constant or varying speed.

I claim:

1. A radioactive static electricity eliminator comprising a substantially rectangular housing provided with an open longitudinal face and including a radioactive foil disposed horizontally therein which emits radioactive particles ionizing a region adjacent to said open longitudinal face, said open face being provided with a metal grid provided with metal brushes connected perpendicularly to the open planal face of said metal grid, said metal brushes being disposed in the adjacent region to said open longitudinal face where the radioactive particles emitted from the radioactive foil create the greatest density of ionization, said metal brushes, metal grid, radioactive foil and housing being electrically connected to a positively grounded cable of low resistance such that articles having an electrostatic charge, on passing through or near the ionized region immediately adjacent to the open face of said housing, will be discharged.

2. A radioactive static electricity eliminator according to claim **1** wherein the radioactive foil comprises material that emits radioactive particles including alpha-particles.

3. A radioactive static electricity eliminator according to claim **1** wherein the radioactive foil emits radioactive particles including beta-particles.

4. A radioactive static electricity eliminator according to claim **1** wherein the radioactive foil emits radioactive particles including gamma-particles.

5. A radioactive static electricity eliminator according to claim **1** wherein the radioactive foil emits radioactive particles including X-rays.

6. A radioactive static electricity eliminator according to claim **1** wherein the metal brushes are electrically connected independently to the grounding cable.

7. A radioactive static electricity eliminator according to claim **1** wherein the metal brushes consist of wire having a diameter in the range of about 0.010 to about 0.001 inches.

8. A radioactive static electricity eliminator according to claim **1** wherein the side walls are sloped at an angle in the range from about 50° to about 60°.

9. A radioactive static electricity eliminator according to claim **1** wherein the grid is provided with a substantially large grate which protects the radioactive foil by preventing the admission into the housing of a person's finger.

10. A radioactive static electricity eliminator according to claim **1** wherein the metal grid is maintained in the range of about 1/4 to 1/2 inch above the radioactive foil.

11. A radioactive static electricity eliminator according to claim **1** wherein the tips of the brushes are maintained in a range of about 1/2 to 2 inches above the radioactive foil.

12. A radioactive static electricity eliminator comprising a substantially rectangular housing including substantially thick sloping side walls, a substantially thick back wall, an open longitudinal face, and a radioactive foil disposed horizontally therein which emits radioactive particles ionizing a region adjacent to said open longitudinal face, said open face being provided with a metal grid, said metal grid being provided with a substantially large grate, and having metal brushes connected perpendicularly to the open planal face of said metal grid, said metal brushes being disposed in the adjacent region of said open longitudinal face where the radioactive particles emitted from the radioactive foil create the greatest density of ionization, said metal brushes, metal grid, radioactive foil and housing being electrically connected to a positively grounded cable of low resistance such that articles having an electrostatic charge, on passing through or near the ionized region immediately adjacent to the open face of said housing, will be discharged.

13. A radioactive static electricity eliminator according to claim **12** wherein the metal grid is horizontally disposed between the side walls of the housing substantially below the open longitudinal face of the housing.

14. A radioactive static electricity eliminator according to claim **12** wherein the radioactive foil comprises material that emits radioactive particles including alpha-particles.

15. A radioactive static electricity eliminator according to claim **12** wherein the radioactive foil emits radioactive particles including beta-particles.

16. A radioactive static electricity eliminator according to claim **12** wherein the radioactive foil emits radioactive particles including gamma-particles.

17. A radioactive static electricity eliminator according to claim **12** wherein the radioactive foil emits radioactive particles including X-rays.

18. A radioactive static electricity eliminator according to claim **12** wherein the metal brushes are electrically connected independently to the grounding cable.

19. A radioactive static electricity eliminator according to claim **12** wherein the metal brushes consist of wire having a diameter in the range of about 0.010 and 0.001 inches.

20. A radioactive static electricity eliminator according to claim **12** wherein the sloped side walls are sloped at an angle in the range from about 10° to about 20°.

21. A radioactive static electricity eliminator according to claim **12** wherein the metal grid is maintained in the range of about 1/4 to 1/2 inch above the radioactive foil.

22. A radioactive static electricity eliminator according to claim **12** wherein the tips of the brushes are maintained in the range of about 1/2 to 2 inches above the radioactive foil.

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