

[54] **STATIC ELIMINATOR**

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Related U.S. Application Data

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

[51] Int. Cl. H01t 19/04, H05f 3/00

[58] Field of Search 317/2 F, 4

References Cited

UNITED STATES PATENTS

2,983,847 5/1961 Spengler 315/111

3,137,806 6/1964 Schweriner 317/2 F
3,369,152 2/1968 Spengler 317/2 F

Primary Examiner—L. T. Hix

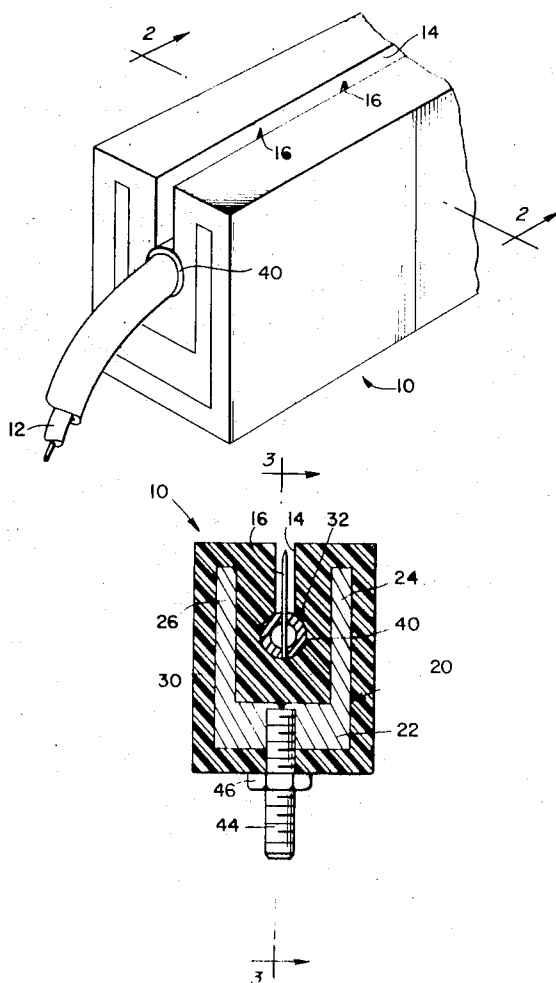
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[57]

ABSTRACT

A static eliminator including a channel-shaped bar entirely enclosed in an insulating sheath: the sheath has a slot in and extending parallel to the channel, the slot at its inner end terminating in a cylindrical bore in which is a metal tube. Ionizing points penetrate into the metal tube and extend through the slot, and contacts are provided to the bar and tube from ground and to a source, respectively.

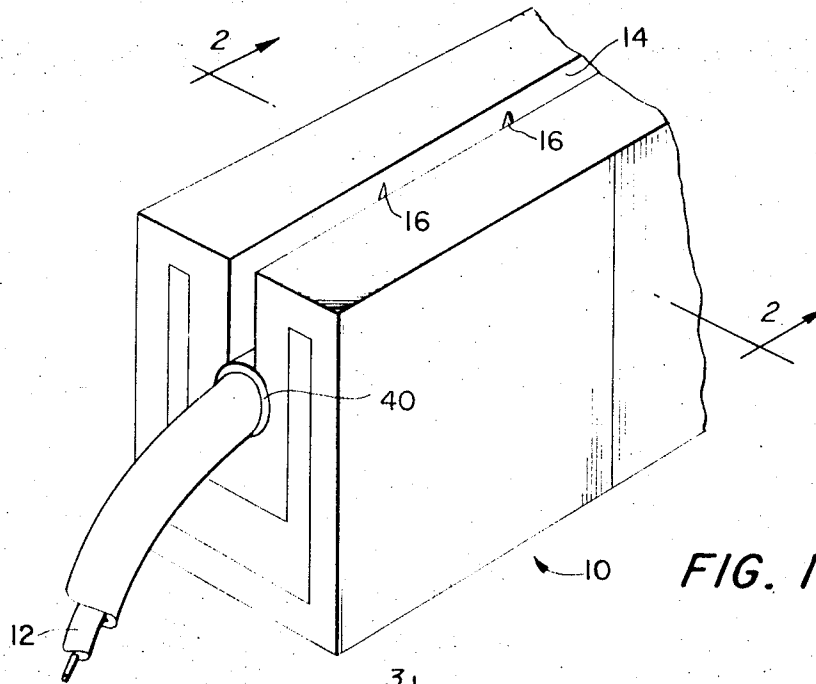
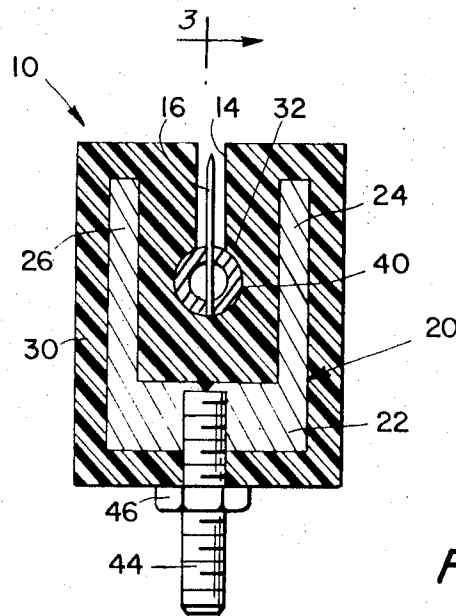
12 Claims, 6 Drawing Figures



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3,746,924

2 Sheets-Sheet 1



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FIG. 3

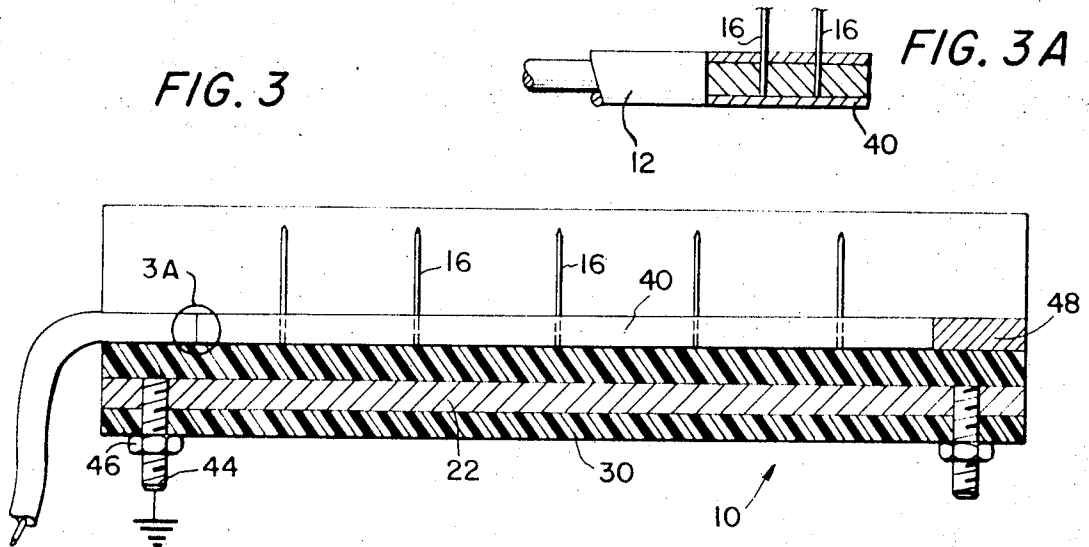


FIG. 4

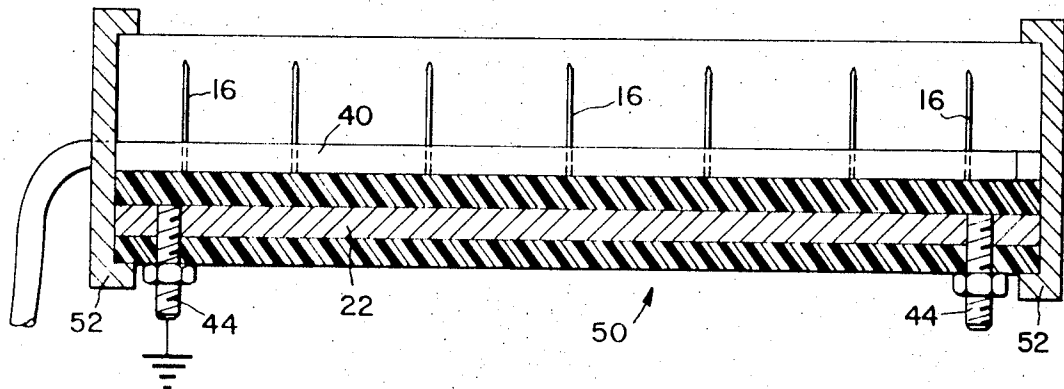
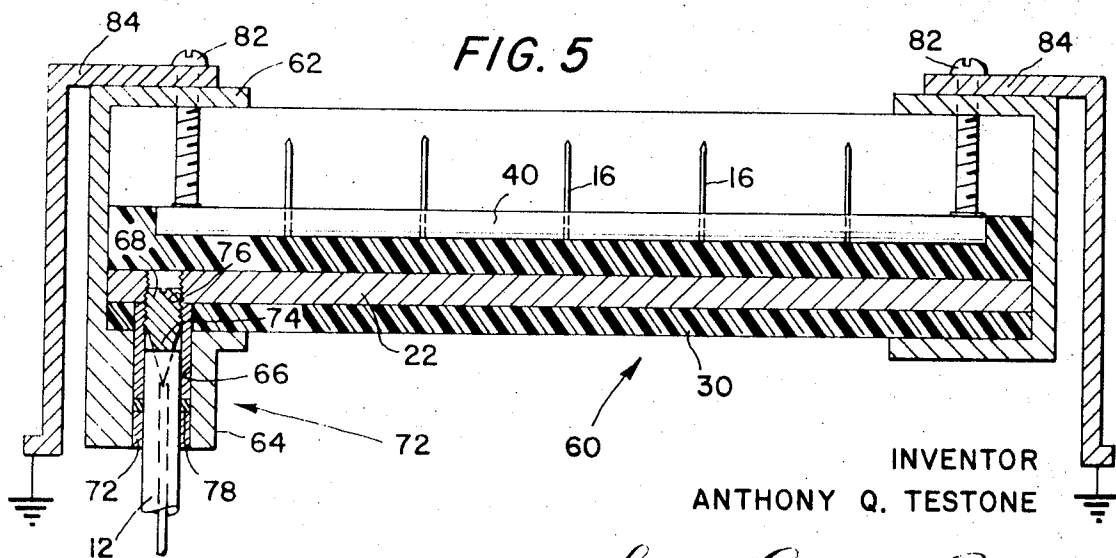


FIG. 5



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STATIC ELIMINATOR

This is a Continuation of application Ser. No. 57,657, filed July 23, 1970, now abandoned.

BACKGROUND OF THE INVENTION

The present invention pertains to static eliminators, which are devices for generating ions.

In many forms of material processing apparatus, a nonconductive web or sheet is fed or conveyed through the apparatus. Examples of this are the feeding of paper and similar sheets through printing equipment and through web cutting and stacking apparatus, as well as the passage of textile webs in laundry apparatus. In these exemplary fields, static electricity is generated due to the rubbing action of the work, such as the paper or textile sheets or webs, on the parts of the apparatus, with the consequent disadvantage that the work adheres to parts of the apparatus, often causing malfunctioning, by failure of the apparatus to properly feed or convey the work.

In order to avoid the difficulties caused by the static electricity thus generated, such apparatus is provided with static eliminator devices, which essentially generate ions which interact with the static electricity charges to neutralize them, and thereby obviate their deleterious effect. It is known to be desirable to provide for the copious generation of ions so as to insure complete static elimination, so that it is known that where the static electricity problem is a severe one, it must be handled by a very substantial generation of ions by the static eliminator device. The static eliminators generally comprise a series of so-called ionizing points, which are supplied with electricity; the higher the voltage supplied to the ionizing points, the more ions they generate, and thereby the more effective they are in performing their function of eliminating static electricity. However, where high voltages are supplied to the ionizing points, there has heretofore been reached an upper limit, due to the fact that arcing occurs between the ionizing points and the parts of the static eliminator.

Further deficiencies found with prior art static eliminators have been their failure to operate when the ionizing points have been inundated by dust or other material, such as where, in a printing operation, offset powder has filled the channels in which the ionizing points are positioned. Further, it is often found that static eliminators, in the form of longitudinally extending bars having a series of ionizing points, are placed in apparatus which has been designed and constructed without the provision of a special or suitable place for the mounting of such static eliminator bars. In such cases, the static eliminator must be positioned in the apparatus wherever a suitable space can be found, and this often results in the striking of the static bar by a relatively heavy or fast moving work web. For example, a plastic web or sheet being fed through some apparatus or a relatively thick rubber web or sheet may, while moving at relatively high speed in the apparatus, deviate sufficiently from the established, intended path to such an extent that the ionizing bar is struck and bent. This will significantly decrease the effectiveness of the ionizing bar, or in some instances, prevent its further operation. Such static eliminator bars have been bent because they were not physically strong enough to withstand impingement by the work, nor could they be moved to another position so as to avoid being struck,

and still maintain their effectiveness. Where the bars have thus been struck, it has sometimes been necessary to shut down the apparatus to which they are attached, thus causing a loss in production.

Static eliminators as shown in U.S. Pat. No. 3,137,806, and providing a row of ionizing points extending from a core of plastic which is in turn surrounded almost entirely by an exterior conductive housing connected to ground have exhibited the deficiencies noted above. In addition, there is known a static eliminator as shown in U.S. Pat. No. 2,983,847 which provides a block of insulating material with parallel grooves and source-connected ionizing points in the grooves; grounded, exposed wire conductors lie on the block between the grooves. This construction is subject to power loss if soiling leads to a conductive connection between the points and the wire conductors, and the risk of electric shock to persons exposed to the energized points. U.S. Pat. No. 3,369,152 is an improvement on U.S. Pat. NO. 2,983,847 and provides that the wire conductors are embedded, and are connected to a source, the points being grounded.

Static eliminator bars are generally known to be of two types. The first type is known as a shock-proof static bar in which the ionizing points are connected to a source of electric energy in such manner that the energy level at the points is very low: this is accomplished normally by capacitive coupling of the points to a high voltage source. In so-called "hot" types, voltage is applied to the ionizing points, and the other part of the bar is connected to ground. Heretofore, a manufacturer was required to produce two basically different constructions of bars in order to provide each of these types.

It is also to be noted that in previously known static eliminator bars, the effective length of the bar was less than the overall physical length of the bar, the effective length being that length over which an effective generation of ions is produced. This has created a problem in some installations, where only a limited space was available for receiving the bar, but where it was desired that the ions be generated over the entire length of that space.

Still further, it is noted that in known static eliminator bars, some parts were provided, positioned and shaped for purposes of electrical conductivity or insulating considerations, whereas other parts were provided for strength considerations.

Still another disadvantage found with previous static eliminator bars was the problem of reverse voltage cut-off. This results because moving dielectric material carries a high potential field which has been generated by static electricity. The moving material generates potential energy which is greater than the potential energy on the ionizing points of the static eliminator, where connected to a potential source through either a capacitor or a resistor.

In accordance with the static eliminator of the present invention, the basic structure may be utilized as either a "hot" type or a shockproof type. In addition, the present invention ionizing bar may have an effective length, as above noted, which is equal to its overall length, thereby permitting utilization of the present invention static eliminator in a number of applications where known static eliminator bars could not effectively function. In addition, each of the components of the present static eliminator, except the ionizing points,

contributes to both the electrical properties and functioning of the static eliminator and to the structural strength thereof, thereby providing a comparatively strong as well as electrically effective static eliminator. The present static eliminator is significantly less likely to suffer from cut-off than previously known static eliminators.

Accordingly, among the objects of the present invention are to provide a static eliminator in the form of a bar which is capable of generating a copious supply of ions. A other object of the present invention is to provide such a static eliminator in the form of a bar which is capable of operating at relatively high voltages, without arcing. Still another object of the present invention is the provision of a static eliminator in the form of a bar which will continue to operate even though the channel thereof in which ionizing points are located becomes filled. Still another object of the present invention is to provide a static eliminator in the form of a bar which is physically strong, and capable of withstanding impingement by work being fed in apparatus on which the static eliminator is positioned, and which is sufficiently strong so as not to sag, even when supported at a single point, or at widely spaced points. Other objects of the present invention are to provide a static eliminator bar having improved cut-off performance characteristics.

SUMMARY OF THE INVENTION

The present invention is a static eliminator generally in the form of an elongate bar. An aluminum channel is provided having a base and a pair of spaced, parallel flanges, the channel being entirely encased within a sheath of insulating material, preferably rigid polyvinyl chloride having an insulative value of at least 600 volts per mil. The insulating sheath has a slot extending between and parallel to the flanges, and at the bottom of the slot there is a generally cylindrical bore, the bore preferably having a diameter larger than the width of the slot. A metal tube fits snugly in the cylindrical bore, and a series of ionizing points extend or penetrate into the tube, to make electrical contact therewith and to be supported thereby, these points preferably terminating within the slot in the insulating sheath. A bolt or the like extends into the base of the aluminum channel, to provide for electrical contact to a ground connection, and a contact is also provided on the metal tube to supply high voltage electricity to it and to the ionizing points. In one embodiment, end caps of insulative material are used, the effective length of the bar being thereby equal to the overall length. In another embodiment, an end cap is provided which receives an insulative conductor, the wire therein being connected to the aluminum channel to provide a shock-proof bar.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a portion of a static eliminator in accordance with the present invention.

FIG. 2 is a cross-sectional view taken on the line 2 — 2 of FIG. 1.

FIG. 3 is a cross-sectional view taken on the line 3 — 3 of FIG. 2.

FIG. 3A is an enlarged detail view of the parts within the circle of FIG. 3.

FIG. 4 is a cross-sectional view similar to FIG. 3, showing a modification.

FIG. 5 discloses, in cross-sectional view, a shock-proof embodiment of the present invention static eliminator bar.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like or corresponding reference numerals are used to designate like or corresponding parts throughout the several views, there is shown in FIG. 1 a static eliminator 10 in accordance with the present invention, which may be seen to be in the form of an elongate bar of any suitable length, and having an electrical conductor 12 connected thereto. The static eliminator 10 may be seen to have a slot 14 in the upper surface thereof, and a plurality of ionizing points 16 in the slot 14.

As may be seen from FIG. 2, the static eliminator 10 is of rectangular, almost square, cross-section, and comprises an aluminum channel 20 which includes a base portion 22 and a pair of spaced, parallel flanges 24, 26, which define between them a channel. A sheath 30 surrounds and engages all of the surfaces of the channel bar 20. Thus, the sheath 30 will be seen to engage both the interior and exterior surfaces of the flanges 24 and 26 and the base 22 which form the channel 20. The sheath 30 is shaped to provide the aforementioned slot 14, which extends between the flanges 24 and 26, from the upper surface of the sheath 30, downwardly between the flanges 24 and 26 and terminating in a generally cylindrical bore 32. Bore 32 has a diameter somewhat greater than the width of slot 14.

Referring now also to FIG. 3, there may be seen the base 22 with portions of the sheath 30 above and below it. A cylindrical tube 40 is positioned in the cylindrical bore 32, snugly engaging the bore so as to be firmly held in the sheath 30. The ionizing points 16 extend radially through the metal tube 40, the lower ends of the points 16 engaging the tube 40 at the bottom thereof and an intermediate portion of each of the points 16 engaging the tubing at a diametrically spaced point. The points 16 extend outwardly so that the terminus of each of the points 16 is at or slightly below the upper surface of the sheath 30. As shown in FIG. 3A, the end of the metal tube 49 receives the conductor element of conductor 12, which is held therein by ionizing points 16 penetrating both tube 40 and conductor element. In addition, a bolt 44 is threadedly engaged with the base 22, extending through the bottom portion of the sheath 30, where a safety nut 46 may be provided to secure the bolt 44 in position. Bolt 44 serves as a contact, and is preferably connected to ground, as schematically indicated in FIG. 3.

At the right hand end of FIG. 3, there may be seen a nylon cylindrical plug 48 inserted into the cylindrical bore 32, at the right hand end thereof, the cylindrical tube 40 having its right hand end in abutting relationship to one end of nylon plug 48. The function of the nylon plug 48 is to provide insulation between the right hand end of the metal tube 40 and the right hand end of the channel 20.

Referring now to FIG. 4, there is shown an alternate embodiment of the present invention static eliminator, which has an effective length substantially equal to the overall length thereof. This is accomplished by providing end caps 52 on the assemblage of the aluminum channel 20 and sheath 30. In this embodiment, the metal tube 40 extends very closely to each of the ends

of channel 20, the end caps 52 being made of polyvinyl chloride or a similarly insulative material, and thereby preventing a short-circuit from either end of the metal tube 40 to the closest adjacent portion of the channel 20. An insulating adhesive material, preferably epoxy, is used to adhere the end caps 52 to the sheath 30. It is to be noted that the ionizing field generated at each of the ionizing points 16 may be generally considered as a conical pattern having its tip at the tip of the ionizing point 16, the pattern being within an included angle of 120°. However, the ionizing field extends only approximately one inch along the axis of the conical pattern from the tip, so that it is necessary that the endmost ionizing points 16 be placed within approximately three-sixteenths inch of the endmost boundary of the static eliminator bar 10: in connection with the static eliminator bar shown in FIG. 4, this boundary would be the outer surfaces of the end caps 52.

While the embodiment shown in FIG. 4 obtains superior results because of the fact that the overall length of the static eliminator is substantially equal to the effective length, it is somewhat more expensive than the embodiment shown in FIG. 3, wherein the effective length is somewhat shorter than the overall length of the static eliminator.

FIG. 4 is utilized in installations where the equipment has a certain length which is capable of receiving the static eliminator bar, as between two frame members; in such an installation, there is a requirement that, in order to provide static elimination over the entire width of a conveyor belt that the effective length of the static eliminator bar be equal to the overall length thereof.

Referring to FIG. 5, there is shown in cross-section a static eliminator bar 60 which is generally similar to the static eliminator bar 10, in that it comprises the aluminum channel 20, sheath 30 and metal tube 40, with ionizing points 16. However, in the static eliminator bar 60 shown in FIG. 5, an end cap 62 of insulative material is provided, having a depending cylindrical extension 64 having a bore 66 therein. The base 22 of channel 20 has a threaded opening 68 adjacent one end thereof, in alignment with the bore 66. An insulated conductor 12 is inserted into a plastic sleeve 72, conductor 12 including an insulating casing and a metal wire therewithin, both of which are cut off to provide a square end to the conductor 12. The conductor 12 has its said terminus penetrated by the point 74 of a screw 76 of a suitable conductive material, screw 76 being partially threaded into the sleeve 72, so that the point 74 penetrates into and makes electrical contact with the wire within the conductor 12. Screw 76 also extends above the upper end of the sleeve 72. This connecting assemblage is joined to the channel 20 by having the extending end of the screw 76 screwed into the aforementioned opening 68. In order to prevent separation of the sleeve 72 and conductor 12, a nylon set screw 78 extends through the sleeve 72 into engagement with the exterior of the conductor 12. This construction provides a completely shielded connection between a high voltage source and the channel 20.

In the embodiment shown in FIG. 5, the tube 40 is connected to ground in suitable fashion, as by set screws 82 which extend into contact with tube 40, and which pass through mounting brackets 84, which are suitably connected to ground, as by being screwed to the frame of the machine on which the static eliminator bar 60 is used.

As is well known, in some installations it is necessary to mount the static eliminator bar in an exposed position, that is, in a position where it is exposed to being contacted by operating personnel. In such instances, it is necessary to utilize a static eliminator bar in which any portion of the bar which is subject to contact by operating personnel has a very low energy level; hence, FIG. 5 discloses an embodiment of a static eliminator bar for such installations. In addition, the static eliminator bar 60 is suitable for use where potentially explosive fumes or an explosive atmosphere is in the environment of the static eliminator.

On the other hand, where danger of explosion or danger of contact by operating personnel is not present, then the static eliminator bars as disclosed in FIGS. 1-4 are preferred because these are less expensive to produce.

The static eliminator as herein disclosed has operated effectively and without arcing at an extremely high voltage, for example, it has operated at 10,000 volts, supplied to it by means of the conductor 12. At such high voltage, arcing has been experienced in previously known static eliminators. In its preferred form, the static eliminator herein disclosed is of extremely small cross-section, having a width of approximately one-half inch and a height of approximately five-eighths inch. The sheath 30 is made of rigid poly vinyl chloride having an insulating value of 600 volts per mil thickness, and the thickness of the sheath 30, measured from the surface of contact with any surface of aluminum channel 20 to the closest free surface of the sheath 30 is not less than one-sixteenth inch. The metal tube 30 has an outside diameter of 1/4 inch, and the ionizing points 16 are approximately 1/4 inch long.

Although the present invention static eliminator is of small cross-section, as hereinabove noted, it is able to generate a copious quantity of ions due to the fact that it can be supplied with current at an unusually high voltage, as noted above, and still work effectively; that is, it can operate without arcing, which is a breakdown of the equipment. In addition, despite the small size, the static eliminator as herein disclosed has comparatively great physical strength, which will permit it to retain its shape even if struck by a relatively heavy web of fast moving material in apparatus on which it is installed. It can be supported either at a single point, or at a plurality of widely spaced points, without sagging and thereby interfering with the work being fed in the apparatus to which it is attached, or otherwise resulting in a harmful effect. Its basic construction may be utilized to provide a static eliminator of either the "hot" or shock-proof types, and may be constructed with minor modification to provide an effective length equal to overall length.

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. A static eliminator comprising:

a longitudinally extending metal bar having a cross-section of channel shape,

a sheath of insulating material on said bar, said sheath encompassing substantially all longitudinal surfaces of said bar, a longitudinally extending slot

entering said sheath and extending into said channel shape bar and terminating in a generally cylindrical bore separated from said bar by said insulating material sheath,

a longitudinal member of conductive material in said bore,
a plurality of spaced, parallel ionizing points in said slot, said points being of conductive material and extending into and engaging said member, and means connecting said longitudinal member of conductive material to a source of electric potential and means for connecting said metal bar to ground.

2. The static eliminator of claim 1, wherein said bar is aluminum.

3. The static eliminator of claim 1, wherein said sheath is of rigid polyvinyl chloride.

4. The static eliminator of claim 1, wherein said sheath has an insulating value of at least 600 volts per mil.

5. The static eliminator of claim 1, wherein said bore has a diameter greater than the width of said slot.

6. The static eliminator of claim 1, said member comprises a conductor, a metal tube having said conductor therein, said metal tube engaging said insulating sheath material defining said bore.

7. The static eliminator of claim 6, and means for securing said conductor to said tube.

8. The static eliminator of claim 7, said last mentioned means comprises at least one of said ionizing

points, said means extending through said tube and into said conductor.

9. The static eliminator of claim 1, said member having one end inwardly of the end of the bar and sheath, and a cylindrical plug of insulating material in said bore extending from said one end of said member substantially to said end of the bar and sheath.

10. The static eliminator of claim 1, wherein said ionizing points extend substantially from one end of said member to the other end thereof.

11. The static eliminator of claim 10, and further including end caps of insulating material positioned on each end of said sheath.

12. A static eliminator comprising:

longitudinally extending structural conductive means providing strength against bending and sagging, insulating material encompassing substantially all longitudinal surfaces of said conductive means and having a longitudinally extending bore generally parallel to said conductive means and spaced from said conductive means by said insulating material, a longitudinal conductor member in said bore, a plurality of spaced, parallel ionizing points of conductive material engaging said member and in spaced relation to said conductive means, means for connecting said conductive means to ground and means connecting said member to a source of electric potential.

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