United States Patent [19]

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[11] **3,711,742**

[45] **Jan. 16, 1973**

[54] **SYSTEM FOR PREVENTING ELECTROSTATIC SPARK DISCHARGE FROM A PERSON OPERATING AN ELECTRICAL APPLIANCE**

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[22] Filed: **Feb. 22, 1971**

[21] Appl. No.: **117,281**

[52] **U.S. Cl.**.....**317/2 R,** 317/2 B, 174/5 SG

[51] **Int. Cl.**.....**H05f 3/00**

[58] **Field of Search**....174/5 R, 5 SB, 5 SG; 317/2 R, 317/2 B; 331/63; 328/7; 325/149

[56] **References Cited**

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[57] **ABSTRACT**

In accordance with the present invention, there is provided on the handle of a vacuum cleaner nozzle, or other electrical appliance, a member of conducting material so located as to be apt to be contacted at all times during use by the hand of the operator. This member is connected to both conductors of the 120 volt circuit of the appliance through a high loss dielectric material having resistivity high enough to prevent any significant current flow at 120 volts, either between the conductors or from either conductor to the person; but low enough to permit current flow at the high voltages of a static charge from the person to the conductors and at a rate sufficiently high to drain off the charge before the voltage reaches a high enough value to produce a spark discharge, but not at a rate sufficiently high to drain off an already accumulated high static charge rapidly enough to produce a spark discharge.

5 Claims, 7 Drawing Figures

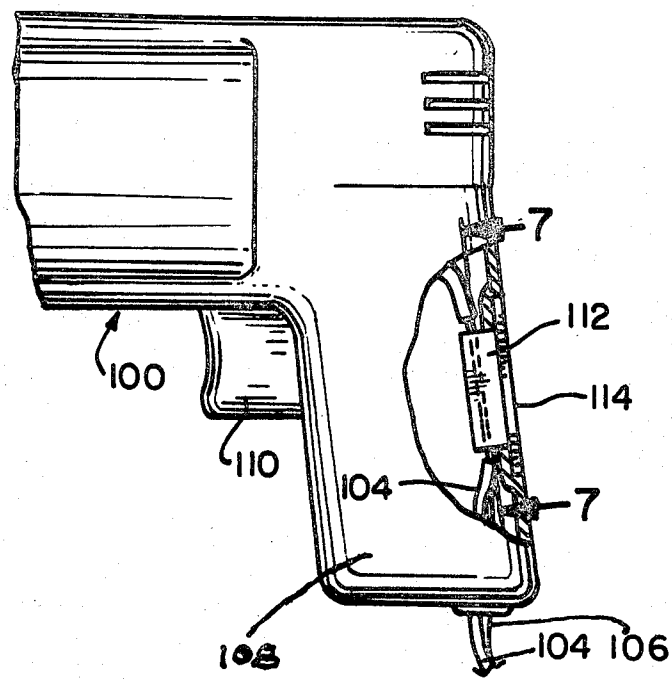

FIG. 1

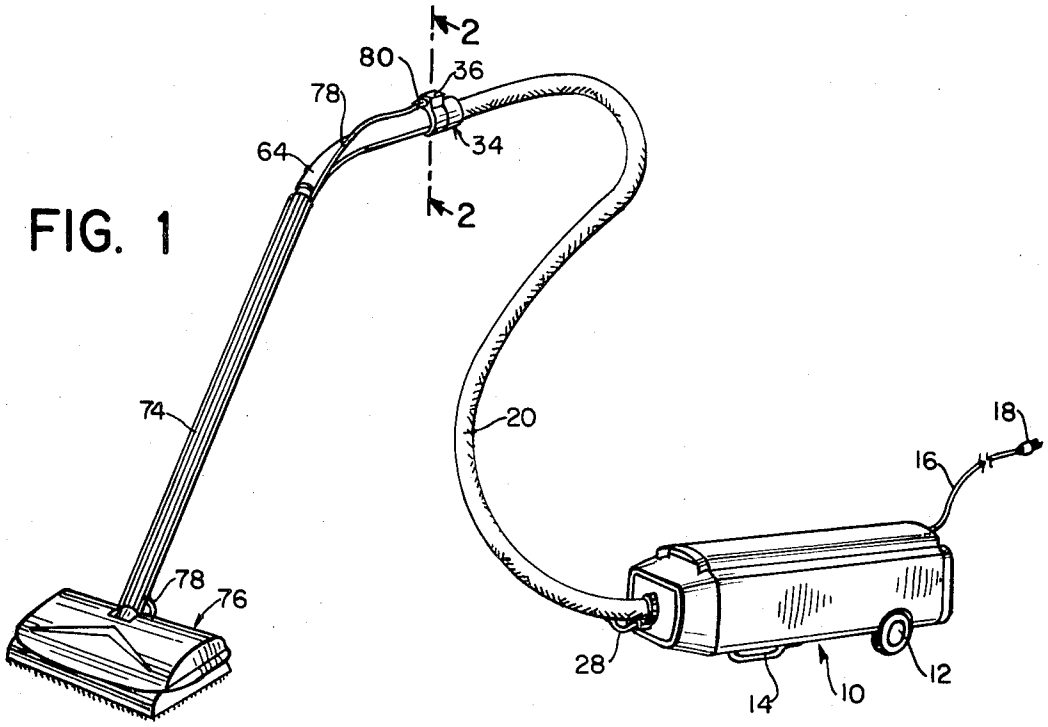

FIG. 2

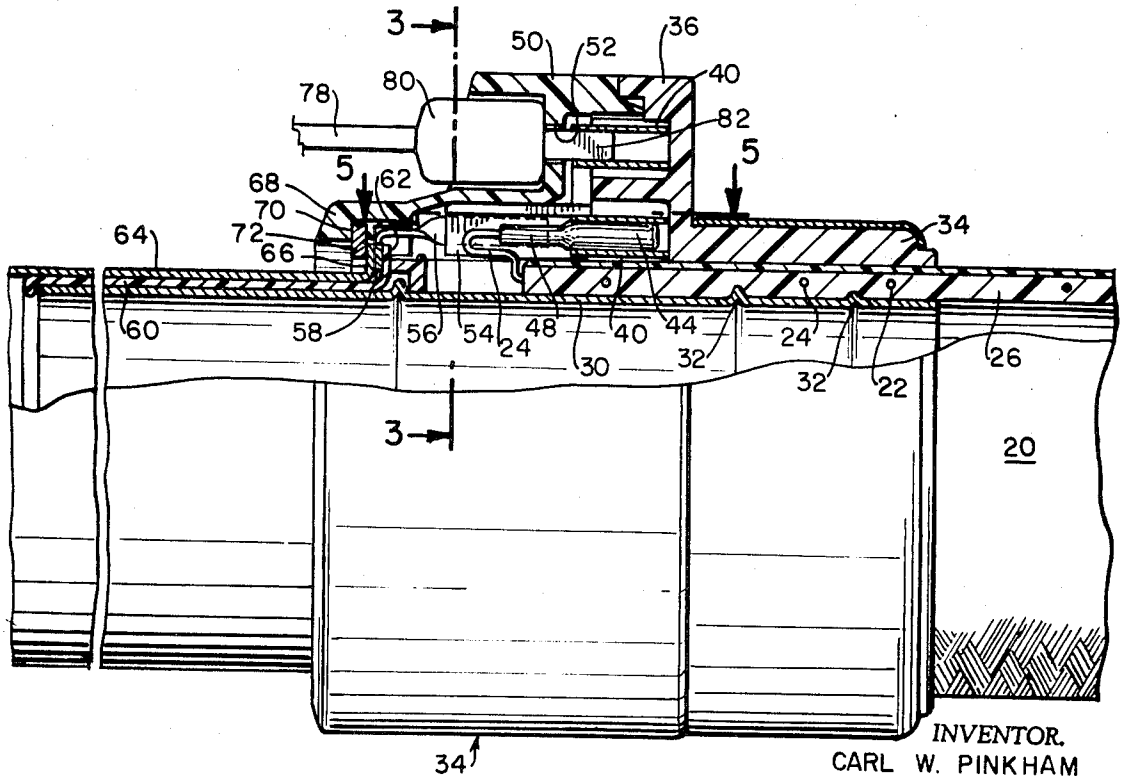

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FIG. 3

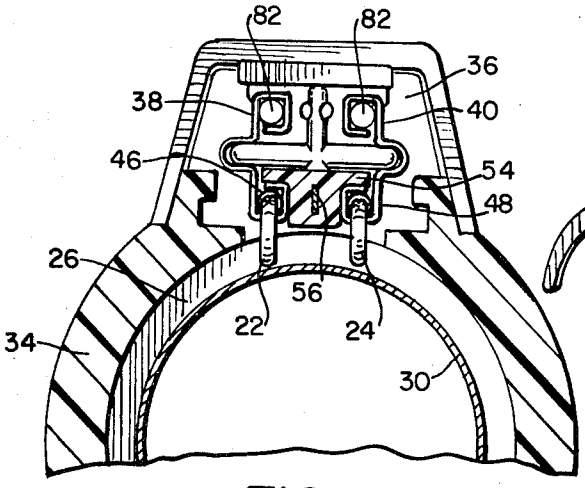


FIG. 4

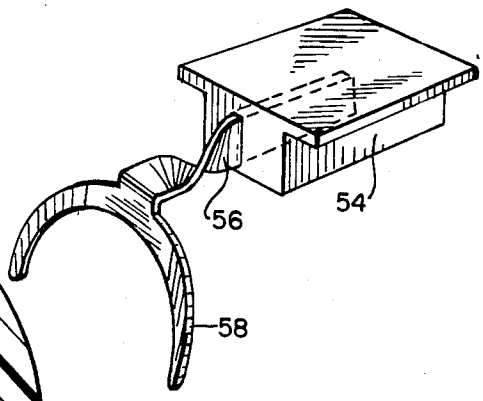


FIG. 5

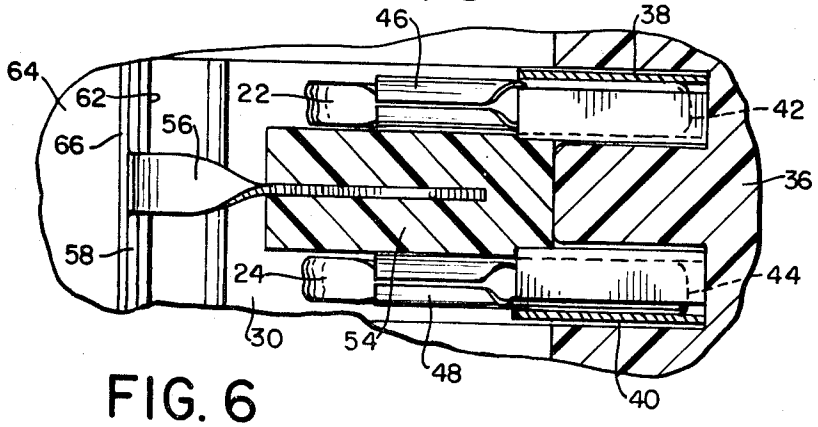


FIG. 6

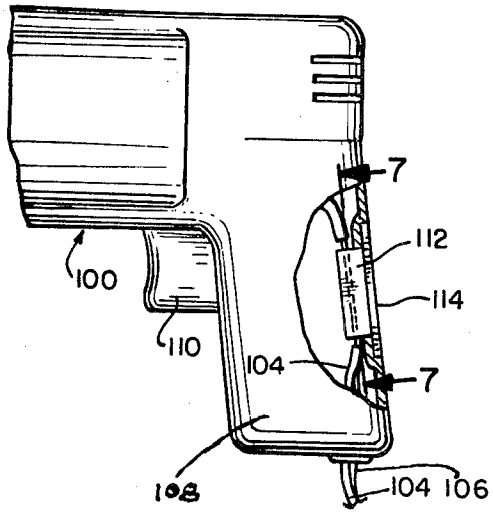
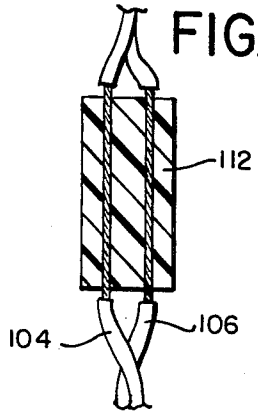


FIG. 7



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SYSTEM FOR PREVENTING ELECTROSTATIC SPARK DISCHARGE FROM A PERSON OPERATING AN ELECTRICAL APPLIANCE

BACKGROUND OF THE INVENTION

The problem of spark discharge of static electricity from the body of a person on which it has accumulated to a grounded object or to a body of sufficient capacity to act as a static charge receiver is one of long standing. In some situations, such as in a plant manufacturing explosives, it is extremely dangerous as it may cause a most destructive explosion, but in the home it is usually merely annoying. While the voltage of the static charge may be extremely high, in the neighborhood of 5,000 volts or more, the current present in very low, and consequently the spark discharge cannot possibly cause physical injury, not even a slight burn. Nevertheless, the spark, which usually is unexpected, can be very annoying, and might cause the person to jump and possibly damage any nearby fragile object or even injure himself.

The generation of a static charge is usually caused by friction and in a home the friction frequently results from a person walking on a rug or carpet. During periods of high atmospheric humidity, such as during the summer months, the moisture present makes the rug or carpet sufficiently conductive so that the static charge drains off to ground as fast as it is generated and hence does not build up in the person. However, under conditions of low humidity, as often prevail in a heated house in the Winter time, a high voltage static charge does accumulate and is suddenly discharged by a spark when the person happens to approach contact with a grounded object such as a radiator or a switch, or other static charge receiver.

Another common cause of the generation of static electricity is the operation of cleaning a rug or carpet by a vacuum cleaner as this involves not only walking back and forth, but also repeated strokes of a suction nozzle over the rug or carpet. A very popular type of vacuum cleaner has a dust bag and a motor driven fan in a unit which sets on the floor and is connected to the suction nozzle by a flexible suction hose. Moreover, many of these vacuum cleaners employ a motor driven brush in the nozzle and electric power for operating this latter motor is transmitted from the unit on the floor through conductors built into the hose. While these conductors are insulated heavily enough to prevent any possibility of electric shock from the 120-volt circuit in the hose to a person grasping the hose, it has been found that a spark discharge from a person carrying a static charge which may be 5,000 volts or more, may take place to the capacitances created by the high dielectric strength materials constituting the hose such as a nylon carcass and a polyethylene outer braid, or to ground by the route of arcing over air gaps and thence to the house ground via the 120-volt circuit of the cleaner. While this can cause no physical injury, as previously explained, it can cause serious fright as the average person who is not technically trained, is apt to assume that the spark is the result of an insulation failure that could cause injurious shock from the 120-volt circuit in the hose.

In order to prevent such accumulation of a static charge, there are available numerous products, usually in aerosole form, for spraying on rugs and carpets.

These are hydroscopic in order to extract moisture from the air, thus making the rug or carpet slightly conductive. However, as they depend on the extraction of moisture from the air, they are least effective when the humidity is low which, as above explained, is when they are most needed. Moreover, they are not indefinitely effective, and usually have to be applied several times during a heating season.

SUMMARY OF THE INVENTION

By means of the present invention, the static charge which tends to accumulate on the body of a person using a vacuum cleaner or other electrical device, is continuously drained off by contact with the member of conducting material and passes through the high loss dielectric material to the conductors of the 120-volt circuit and through one of the conductors to ground. Thus, the charge never builds up to a voltage high enough to produce a spark discharge should the person grasp the hose or approach contact with a grounded object or any metal object of sufficient capacity to act as a static charge receiver. At the same time, the operator is in no danger of receiving a shock from the 120-volt circuit inasmuch as the resistance of the high loss dielectric material is great enough to prevent the flow of any substantial current to the member of conducting material.

In addition, the time constant of the circuit through the high loss dielectric material is long enough so that if a large charge is produced and then the operator comes effectively into contact with the member of conducting material, the charge drains off without sensation of shock.

FIG. 1 is a perspective view of a vacuum cleaner system embodying the present invention;

FIG. 2 is a cross-sectional view on an enlarged scale 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. 4 is a perspective view of a portion of the device shown in FIG. 3;

FIG. 5 is a cross-sectional view taken substantially on the line 5—5 of FIG. 2;

FIG. 6 is a view, partially in cross-section of a portion of an electrical appliance, such as an electric drill, embodying the present invention; and

FIG. 7 is a cross-sectional view on an enlarged scale taken on the line 7—7 of FIG. 6.

Referring more particularly to FIG. 1, reference character 10 designates generally the unit of a vacuum cleaner system which contains a dust bag and a suction fan driven by an electric motor. The unit is movably supported on a floor by means of wheels 12 and a skid 14, the motor being supplied with electric power through a flexible electric cord 16 having a plug 18 which may be connected to any convenient outlet of the usual 120-volt house circuit. As is well known, one conductor of such a circuit is grounded, but inasmuch as the plug 18 may be inserted in the outlet in either of the two possible positions, there is no way for the ordinary user to know which conductor of the circuit in the vacuum cleaner is grounded.

Connected to the unit 10 is a flexible suction hose 20 having conductors 22 and 24 disposed spirally within the wall 26 of the hose, as is shown in FIG. 2 and 3.

These conductors are provided with the normal insulation which is sufficient to prevent the flow therethrough of any significant current at 120 volts. These conductors are supplied with power through an insulated lead or pigtail **28** which may be plugged into a receptacle on the unit **10** which is connected to the 120-volt circuit in the unit.

A metal tube **30** has one end thereof inserted into the hose wall **26** and secured therein by expanded ribs **32**, the other end of tube **30** extending a substantial distance beyond the end of the hose wall. Disposed around the wall **26** is a tubular collar **34** of molded plastic or other suitable insulating material. Integral with the upper part of the collar **34** is a receptacle housing **36**. Supported in suitably shaped grooves molded in the housing **36** are electrical contacts **38** and **40**. The conductors **22** and **24** are brought out of the end of the hose wall **26**, as shown in FIG. **2**, **3** and **5**, and are connected to shanks **46** and **48** of contact pins **42** and **44**, respectively, which pins are inserted in lower rectangular recesses formed by the contacts **38** and **40**, the resiliency of which provides a frictional grip on the pins. The contacts also form upper rectangular recesses which are in allignment with openings formed in the wall of a cap member **50**, one of which openings is indicated by reference character **52** in FIG. **2**. This cap has been omitted from FIG. **3** so as to better reveal parts within housing **36**.

Disposed between and in contact with shanks **46** and **48** is a block **54** of a high loss dielectric material having resistivity high enough to prevent any significant current flow at **120** volts, but low enough and of adequately long time constant to permit current flow at the high voltages of a static charge and at a rate sufficiently high to drain off the charge before the voltage reaches a high enough value to produce a spark discharge, but not at a rate sufficiently high to drain off an already accumulated high static charge rapidly enough to result in a spark discharge.

A suitable value of the resistivity of this material is within the range of 10^6 to 10^{12} ohms per cm. and the material may be a dielectric the resistivity of which has been decreased by the use of suitable plasticizing agents. As an example, the basic material may comprise polyvinylchloride of medium molecular weight plasticized with alkylphthalate esters, alkylsebacate esters, epoxidized fatty acids esters and combinations thereof in proportions that ensure the resistivity consistant with the compatability and stability of the mixture. An example of a resin-plasticizer combination that has desired performance characteristics consists of 100 parts polyvinylchloride (PVC), and a plasticizer comprising 71 parts dioctyl phthalate, 50 parts butylbenzlphthalate and 7 parts epoxidized soybean oil by weight proportions (a total of 228 parts). This platicized resin has a resistivity of 1.67×10^{10} ohms per cm.

Molded within the block **54** is a blade **56** of metal which is integral with a semi-circular ring portion **58**. A bearing sleeve **60** of plastic having a radial flange **62** is disposed around the outwardly extending portion of tube **30**. Disposed around sleeve **60** is one end of a metal tube **64** having a radial flange **66**. Ring portion **58** is located between flanges **62** and **66** and hence is in electrical conducting relationship with tube **64**.

Cap member **50** of housing **36** has a skirt portion **68** which, when the cap is in position, is flush with the end of tubular collar **34** and is formed with an internal groove **70** which is in alignment with and forms a continuation of a similar groove formed in collar **34**. A split lock ring **72** is received within these grooves and radially overlaps flange **66** so as to retain tube **64** on the end of the hose while permitting the hose to swivel relative to the tube.

Tube **64** preferably is bent, as shown in FIG. **1**, the opposite end being insertable into a hollow tube or wand **74** connected to a suction nozzle **76**. The latter is provided with a rotary brush driven by an electric motor which is supplied with **120** volt electric power through a cord **78** extending through a channel in wand **74** and terminating in a plug **80** having prongs **82** which may be inserted through openings **52** in cap **50** so as contact the upper rectangular portions of contacts **38** and **40**.

In using the vacuum cleaner, the operator grasps the bent tube **62** in order to move the nozzle **76** back and forth over the rug. If during this use a static charge is generated in the operator as previously explained, it is continuously drained off through the metal tube **64**, the ring **58**, which is in sliding conductive contact with the flange **66** of the tube, and through the blade **56** and the block **54** to whichever of the shanks **46** or **48** is in the grounded side of the 120-volt house circuit. Consequently, the static charge never builds up in the operator to a voltage sufficient to cause a spark discharge should he or she grasp the hose **20** or approach contact with a grounded metal object, such as a water pipe or radiator. On the other hand, the resistivity of the block **54** is sufficiently high to prevent the flow of current at 120 volts to the operator through **56**, **58**, **66** and tube **64**, or between the shanks **40** and **48**.

Should the operator already have a high static charge when she grasps the bent end tube **64**, this charge will be drained off through the material **54** at a slow enough rate to prevent a spark discharge.

In FIGS. **6** and **7**, the invention is shown as applied to a portable electric drill designated generally by reference character **100**. As is well known, such a device has an electric motor which is supplied with the usual 120-volt current through a cord having a pair of conductors **104** and **106** therein. This cord enters a hollow handle **108** which is grasped by the operator when the drill is in use. Operation of the motor is controlled by a trigger switch **110** located in a convenient place relative to the handle.

Within the handle and adjacent to the rear surface thereof is a block of material **112** of the same nature as the block **54** in the first embodiment. The conductors **104** and **106**, without other insulation, extend through this block and the latter is secured in close contact with a metal plate or button **114** disposed on the outer surface of the handle so as to be contacted by the hand of the operator when grasping the handle.

The operation of this embodiment is similar to that previously described. Should a static charge tend to accumulate in the body of the operator, it is bled off through the plate **114** and the block **112** to one or the other of the conductors **104** or **106** at a sufficient rate to prevent it building up to a voltage high enough to cause a spark discharge should the operator approach

contact with a grounded object. At the same time, the resistance of the block 112 to current at 120-volts is high enough to prevent flow of such current to the plate 114 and thence to the hand of the operator, or between the two conductors.

While there has been described two more or less specific embodiments of the present invention, this has been done for purposes of illustration only and the scope of the invention is to be determined from the appended claims.

What is claimed is:

1. In a device contactable by a human body, said device including a low voltage electric power circuit having a grounded conductor, and a high loss dielectric material disposed so as to be between said conductor and the human body for draining static charge from the body to the conductor to thereby maintain the voltage level of the static charge below that required to produce a spark discharge.

2. A device as defined in claim 1 wherein the power circuit has two conductors either one of which is grounded and said high loss dielectric material is disposed between both said conductor and the human body.

3. A device as defined in claim 2 wherein said device is the suction hose of an electric vacuum cleaner system and said conductors are insulated and disposed in said hose and comprise a portion of the electric circuit of said vacuum cleaner.

4. A device as defined in claim 3 wherein said hose includes a handle having a conducting portion and said high loss dielectric material is between said conducting portion and said conductors.

5. A device as defined in claim 2 wherein said device is an electrical appliance having a handle provided with a conducting portion, and said high loss dielectric material is between said conducting portion and said conductors.

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