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Sheelor

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[54] **ELECTRICAL GROUNDING DEVICE**

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[52] **U.S. Cl.** ..... **174/6;** 339/13; 339/265 F

[51] **Int. Cl.²** **H01R 3/06**

[58] **Field of Search** ..... 174/5 SG, 6, 7, 78; 204/196; 343/846, 849; 339/13, 14 R, 14 L, 244 UC, 249 S, 263 L, 265 R, 265 F, 266 G

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Attorney, Agent, or Firm—Herbert E. Kidder

[57] **ABSTRACT**

An electrical grounding device comprising a metal pipe capped and perforated at both ends and filled with deliquescent salts which dissolve to form an electrolyte. The pipe is buried vertically in the ground, with only the perforated upper end protruding above the surface. The upper end cap has a flared skirt that extends down over the upper end perforations to a point closely adjacent the surface of the ground, so that the perforations are shielded from rain or sprinkler water, without interfering with free flow of atmospheric air into and out of the pipe. The upper end cap is also provided with pairs of horizontally aligned apertures, through which the legs of a U-bolt are passed, and a bridge member is secured by nuts to the protruding ends of the U-bolt legs. The electrical conductor to be grounded is clamped between the bridge member and the sidewall of the end cap. In the bottom of the pipe is an inverted, cup-shaped, perforated member that provides an elevated support for the column of salts, and stuffed into the interior of the cup is a wad of fiber glass, which prevents soil from entering the pipe through the lower end perforations, while allowing dissolved salts to percolate down into the bottom end of the pipe and out through the perforations. Atmospheric air enters and leaves the pipe through the exposed upper perforations, and moisture is continually taken out of the air by the deliquescent salts, which slowly dissolve and leak out through the bottom perforations into the soil to provide a low resistance electrical path to ground.

8 Claims, 2 Drawing Figures

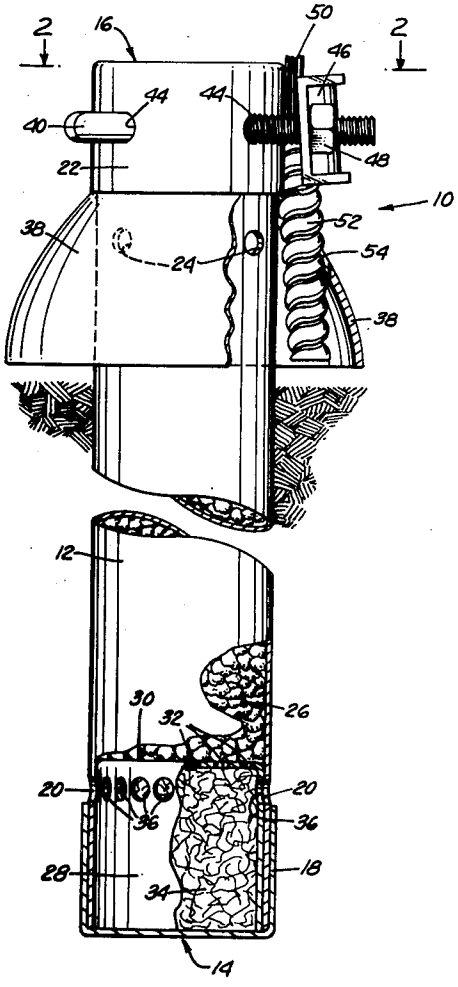

FIG. 1

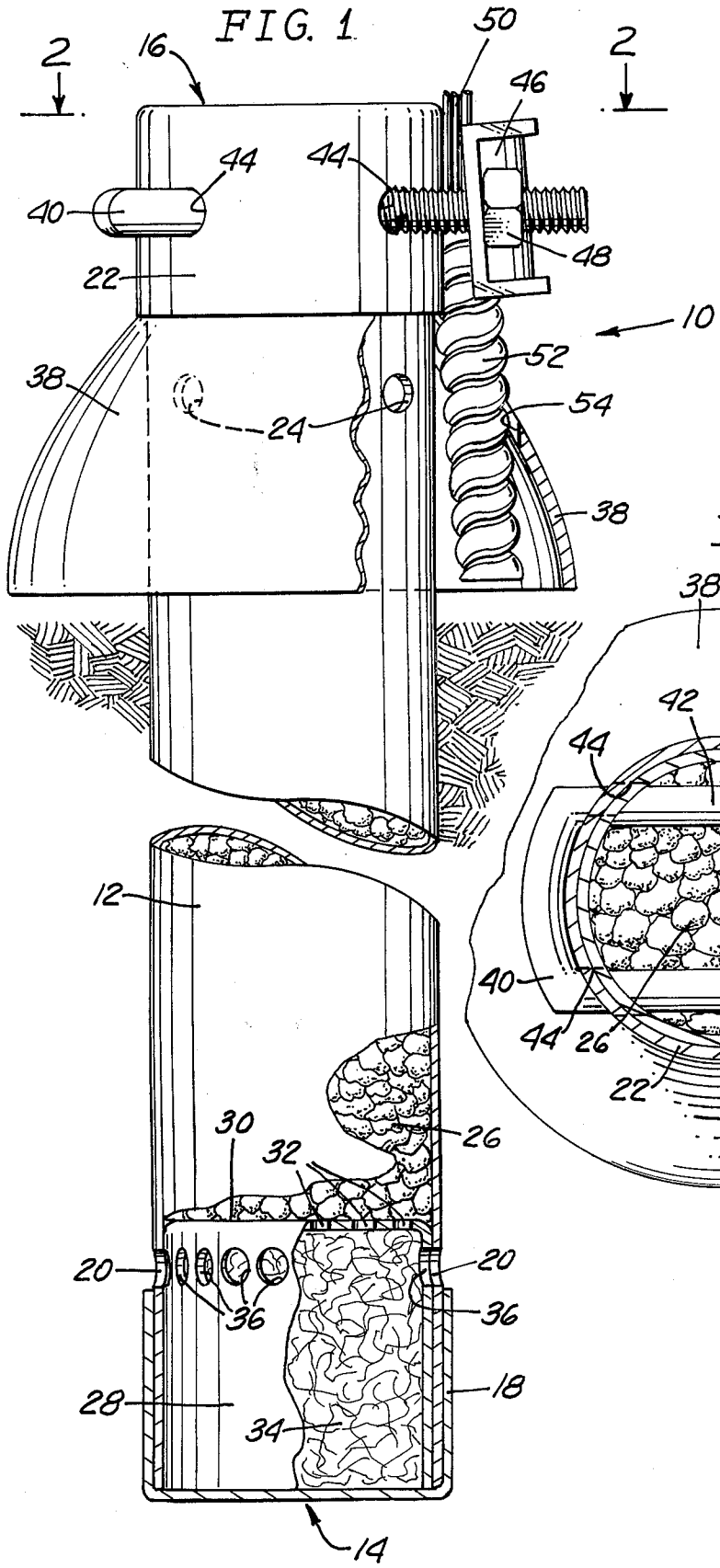
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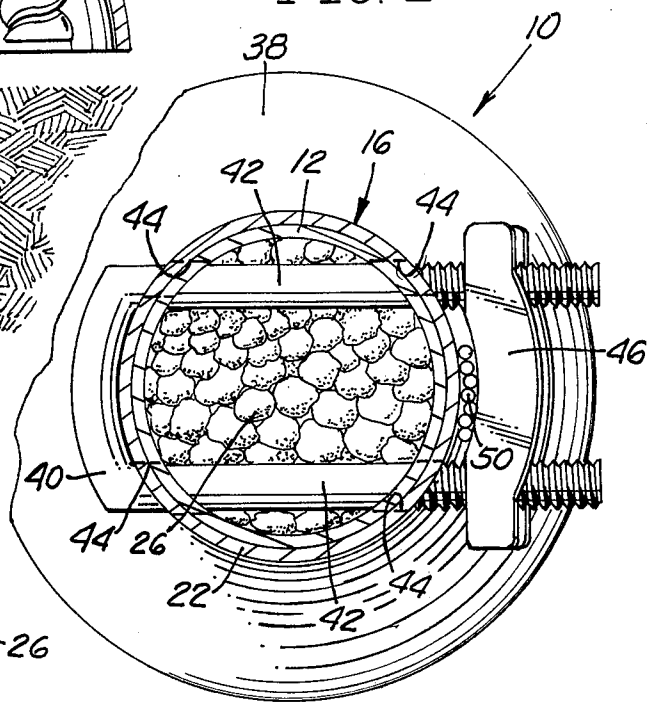
FIG. 2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ELECTRICAL GROUNDING DEVICE

BACKGROUND OF THE INVENTION

The present invention pertains to electrical grounding devices, and more particularly to a grounding device that is buried in the ground to provide a secure, safe, low resistance return ground path for electrical service circuits installed in nearby buildings.

Usually, the grounding of an electrical system has been accomplished by the use of water piping. This manner of grounding has heretofore been recommended by Building and Safety authorities and their approved codes. In recent years, however, serious difficulties have been encountered in some localities with galvanic interaction in such water and plumbing systems, and as a result, there has been a general review of the codes to alleviate the problem by changing the present grounding practices.

An additional factor compounding the problem of using water pipes as a grounding system is the growing use of plastic pipe and fittings, which are non-conductive and make it impossible to utilize the water pipes as a service grounding medium.

Still another factor that has militated against the use of water pipes as a grounding system, is the danger of accidental electrocution. Many lives have been lost where victims have inadvertently touched a water pipe while in contact with a "hot" wire. Such accidents can be prevented by isolating the electrical ground circuit from the water pipes and, instead, connecting the ground wire of the electrical service to a separate grounding device buried in the soil.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a new and improved electrical grounding device of the character described, which is completely isolated from the water pipes, so that the pipes form no part of the electrical system and therefore cannot cause accidental electrocution of a person who is in contact with both a hot wire and the water pipes.

This object is achieved by providing an elongated copper pipe that is capped and perforated at both ends and filled with deliquescent salt which slowly dissolves to form an electrolyte. The pipe is buried vertically in the ground, with only the perforated upper end protruding above the surface, to which electrical circuits are connected. Atmospheric air enters and leaves the pipe through the exposed perforations at the top, and moisture is continually taken out of the air by the deliquescent material, dissolving some of the salt. The resultant solution leaks out through the perforations in the bottom of the pipe, penetrating and moistening the soil with electrolyte to provide a low resistance electrical path to ground.

Another important object of the invention is to provide a new and superior method of attaching the electrical conductor to the grounding device. This is accomplished by providing a U-bolt which passes through horizontally aligned holes in the upper end cap, and which has a bridge member secured by nuts to the threaded protruding ends of the U-bolt legs. The electrical conductor to be grounded is clamped between the bridge member and the sidewall of the end cap. Thus, the cap is not only an end closure for the pipe, but is also half of the clamping device, with the U-bolt

serving as a mechanical lock, an electrical conductor, and a holding or pressure device.

Still another object of the invention is to provide means for shielding the apertures in the top end of the pipe from rain or sprinkler water. This is accomplished by providing the upper end cap with a flared skirt that extends down over the upper end perforations at a distance out from the pipe, said skirt extending down to a point closely adjacent the ground surface, so that the perforations are shielded without interfering with free flow of atmospheric air into and out of the pipe.

A further object of the invention is to provide means for preventing the column of salt from settling down into the bottom end of the pipe, compressing the wads of fiber glass that prevent soil from entering the bottom perforations. This object is accomplished by providing an inverted cup-shaped member in the bottom of the pipe, which serves as an elevated support for the column of salt. The cup-shaped member thus carries the entire weight of the salt, and the fiber glass which is packed into the space beneath the cup is not required to carry any weight. The cup is perforated in the top and sides, so that salt solution can percolate down into the bottom end of the pipe and out through the bottom perforations of the pipe.

These and other objects and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment thereof, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a partially cut away, elevational view of an electrical grounding device embodying the principles of the invention; and

FIG. **2** is a cross-sectional view through the same, taken at **2—2** in FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the reference numeral **10** designates the grounding device in its entirety. The main body of the device is a metal pipe **12,** preferably of copper, which is typically about 2½ to 3 meters long, about 53 mm. in diameter, and with a wall thickness of about 2mm. Mounted on the bottom end of the pipe is a lower cap **14,** and on the top is an upper cap **16.** The lower cap **14** is cup-shaped, and has an annular side wall **18** that is telescoped over the bottom end of the pipe. Formed in the pipe just above the top edge of side wall **18** is a plurality of holes **20,** the purpose of which will be apparent presently.

The upper cap **16** also has an annular side wall **22** that is telescoped over the top end of the pipe, and the pipe has a plurality of holes **24** formed therein a short distance below the bottom edge of the wall **22.**

The pipe **12** is filled with a quantity of moisture-absorbing material **26** consisting of deliquescent or hygroscopic salts such as calcium chloride, magnesium chloride, sodium hydroxide, sodium chloride, copper sulfate, or other salts which, alone or in combination, act to extract moisture from atmospheric air and to dissolve some of the salt to form an electrolyte. This electrolyte solution then bleeds out of the holes **20** in the bottom of the pipe and spreads out by capillary action until it is dispersed throughout the soil for a considerable distance in all directions, forming a low-resistance path of electrical conductivity into the soil.

Moreover, by greatly extending the effective size and depth function of the grounding device, the invention reduces the current density per unit area, thereby eliminating or minimizing overheating of the unit during momentary current overloads, as in the case of a short circuit.

The choice of salt used to fill the pipe **12** is governed by the type of soil in which the pipe is to be buried. For example, in a wet soil the choice might be copper sulfate of one-half inch aggregate size; selected because of its slow dissolving rate and the fact that it is hygroscopic instead of deliquescent. Deliquescence is not needed in a wet soil. On the other hand, with a dry soil in an arid region, sodium hydroxide or calcium chloride might be used, either alone or mixed with sodium chloride in the form of coarse rock salt. The deliquescent property of the calcium chloride or sodium hydroxide causes it to take up moisture from the atmospheric air contained within the pipe, which then dissolves part of its own substance, or the sodium chloride mixed therewith, to form the liquid electrolyte which then leaks out into the soil and becomes dispersed therein. Mixtures of calcium sulfate and calcium chloride in various proportions have produced good results.

Disposed within the pipe at the bottom end thereof is an inverted cup-shaped member **28** having a horizontal surface **30** located slightly above the bottom apertures **20.** The horizontal surface **30** provides an elevated platform for supporting the weight of the column of salt **26,** and the surface is provided with holes **32** through which the dissolved salt solution flows into the bottom of the pipe. Packed into the cavity on the underside of the cup-shaped member **28** is a wad of fiber glass or rock wool **34,** which completely fills the space and excludes soil from entering the pipe through openings **20** and **36.** Openings **36** are formed in the annular side walls of member **28,** and they register with openings **20.** The platform **30** prevents compression of the fiber glass or rock wool packing **34,** and thus enables the fibrous packing **34** to perform its function of preventing soil from entering the pipe through the openings **20, 36,** while allowing the salt solution to flow freely out through the openings.

Flaring outwardly from the bottom edge of the cylindrical side wall portion **22** of upper cap **16** is a skirt **38,** which extends down over the holes **24** at a short distance outwardly therefrom. The bottom edge of the skirt **38** should reach almost to the ground surface when the pipe has been buried, as shown in FIG. **1,** and the skirt thus acts as a depth gauge. The primary function of the skirt **38** is to shield the openings **24** from rainfall or sprinkler water, which it does most effectively. At the same time, the skirt **38** allows atmospheric air to pass freely through the openings **24,** without any restriction.

The upper cap **16** is locked to the top end of pipe **12** by means of a U-bolt **40,** the two legs **42** of which pass through horizontally aligned holes **44** in the cap and pipe. The protruding ends of the legs **42** pass through openings in a bridge member **46,** and are threaded to receive nuts **48.** The center portion of the bridge **46** bears against the end of a service ground wire **50** and its flexible conduit **52,** clamping them solidly between the bridge and the end cap wall **22.** The bridge **46** fits loosely on the U-bolt legs **42** and is free to rock slightly, as shown in FIG. **1,** as the bottom edge of the bridge bites against the conduit **52,** while the top edge of the bridge bites against the ground wire **50,** which is smaller than the conduit. The conduit **52** and ground wire **50** approach the clamping bridge **46** from below, and pass through an opening **54** in the skirt **38.** The conduit **52** is, in most cases, buried in the ground.

The grounding device **10** is installed at a building site by digging a hole in the ground at a selected spot to a depth of about 225 cm., using a soil auger or water drill. The pipe **12** is then lowered into the hole which, if it has been dug to the correct depth, will leave only the upper end cap **16** protruding above the surface of the ground, with the bottom edge of the skirt **38** touching, or closely adjacent to the ground surface. It is essential that the holes **24** in the top end of the pipe be open to the atmosphere. Before the hole is back-filled, it is advisable to provide some dampness or moisture at depth, by pouring several liters of water into the hole around the pipe. After back-filling the hole, the service ground wire **50** is connected to the device by clamping the bridge **46** tightly against the ground wire and its conduit. The device is now ready for use.

Almost immediately, the deliquescent or hygroscopic salt **26** within the pipe begins to absorb moisture from the atmospheric air within the pipe. The absorption of moisture goes on day and night, through periods of low relative humidity as well as high. However, maximum moisture absorption takes place when the relative humidity is high, which is often in the cool of the night, or during and after a shower. The atmospheric air within the pipe is being constantly "breathed" in and out through the open holes **24** in the top end of the pipe, due to changing temperature and barometric pressure. Thus, the supply of moisture is constantly replenished, and the electrolyte inside the pipe and dispersed throughout the soil surrounding the pipe never dries out.

With the ground service line thus connected to the grounding device **10,** there is no electrical connection between the service lines and the water pipes of the building. The water pipes are therefore isolated from the electrical system, and it is virtually impossible for a person to be electrocuted by touching a water pipe while in contact with a hot wire.

The inverted cup-shaped member **28** supports the weight of the column of salt **26,** and prevents the latter from compressing the wad of fiber glass or rock wool **34,** so that the openings **20** could become uncovered and allow soil to crowd into the openings, eventually plugging them completely.

The U-bolt **40** and bridge **46** serve the dual function of locking the upper cap **16** to the pipe, and also clamping the ground wire **50** and flexible conduit **52** to the pipe. Skirt **38** shields the openings from rain water or sprinklers, and keeps the device from being flooded with excess water.

While I have shown and described in considerable detail what I believe to be the preferred form of my invention, it will be understood by those skilled in the art that the invention is not limited to such details, but might take various other forms within the scope of the following claims.

What I claim is:

1. An electrical grounding device for connecting the neutral ground wire of an electrical service line to the soil, comprising:

a metal pipe having openings at both ends thereof and filled with moisture-absorbing salts that are soluble in water to form a highly conductive electrolyte;

said pipe being buried in the ground with one end thereof protruding above the surface of the ground so that the openings in that end are exposed to the atmosphere, thereby allowing air to flow freely into and out of the pipe;

said moisture-absorbing salts taking moisture out of the air, which dissolves some of said salts and runs out of said openings at the bottom end of the pipe, permeating the soil to make a good electrical contact between the pipe and the soil;

means at the bottom end of said pipe for retaining said salts in said pipe;

an end cap telescopically engaged with the top end of said pipe, said pipe and end cap each having pairs of horizontally aligned holes formed in opposite sides thereof, the holes in said cap registering with the corresponding holes in the pipe;

fastening means passing through said registered holes, said fastening means terminating in threaded members projecting from said end cap on one side thereof;

a bridge member having holes at opposite ends thereof through which said threaded members pass; and

nuts screwed onto said threaded members and bearing against the outer side of said bridge member;

the neutral ground wire of the electrical service line being clamped between said bridge member and said end cap, and said fastening means serving both to lock said cap to said pipe and to secure said grounding wire to the device in a solid mechanical and electrical connection.

2. The device of claim **1,** wherein said fastening means comprises a U-bolt having a pair of laterally spaced, parallel legs that pass through said registered holes in said cap and pipe.

3. The device as set forth in claim **2,** wherein the neutral ground wire is enclosed within a flexible conduit, and the end of the flexible conduit is clamped between one edge of said bridge member and said end cap, said bridge member being tiltable on the legs of said U-bolt so that the other edge thereof engages the neutral ground wire protruding from the conduit, clamping the same to said end cap.

4. The device of claim **1,** wherein said end cap has a flared skirt at the lower end thereof, said skirt extending down over said holes at a distance out from the surface of the pipe, so as to protect said holes against rain or sprinkler water.

5. The device of claim **4,** wherein said end cap has a cylindrical upper portion that telescopes down over the top end of the pipe, said cylindrical upper portion of the end cap having said pairs of holes formed therein which register with corresponding holes in the pipe, said fastening means comprising a U-bolt having a pair of laterally spaced legs that pass through said registered holes, and said flared skirt having a hole formed therein directly below said bridge member through which the neutral ground wire passes upwardly from below ground to its point of attachment between the bridge member and the end cap.

6. The device of claim **1,** wherein said means at the bottom end of the pipe for retaining said salts comprises a platform fixedly secured to the pipe at a level above the holes in the bottom end of the pipe to support the weight of the salts, said platform being perforated to allow the salt solution to flow through; and a wad of porous material packed within the pipe below said platform and covering said holes at the bottom end of the pipe so as to exclude soil.

7. The device of claim **6,** wherein said platform comprises an inverted cup having cylindrical side walls that are telescoped into the bottom end of the pipe, said cup side walls having apertures at least some of which register with said holes in the bottom end of the pipe.

8. The device of claim **7,** which further includes a bottom end cap that is telescoped over the outside of the pipe at the bottom end thereof.

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