(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 136 039**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **84305590.6**

(22) Date of filing: **17.08.84**

(51) Int. Cl.⁴: **H 01 R 4/66**

(30) Priority: **19.08.83 US 524958**

(43) Date of publication of application: **03.04.85 Bulletin 85/14**

(84) Designated Contracting States: **AT BE CH DE FR GB IT LI NL SE**

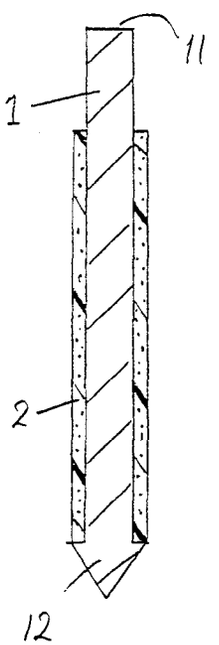
(71) Applicant: **RAYCHEM CORPORATION, 300 Constitution Drive, Menlo Park California 94025 (US)**

(72) Inventor: **Siden, Dennis Carl, 9 Vista Verde Way, Portola Valley California 94025 (US)**
Inventor: **Ratzlaff, Thomas Dean, 319 Haight Street, Menlo Park California 94025 (US)**

(74) Representative: **Benson, John Everett et al, Raychem Limited Intellectual Property Law Department Swan House 37-39, High Holborn, London WC1 (GB)**

(54) Grounding devices.

(57) Grounding devices comprise a metallic central member and a conductive polymer member which surrounds that part of the metallic member which is buried within the ground. The conductive polymer member retards corrosion of the central member by moist soils, and thus increases the life of the device and/or makes it possible to use steel or other relatively cheap metals in place of copper. Preferably the conductive polymer increases in resistivity when its temperature is raised by passage of a grounding current therethrough, so that current density tends to be equalized over the surface of the device.



EP 0 136 039 A2

DESCRIPTION

GROUNDING DEVICES

This invention relates to grounding devices for grounding electrical systems.

Background of the Invention

It is essential to ground almost all electrical systems, e.g. in homes, offices, factories, power stations, and other buildings. For this purpose, ground pins and other grounding devices have been extensively used. The grounding device is buried in, or driven into the ground adjacent or under the building, and the electrical system is connected thereto. Because the grounding device is exposed to moisture and other electrolytes in the ground, it is liable to corrosion, and for this reason, is preferably made of copper rather than steel or aluminum, which are substantially cheaper than copper but which are much more rapidly corroded by moist soil.

SUMMARY OF THE INVENTION

We have now discovered that by using a conductive polymer member to prevent contact between the metal component of a grounding device and the soil in which the device is buried, corrosion of the metal can be prevented or greatly retarded, without adverse effect on the electrical performance of the device. We have found that this discovery makes it possible to use steel, aluminum or another relatively cheap metal in place of copper.

The grounding device used in the invention is often a ground pin which is driven into the ground. However, especially for the grounding of power stations and the like, it may be preferable to use an open mesh mat which is buried beneath the building containing the electrical system.

Accordingly, in one aspect, the invention provides an electrical system which is grounded through a grounding device buried in the ground, the device comprising

(1) a first member which is composed of a metal, and which is at least partially buried in the ground; and

(2) a second member which

(a) is composed of an electrically conductive composition comprising

(i) an organic polymer, and

(ii) a particulate electrically conductive filler dispersed in said polymer, and

(b) is in electrical contact with the first member and the ground, and

(c) electrically surrounds the first member so that substantially all electrical connection between the ground and the first member passes through the second member.

DETAILED DESCRIPTION OF THE DRAWING

The invention is illustrated in the accompanying drawing, in which

Figures 1 and 2 are longitudinal cross-sections through ground pins used in the invention.

DETAILED DESCRIPTION OF THE INVENTION

The first member of the grounding device is composed of a metal, e.g. steel or aluminum. In the case of a ground pin, the first member has an upper bearing surface against which force can be applied to drive the ground pin into the soil and is sufficiently strong for this purpose. The metal for a ground pin is preferably steel, which is both cheap and strong, and the first member is typically a steel rod of diameter 0.2 to 1 inch (0.5 to 2.5 cm), preferably 0.25 to 0.5 inch (0.6 to 1.25 cm).

The second member is composed of a conductive polymer, and electrically surrounds and is in electrical contact with the first member, preferably so that little, if any, of the first member is exposed to corrosive action from the soil in which the grounding device is buried. Typically the second member is in the form of a coating of thickness at least 0.1 inch (0.25 cm), preferably 0.2 to 0.5 inch (0.5 to 1.25 cm), around the first member. Contact between the first member and the soil can be prevented by means of one or more other members (e.g. of an insulating polymeric composition or of a metal which is less rapidly corroded than the first member) in addition to the second member. The conductive filler in the conductive polymer is preferably one which is resistant to corrosion, and for this reason preferably consists essentially of carbonaceous material such as carbon or graphite or both, e.g. carbon black, carbon fibers, graphite flake or graphite fibers. Acetylene black is a preferred conductive filler. Especially when the filler is fibrous, it can also serve as a reinforcing

agent. The conductive polymer can contain conventional additives for polymeric compositions, e.g. antioxidants, flame retardants, and non-conductive fillers. The amount of the conductive filler should be sufficient to ensure that the grounding pin will perform its grounding function. The resistivity of the conductive polymer at 25°C is preferably 10 to 10^{-2} ohm.cm, particularly 5 to 0.1 ohm.cm. If the amount of filler is insufficient, the second member has too high a resistance, but if the amount is too high, the resistance of the second member to physical abuse is too low and the composition is difficult to shape. Preferably the conductive polymer increases in resistivity when it is heated by passage of a grounding current therethrough, since this tends to equalize the current density over the surface of the grounding device when a grounding current is passed through it. A large increase in resistivity is not necessary. Preferably the resistivity increases by a factor of at least 2 between 25°C and 75°C.

The polymer in the conductive polymer can be a single polymer or a blend of polymers. A factor which needs to be considered in choosing the polymer is the physical abuse to which the second member will be subjected, e.g. when a ground pin is driven into the soil. As explained below, measures can be taken to reduce or eliminate frictional forces on the second member as a ground pin is driven into the soil, but if such measures are not taken, the polymer should be one having sufficient strength to allow the ground pin to be driven into the soil without substantial damage to the second member, e.g. a polyarylene polymer.

As just noted, measures can be taken to reduce or eliminate frictional forces on the second member as a ground pin is driven into the ground. Thus in one embodiment, the ground pin has a pointed lower end portion which (i) is composed of an insulating material, e.g. a hard polymer, or (ii) is composed of a conductive material and is separated from the first member by the second member or by an insulating member. The lower portion can be enlarged so that, when the ground pin is driven into the soil, the lower portion makes a hole sufficiently large to prevent substantial frictional forces from acting on the second member. In another embodiment, the lower end portion is part of a third member which

(a) is composed of a metal; and

(b) surrounds the second member so as to prevent substantial frictional forces from acting on the second member as the pin is driven into soil.

After a ground pin having an outer metal member has been inserted, the outer member, having served its function of protecting the second member while the pin is inserted, can corrode rapidly without adverse effect on the electrical efficiency of the ground pin.

Referring now to the drawing, Figures 1 and 2 are vertical cross-sections through ground pins for use in the invention comprising a first metal member 1 having an upper bearing surface 11, and a second conductive polymer member 2 surrounding the first member. In Figure 1, the first member has a pointed and enlarged lower portion 12 which is composed of a

hard insulating polymer and which protects the conductive polymer when the ground pin is driven into the soil. In Figure 2, the ground pin includes a third member 3 which is made of metal and which surrounds the conductive polymer member. In Figure 2, a clamp 4 is shown for securing a ground wire to the first member.

CLAIMS:

1. An electrical system which is grounded through a grounding device buried in the ground, the device comprising

(1) a first member which is composed of a metal, and which is at least partially buried in the ground; and

(2) a second member which

(a) is composed of an electrically conductive composition comprising

(i) an organic polymer, and

(ii) a particulate electrically conductive filler dispersed in said polymer,

(b) is in electrical contact with the first member and the ground, and

(c) electrically surrounds the first member so that substantially all electrical connection between the ground and the first member passes through the second member.

2. A system according to claim 1 wherein the grounding device is a ground pin which has been driven into the soil by applying force against an upper bearing surface of the first member.

3. A system according to claim 2 wherein the ground pin has a pointed lower end portion whch is composed of an insulating material.

4. A system according to claim 2 wherein the ground pin has a pointed lower end portion which is composed of a conductive material and which is separated from the first member by the second member or by an insulating member.

5. A system according to claim 1 wherein the grounding device is in the form of an open mesh mat.

6. A system according to any one of the preceding claims wherein the second member is composed of an electrically conductive composition having a resistivity at 25°C of 10 ohm.cm to 10^{-2} ohm.cm.

7. A system according to any one of the preceding claims wherein the resistivity of the electrically conductive composition increases by a factor of at least 2 between 25°C and 75°C.

8. A system according to any one of the preceding claims wherein the electrically conductive filler consists essentially of carbonaceous material.

9. A ground pin which is adapted to be driven into the ground and which comprises

(1) a first member which is a rigid metal rod having an upper portion for connection to an electrical system which requires grounding and a lower portion to be buried in the ground, and

(2) a second member which

(a) is composed of an electrically conductive composition comprising a polymer and a carbonaceous, particulate, electrically conductive filler dispersed in the polymer, and

(b) surrounds and is in electrical contact with the lower portion of the first member so that, when the grounding pin is driven into the ground, substantially all electrical connection between the ground and the first member passes through the second member.

10. A ground pin according to claim 9 wherein the second member is at least 0.1 inch (0.25 cm) thick and is composed of a material having a resistivity at 25°C of 10 to 10^{-2} ohm.cm.

MP0877 1/1

FIG 1

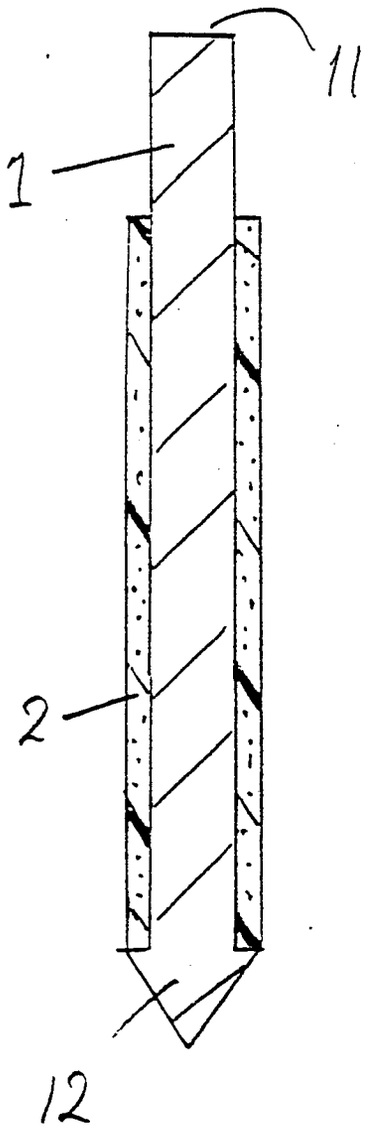


FIG 2