United States Patent [19]
Smith et al.

[11] 3,716,649
[45] Feb. 13, 1973

[54] GROUNDING ROD AND COUPLER THEREFOR

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[22] Filed: **March 16, 1971**

[21] Appl. No.: **124,788**

[52] **U.S. Cl.** ....**174/7**, 16/108, 174/94 R, 287/108, 287/126

[51] **Int. Cl.** **H01r 3/06**

[58] **Field of Search** ....174/2, 3, 4, 6, 7, 84 C, 90, 174/94 R, 126 CP, 84 R; 16/108; 287/75, 108, 109, 126; 339/276 R, 276 C

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Primary Examiner—Laramie E. Askin
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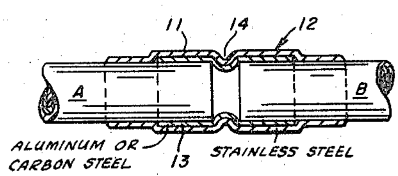
[57] **ABSTRACT**

Described herein is an electrical grounding rod comprising a thin-walled tube of a corrosion resistant steel, a conductor tube of aluminum or other suitable electrically conductive material to provide a low resistance path to ground and a core of a plastic-type filler within the inner tube, the core being sufficiently rigid to provide structural support to the thin-walled tube yet resistant enough to allow some bending of the rod to circumvent obstructions encountered in driving the rod into the ground. A driving point is provided to fit over one end of the rod to isolate the aluminum from the earth and to facilitate driving the rod into the ground. In an alternative embodiment an additional steel tube is provided within the conductor tube to form a three-wall or "sandwich" composite.

21 Claims, 5 Drawing Figures



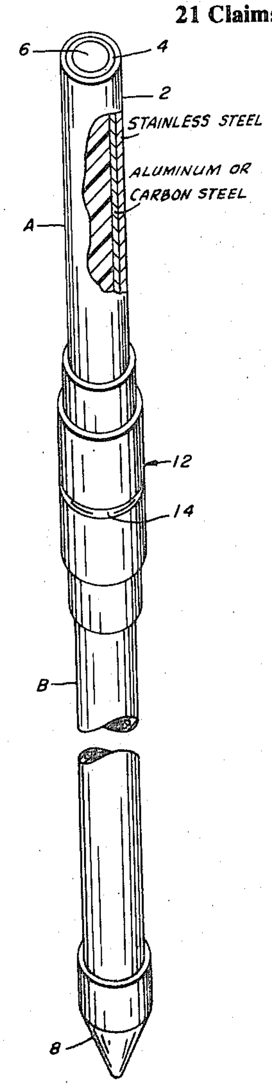


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FIG. 1.

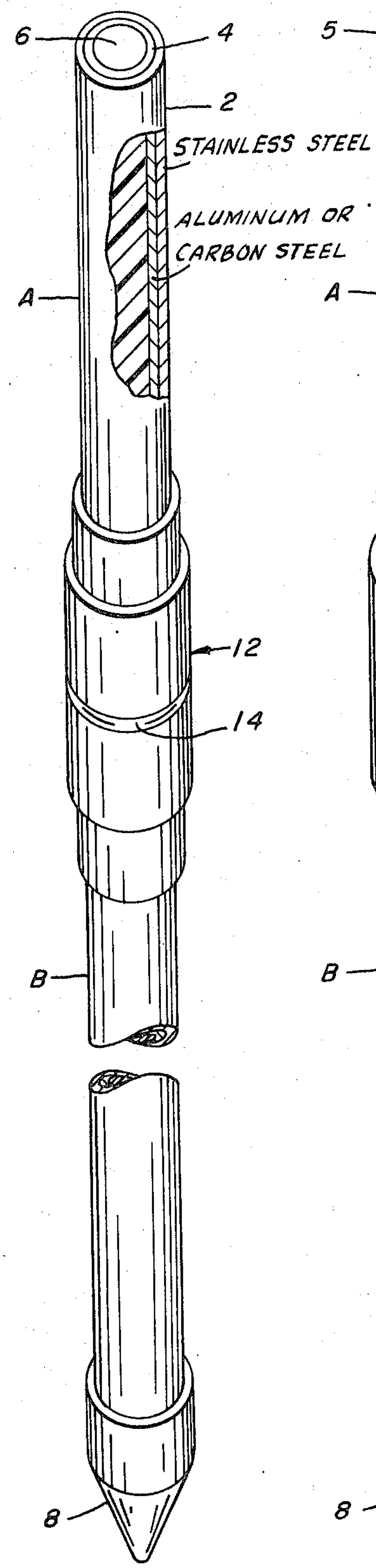


FIG. 2.

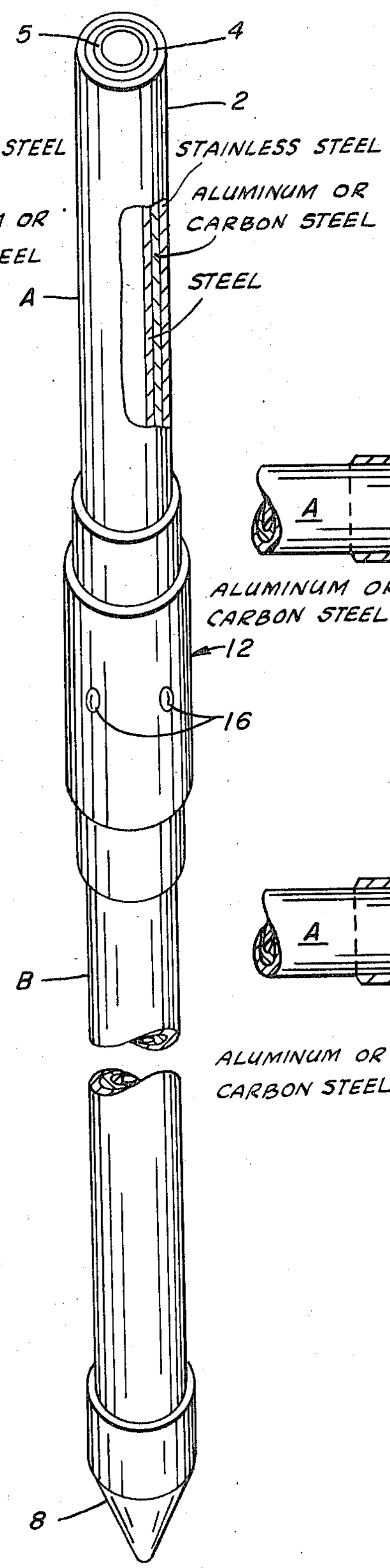


FIG. 3.

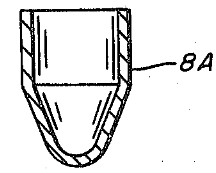


FIG. 4.

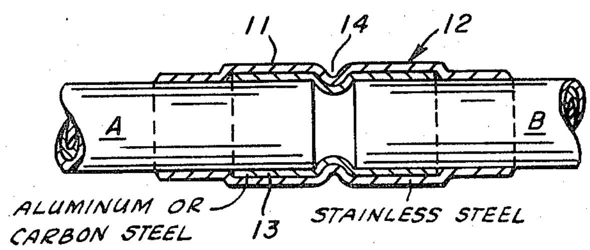
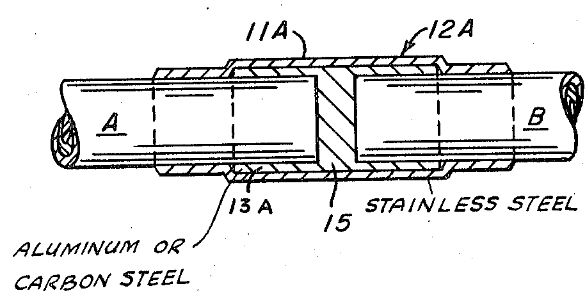


FIG. 5.



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GROUNDING ROD AND COUPLER THEREFOR

BACKGROUND OF THE INVENTION

Grounding rods have been used for many years for the protection of buildings and equipment against electrical discharge, such as lightning and fault currents. A number of designs are currently available, conventionally incorporating a solid type construction and frequently sheathed with a corrosion resistant material, such as copper. Additional types of grounding rods exist of high strength but lower conductivity. They are constructed of iron pipe and often filled with a material designed to cooperate with the ground waters in the location of the rod to promote the electrical contact of the rod since the iron pipe is itself a relatively poor conductor. There are numerous disadvantages suffered by these conventional grounding rods. Solid rods of highly conductive material are expensive. Quite often high conductivity materials are soft and rods of these materials may buckle or mushroom readily if they encounter an obstruction while being driven into the ground. The inclusion of holes in a rod as is conventionally done to promote dissolution of filler materials with the earth and electrical conductivity between the electrical conductor and the ground, may further weaken the rod and reduce its utility in areas where the earth into which the rod must be driven is fairly hard.

An additional disadvantage of conventional grounding rods was inflexibility. Often, obstructions were encountered in driving rods into the ground. Conventional rods tended to buckle with further driving and frequently the surplus of the rod above the ground which is unable to be driven further is cut off leaving a ground rod of improper length. More recently, a grounding rod was developed which avoided many of the disadvantages of prior devices. This rod is described in U.S. Pat. No. 3,566,000 dated Feb. 23, 1971, and comprises a thin-walled stainless steel tube filled with a resilient plastic material. Such a rod is both sufficiently sturdy and resilient and can effectively handle current surges of limited magnitude. However, no sooner are devices developed for specific applications, than new demands are made for still further improvements. The grounding rod of U.S. Pat. No. 3,566,000 although useful for current surges up to those normally necessary for residential protection, does not provide a sufficient margin of safety for various industrial applications.

Thus, there still exists a need for a grounding rod exhibiting a high conductivity, strong construction, of low cost material which is easily manufactured, which is substantially non-corrosive in the earth environment and which is able to handle very large current surges such as may be required in utility and industrial power applications but will not buckle when encountering moderate obstruction in the ground even when segments are coupled into longer lengths. Although some prior ground rods such as those described in Australian Pat. No. 250,812, contemplate coupled segments, no consideration is given to protecting the conductor from the surrounding earth or from galvanic cell conditions. In our coupling, the electrically conducted tubular member, e.g., aluminum, plain carbon steel, etc., is a metal less noble (i.e. anodic) with respect to stainless steel. The corrosion resistant steel shield protects the conductive member and substantially prevents establishment of an electrolytic cell which would sacrificially deteriorate the conductive member.

SUMMARY OF THE INVENTION

The present invention provides an electrical grounding rod in one embodiment comprising a thin-walled, tubular sheath or envelope or corrosion resistant steel, a tubular shaped conductor member and a supporting core of semi-rigid, resilient material nonreactive with the envelope or conductor member and with the environment in which the rod is placed. Advantageously, the core material is put into compression within the tube. In a second embodiment, the grounding rod comprises a three-wall or "sandwich" composite additionally including an inner steel tubular supporting member inside the rod sandwiching the conductor tube within the corrosion resistant steel shield. In this embodiment the plastic core may be omitted since the inner supporting member supplies sufficient additional strength.

A driving point for the rod is provided at one end of the rod to assist in circumventing obstructions while the rod is driven into the earth and to isolate the conductor member from the earth. Also, a removable cap member, e.g., driving cap, adaptable to specific driving tools may be provided at the opposite end to distribute the forces of driving to prevent distortion of the rod. Upon completion of driving, a driving point member may be used for a cap to protect the rod interior from the elements. In addition to the foregoing, the invention includes a special section-coupler to join grounding rod lengths together, as necessary, to provide the total length desired for any particular application. Two types of section-couplers are useable: one is a tubular unit and the other may include a solid cross section. Both types are hereinafter described.

DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 illustrate, by elevational views partly in section, two preferred embodiments of the grounding rod assembly of the invention, and

FIG. 3 is a cross-sectional view of an alternative driving point, and

FIGS. 4 and 5 are cross-sectional views of section couplers in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The multi-component ground rod of the invention utilizes a stainless steel outer layer or tube called an envelope, sheath or shield, for columnar strength, corrosion resistance and satisfactory conductivity over a long period of time because corrosion products will not build up on the stainless steel ground rod and inhibit conductivity with the earth. The conductor, which may be mild steel or aluminum, is also a tube within the shield tube, and conducts the electric current the length of the rod without excessive heat buildup. The conductor tube also provides some added columnar strength at a minimum increase in weight. When present, the plastic or other resilient core material preferably is under compression within the conductor tube. The core material helps prevent premature collapse of the tube in columnar compression, prevents mushrooming during the driving of the rod and prevents moisture from accumulating within the rod. An alternative embodiment utilizes an internal thin wall, steel supporting tube in lieu of or in addition to the plastic core to provide added strength for the rod assembly with minimum increase in weight.

Galvanic corrosion of ground rods may lead to failure of the ground to adequately serve its original purpose. The U.S. Navy report "Field Testing of Electric Ground Rods AD702040 Naval Civil Engineering Laboratory, Port Hueneme, California, February 1970," recommends stainless steel sheathed ground rods for general use because they are more resistant to general corrosion than other rods in common usage. The multi-component rods described above provide the resistance to corrosion, the conductivity, and the drivability required and weigh less than half of bi-metal rods of the same dimension.

These multi-component electric ground rods described above have the advantages that they will not galvanically attack adjacent steel or iron structures such as tanks, anchor rods, pipe lines or foundation bolts. These multi-component rods can be coupled without threading or other fabrication or modification and are designed to be used with a separate driving point that facilitates driving and seals the conductor tube and plastic from contact with the earth. The driving points can also be used as end caps or closures to seal the upper end from the atmosphere or earth.

Referring now to FIGS. 1 and 2, reference numeral 2 indicates a thin-walled tubular envelope or corrosion resistant steel. The tube in the figure is cylindrical in shape, however, it may have other cross sections including polygonal and the word "tubular" is intended in its broadest sense. Tube 2 may be a seamless extruded tube, a welded tube or one which is lockseamed or similarly joined. The diameter and length are generally dependent upon the electrical grounding requirements for the installation. A typical size would be a five-eighths inch diameter tube, 8 feet long. Numeral 4 indicates the tubular electrical conductor member which may be of any suitably conductive material considering the current surges anticipated but in the preferred embodiment is plain carbon steel or aluminum or aluminum alloy. The term "aluminum" as used herein is understood to include aluminum alloys. Two rod segments, A and B, are shown in the drawings connected by a coupler 12, hereinafter described, and as having a driving point 8. The rod in FIG. 1 has a plastic core 6 which is replaced in the rod of FIG. 2 with an inner steel tube 5. In our invention, "thin-walled tubes" are used and stainless steel and aluminum tubes through 0.05 inches and carbon steel tubes through 0.065 inches are included in this term.

Though other materials may provide adequate conductivity and strength characteristics for the shield, in accordance with the invention a corrosion resistant steel such as a stainless steel (e.g., AISI Type 304) is used. Such a material provides additional strength and nonreactive properties which allows minimizing the use of expensive conductive materials, yet provides additional characteristics described below. Grounding rods of our invention may be constructed with very thin tube walls, i.e., less than 0.07 inches. Typical of the practice of our invention is the use of a stainless steel tube having a wall thickness of as little as 0.030 inches. Such structures contribute substantially to the objectives of reducing cost and provide a facility to circumvent obstructions when being driven into the ground. Only corrosion resistant steels provide the combination of properties and economy which permits construction of a tubular shield strong enough to be driven into the ground when supported internally, yet flexible enough to be able to circumvent moderate obstructions encountered during pounding into the ground. The aluminum or carbon steel tubular conductor member may be of any wall thickness capable of providing low impedance to grounding. A common wall thickness is about 0.035 inches.

As mentioned above, the illustration shown in FIG. 1, conductor tube 4 is filled with a supporting core 6 nonreactive with the shield 2 and conductor 4 and the earth environment. Materials known as "plastics" may be advantageously utilized, however, the material need not be organic. The necessary characteristics of the core material are:

1. that it be nonreactive with the corrosion resistant steel shield and tubular conductor, e.g., carbon steel or aluminum, and the earth environment,

2. that it provide a sufficiently rigid support when in position within the tube so that the filled tube may be driven into the ground, and

3. that it be slightly resilient so as to allow some bending of the composite rod. If core 6 is in compression, its value is enhanced by ensuring the tube is supported over its entire inside diameter.

In one embodiment of the grounding rod the conductive tube 4 may be filled with a flowable core material such as an epoxy, a polyurethane or an elastomer which is solidified or hardened within the tube. In order to achieve a core which would be in a condition of compression when solidified within the tube, the optimum flowable material would be one which would expand slightly as it solidified. This would eliminate an additional step of placing the core in compression such as by compressing the ends of the core, after solidification to achieve this condition.

The grounding rod of the invention has a separate driving point 8 affixed to one end of the tube 2. Such an attachment facilitates driving the rod into the earth with a lesser driving force and prevents direct contact of aluminum conductor with earth which could cause corrosion of the conductor. As a preferred alternative to a sharply pointed detachable driving point, the driving point 8 may present a rounded aspect, 8A, such as shown in FIG. 3. Such a rounded point encourages the rod to slide slightly to one side or the other in the event an object is encountered below the earth level while driving the rod.

The combination of the strong, thin-walled tube, a thin-walled conductor tube and a semi-rigid core permits some flexing of the rod further enhancing the ability of the driven rod to pass an obstruction without collapse of the rod. The higher strength of the corrosion resistant steels inhibits splitting, tearing and collapse of the tube while the thin walls allow some flexing without buckling and the conductive tube enables the rod to handle very large current surges.

The semi-rigid core supports the assembly uniformly throughout the inside diameter while also flexing to accomodate a path around ground obstruction. More rigid, less resilient cores, such as compressed wood, concrete, etc., and thicker wall construction add to its weight and restrict flexibility of the rod and its ability to circumvent obstructions and thus encourage buckling. More ductile tube materials such as copper provide insufficient wall strength to retard buckling or protect against splitting and tearing of the rod during the driving.

As indicated above, the grounding rod may be constructed with a thin-walled, inner supporting tube which may replace the plastic core and which has certain advantages thereover, such as reducing electrical impedance and withstanding higher temperatures although the plastic core has the important practical advantage of less weight. The supporting tube may be of any steel composition, including plain steel and furnish considerable strength by forming a sandwich wall for driving into the ground, particularly in hard ground and for longer rod lengths.

The rod assembly shown in FIG. 2 has the same type of corrosion resistant shield 2 and conductor tube 4 but additionally includes a supporting tube 5, which together with shield 2 sandwiches conductor tube 4. In almost all other respects the rod assembly is the same as that shown in FIG. 1. The core 6 is omitted in the FIG. 2 rod assembly, but such a core may be included if found desirable in a given design to provide further columnar strength and integrity. Both the driving point 8 and the cap member may be the same in each embodiment as well as the section couplers, hereinafter described.

Frequently, it is necessary to provide relatively long lengths of grounding rod. To meet this requirement, it is preferred that the rods be manufactured in sections which can be conveniently handled, e.g., nominally 8 feet, and then are connectable in the field. In order to join sections of grounding rod it is necessary that some coupler be provided which does not detract from the rod's advantages and which meets the electrical conduction requirements.

Two types of section-couplers are provided. Both couplers are capable of mechanically and electrically joining sections of grounding rods for the purpose of extending said ground rods to depths in the earth greater than the usual eight feet in order to achieve the desired electrical circuit resistance to ground.

Basically, the couplers, as shown in FIGS. 4 and 5, comprise a tubular portion or envelope of the same material as the outer sheath of the ground rod itself, and the I.D. of the tubular portion of such dimension to provide a force fit over the rod sections so as to make a good electrical and mechanical connection. It is also possible, however, to use plastic or other corrosion resistant material for the tubular portion. Within the tubular portion of the coupler is a conductor member of electrically conductive material, preferably the same material or similar material to that of the tubular conductive member 4. The conductor member may be hollow or solid and fits tightly within the tubular portion, where it is firmly held at about the midpoint of said tubular portion by either mechanical means such as by rolling a groove as shown in FIG. 4, by one or more indentations or by welding or brazing. The purpose of the conductor member is:

1. to provide an electrical conduction path for more of the current to flow from ground rod Section A to Section B;

2. to provide a thermal heat sink for the thin-wall sheath, so that it can handle high electrical currents without undue heating or melting.

In ground rod couplings 12 and 12A shown in FIGS. 4 and 5, the slight increase in diameter of the coupling over the diameter of the ground rod provides better ground contact after driving than existing larger outside diameter couplings. In coupling 12, the conductor tube 13 in the coupling (FIG. 4) is retained within the shield 11 by the tight fit thereof, the reduced diameter of the shield tube at both ends and the annular indentation 14. The ground rod sections, A and B, fit into the coupling and rest against the interior stop formed by the annular indentation 14 (FIG. 4).

The coupling 12A shown in FIG. 5 is similar but includes a portion 15 which extends across the diameter of the shield 11A, acting as a stop for rod segments A and B. In this illustration, portion 15 is an extension of conductor tube 13A which may be formed by upsetting this tube. However, separate slugs also can be used which are retained in position by dimpling or rolling an annular indentation as shown in FIG. 4, into the portion. In this connection it is noted that the illustration in FIG. 1 depicts an annular indentation 14 while the rod assembly of FIG. 2 depicts a dimpled indentation 16. Normally, these and other retaining techniques may be used in the alternative. It should be further noted that an alternate embodiment of the coupling 12, FIG. 4, would be constructed with two annular indentations 14, spaced approximately three-quarters inch apart, or one wide annular indentation. When the rod segments A and B are assembled in this embodiment a cavity of suitable length, e.g., approximately 1 inch long, can be formed between each rod end. This cavity allows for any expansion of the resilient core 6, FIG. 1.

In the several embodiments, the coupling employs an outer shield, preferably of the same material as the shield 2 of the rod, to protect the conductor tube part of the coupling. Without such protection, the couplings would represent potential weak points in the overall grounding rod assembly, both with respect to driving into hard ground and for corrosion purposes.

Electrical tests have shown that without the conductor member feature, the coupler as described above can be the limiting factor in the current capabilities of the interconnected ground rods. Tests on couplers as shown in FIGS. 4 and 5 but without the conductor member indicate that currents in the order of magnitude of 7,500 amps for 12 cycles of 60 hz power (one-fifth sec.) can cause the section between the ends of the individual ground rod (the rolled groove) to heat to such a magnitude as to melt and disintegrate. With the addition of the conductor member, the coupler can handle much higher currents for longer periods of time.

The electrical tests also showed that when the plastic filled ground rod is subjected to very high currents the plastic filler can expand out the ends, and if the current and length of time are sufficiently great, the filler will melt, smoke and/or catch on fire. The expanding of the plastic also makes it difficult to couple sections of rods together for deep ground penetration.

By inserting a thin-walled conductor section of a better conducting material between the stainless sheath and the plastic core, the electrical resistance of the rod is vastly reduced and hence heating is reduced. Tests have shown that five-eights inch diameter × 0.030 inch stainless tube with a 0.035 inch aluminum conductor and plastic core, exhibits a temperature rise of less than 250°F., when subjected to a current of 13,600 amps for 6 cycles (one-tenth sec.). A stainless-plastic rod, when subjected to only 3,200 amps for 6 cycles (one-tenth sec.) reached approximately the same temperature. At 11,630 amps for 5.8 cycles (one-tenth sec.) a stainless-plastic rod burned apart at the center with considerable smoke and flame.

In other tests:

A composite stainless-aluminum-plastic rod was subjected to 26,600 amps for 5.5 cycles (of 60 hz power) approximately one-tenth sec. with a resulting temperature rise of <500°F. No damage to rod and only a very small extrusion of plastic filler was observed.

A rod with a 0.043 inch plain carbon steel conductor tube within a stainless sheath also exhibits good properties although the temperature rise for a given current is greater than with an aluminum conductor tube. At 20,700 amps for 5½ cycles (approximately one-eleventh sec.) a temperature rise of between **1,000°** – **1,250°**F. resulted with **5** inches of plastic filler extruded from one end but there was no smoke or flame. Hence it appears that either an aluminum or steel inner conducting tube would be satisfactory to handle currents in the order of magnitude of 15,000 amps for 6 cycles (one-tenth sec.).

The data presented in Table I further illustrates the results obtained with grounding rods of the present invention compared with rod assemblies of just stainless steel tubing and plastic core. In the table, rod type 6105 is the stainless steel-plastic assembly; 6135B is the stainless steel-aluminum-plastic assembly; 6125B is the stainless steel-carbon steel-plastic assembly and 61320 is the three-wall stainless steel-aluminum- carbon steel assembly. The rods tested were 4 foot lengths except for the 61320 rod which was an 8-inch section, five-eighths inch O.D.

TABLE I

Rod Type	Avg. Current Amps	Time Cycles	Peak Temp. °F.	Comments
6105	3,200	6	<250	4 feet length of rod tested. Warm to touch.
6105	11,200	4.8	2250–2500	A small hole was burnt through the steel at one end of the sample close to the connecting clamp. Vaporized plastic ignited with considerable smoke and flame from the rod ends.
6105	11,630	5.8	>2500	The tube burnt apart in the center with considerable smoke and flame from the filler.
6135B	4,260	6	<250	No noticeable effect.
6135B	12,100	6.5	<250	Warm, no other noticeable effect.
6135B	26,600	5.5	<500	1½-inch filler extruded, no smoke or flame.
6125B	12,400	6	200–500	Warm, no other effects.
6125B	16,250	5.5	250–500	Filler extruded 1 inch at one end.
6125B	20,700	5.5	1000–1250	5 inch filler extruded, no smoke or flame.
61320	19,500	29	600	No other effects

The following data is for couplings shown in FIG. **4** with conductor section.

6135B	**17,000**	21.5	FIG. 4 coupling — no heating of coupling — slight discoloration of rod section.
6135B	**15,000**	26	

Table II summarizes the results of the foregoing and of other tests and gives a clear picture of the relative capabilities. It can be seen that the stainless steel-plastic assembly (6105) is limited by parting of joints due to expansion of the plastic and by the core ignition point. The lower resistance types (6135B and 6125B) are limited by the parting of joints. The numbers which appear in Table II are I^2t (current in amps (squared) times cycles) values. It is apparent that rods and couplings of the invention are vastly superior and can attain an I^2t greater than 1,000 or even 2,000 (times 10^6) before a polyethylene filler ignites and coupled segments part due to core expansion.

TABLE II

Rod Type	Filler* Extrudes	Joints* Part	Filler* Ignites	Tube* Melts
6105	≥188	>294	≥ 508	≥ 785
6125	≥1,450	>2,900 estd	≥4,840	≥ 8,400 estd
6135B	≥3,890	>4,500 estd	≥8,190	≥ 13,000 estd

*I^2t values in millions (10^6)

The sandwich wall rod (Type 61320) without the core can withstand even greater I^2t values than shown for the 6135B rod in Table II, since it is not limited by core behavior. An 8 foot section of five-eighths inch O.D. of this rod has an Ohmir resistance of 0.00154 (0.03 inch stainless steel, 0.03 inch aluminum and 0.049 inch carbon steel).

In the preferred method of assembling the grounding rod, the grounding rod may be formed by drawing an aluminum tube over a pliable rod of material such as polyethylene. By example, the diameter of the core may be the same outside diameter as the conductor tube to be drawn over it. By drawing the thin-walled tube **2** over the conductor tube and the core **6**, the core is put into compression which provides the entire composite with rigidity and serves as an additional force to counteract any tendency for the wall to collapse during driving impact. A further embodiment utilizing a pliable rod **6** such as a polyethylene may be formed by inserting the rod **6** into a slightly larger tube and drawing the filled tubes **4** and **2** through a die "shrinking" them or reducing them in diameter sufficiently to place the core **6** in compression. This method may be employed advantageously when the tube material is less workable, such as stainless steel tubing. A further alternate method of manufacturing a grounding rod of a thin-walled tube having a nonreactive core may be by extrusion. The core 6 may serve as a mandrel over which the tubes 4 and 2 would be pushed. It is to be noted that the core would have to be sufficiently rigid to withstand the push of the tubes over it. Depending upon the workability of a tube of particular steel and wall thickness, one of the above methods may be a more desirable method of manufacture.

We claim:

1. An electrical grounding rod assembly comprising a thin-walled tubular shield of stainless steel, a thin-walled tubular conductor of aluminum within said tubular shield, a core of semi-rigid material substantially filling said tubular conductor, driving point means at one end of said tubular shield which facilitates penetration into ground and substantially precludes direct contact between said tubular conductor and the ground, said assembly being flexible but sufficiently rigid to be driven into the ground.

2. An electrical grounding rod assembly according to claim 1 wherein said core is a plastic.

3. An electrical grounding rod assembly according to claim 1 wherein said core is a hardened, expanded, flowable material.

4. An electrical grounding rod assembly comprising a plurality of rod segments, each segment comprising a thin-walled tubular shield of corrosion resistant steel, a thin-walled tubular conductor of low impedance metal within said tubular shield, a core of semi-rigid material substantially filling said conductor tube, a rod segment coupling means between adjacent segments, said coupling means comprising an outer protective tubular envelope of corrosion resistant material, a thin-walled tubular conductor of low impedance metal within said tubular envelope in substantially fixed relation thereto, the ends of said outer protective envelope extending beyond said tubular conductor and engaging the thin-walled tubular shields of said rod segments so as to completely cover and protect said tubular conductor including the end edges thereof, stop means intermediate the ends of said tubular conductor, the ends of said rod segments to be coupled being disposed within said coupling means such that said tubular conductor overlaps said rod segment ends and forms an electrical connection therewith, said stop means of said coupling serving to substantially delimit the extent to which said rod segments may extend into said coupling; driving point means on one end of said tubular shield which facilitates penetration into ground and substantially precludes direct contact between said conductor tube and the ground, said assembly being flexible but sufficiently rigid to be driven into the ground.

5. An electrical grounding rod assembly according to claim 4 wherein said stop means in said coupling is at least one indentation in said tubular conductor.

6. An electrical grounding rod assembly according to claim 4 wherein said stop means is a slug extending across the diameter of said tubular conductor.

7. An electrical grounding rod assembly according to claim 6 wherein said slug is a portion of said tubular conductor.

8. An electrical grounding rod assembly according to claim 7 wherein said envelope is stainless steel and said conductor tube is a material from the group consisting of aluminum and carbon steel.

9. An electrical grounding rod assembly comprising a thin-walled tubular shield of corrosion resistant steel, a thin-walled tubular conductor of low impedance metal within said tubular shield, a thin-walled tubular supporting member within said tubular conductor and forming a three-wall composite with said shield and tubular conductor, driving point means on one end of said tubular shield which facilitates penetration into ground and substantially precludes direct contact between said conductor tube and the ground, said assembly being flexible but sufficiently rigid to be driven into the ground.

10. An electrical grounding rod assembly according to claim 9 including a plastic core within said tubular supporting member.

11. An electrical grounding rod assembly comprising a plurality of rod segments, each segment comprising a thin-walled tubular shield of corrosion resistant steel, a thin-walled tubular conductor of low impedance metal within said tubular shield, a tubular supporting member within said tubular conductor and forming a three-wall composite with said shield and tubular conductor, rod segment a coupling means between adjacent segments said coupling means comprising an outer protective tubular envelope of corrosion resistant material, a thin-walled tubular conductor of low impedance metal within said tubular envelope in substantially fixed relation thereto, stop means intermediate the ends of said tubular conductor, the ends of said rod segments to be coupled being disposed within said coupling means such that said tubular conductor overlaps said rod segment ends and forms an electrical connection therewith, said stop means of said coupling serving to substantially delimit the extent to which said rod segments may extend into said coupling; driving point means on one end of said tubular shield which facilitates penetration into ground and substantially precludes direct contact between said conductor tube and the ground, said assembly being flexible but sufficiently rigid to be driven into the ground.

12. An electrical grounding rod assembly according to claim 11 wherein said stop means in said coupling is at least one indentation in said tubular conductor.

13. An electrical grounding rod assembly according to claim 11 wherein said stop means is a slug extending across the diameter of said tubular conductor.

14. An electrical grounding rod assembly according to claim 13 wherein said slug is a portion of said tubular conductor.

15. An electrical grounding rod assembly according to claim 11 wherein said tubular envelope of said coupling means is longer than said tubular conductor and extends beyond each end thereof to engage said ground rod segments to substantially protect said tubular conductor of said coupling from corrosive contact with surrounding ground.

16. An electrical grounding rod assembly according to claim 11 wherein said envelope is stainless steel and said conductor tube is a material from the group consisting of aluminum and carbon steel.

17. An electrical grounding rod assembly according to claim 11 wherein said tubular supporting member is steel.

18. A coupling device for joining grounding rod segments comprising a hollow, elongated envelope of

stainless steel, an at least partially hollow conductor member of aluminum within said envelope and in substantially fixed relationship therewith, the envelope extending beyond the edges of the conductor member and being bent inwardly at said edges to protect the same, and stop means intermediate the conductor member adapted to substantially delimit the extent to which said rod segments may extend into said at least partially hollow conductor member.

19. A coupling device according to claim **18** wherein said stop means in said coupling is an indentation in said conductor member.

20. A coupling device according to claim **18** wherein said stop means is a slug extending across the diameter of said conductor member.

21. A coupling device according to claim **20** wherein said slug is a portion of said conductor member.

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