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(54) Antenna for a train with protective means against high voltages

(57) A train antenna (1) comprising a radiating element (2) that is connected to a feeder cable (3) and to a grounding inductor (4), and comprising an unbreakable protective enclosure (10) for the radiating element (2), a fuse element (6) provided with a first end (6a) for connection to a first end portion (2a) of the radiating element (2) and a second end (6b) for connection to the inductor (4) and to the feeder cable (3), the fuse element (6) being adapted to disconnect the first connection end (6a) from the second connection end (6b) upon flow of a current whose intensity exceeds a limit current, the first end portion (2a) of the radiating element (2) being connected to at least one spark-gap unit (7) connected to the ground.

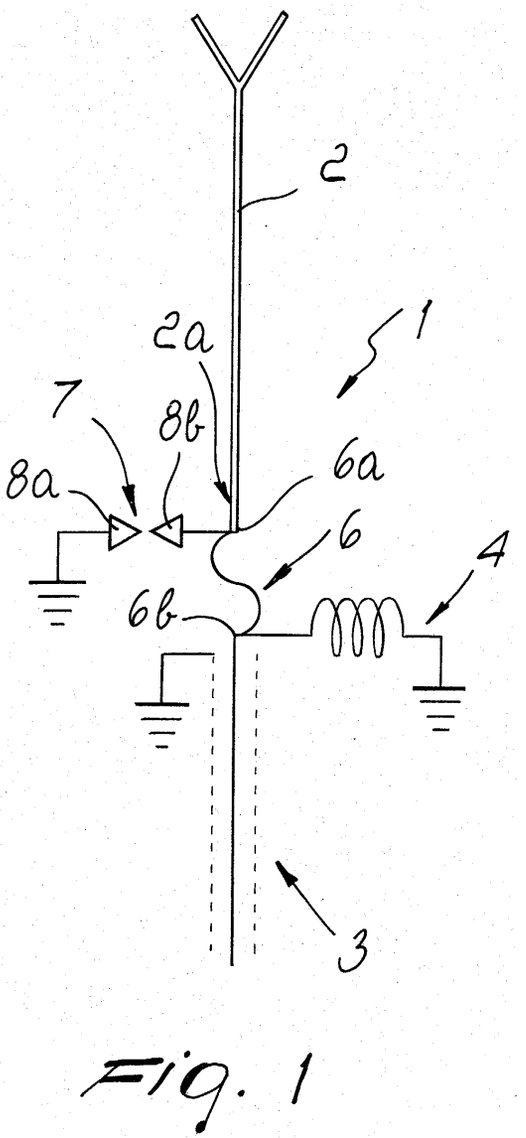

Fig. 1

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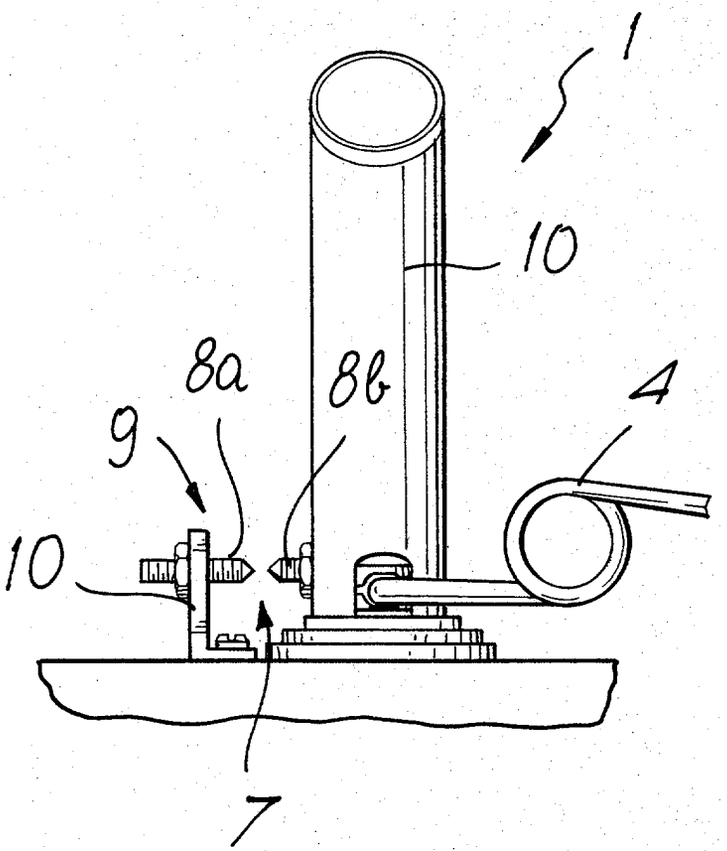

Fig. 3

Description

[0001] The present invention relates to an antenna for trains.

[0002] Currently, antennas are generally provided with devices that allow to protect them from so-called static charges that can accumulate on the radiating rods.

[0003] Such devices are generally constituted by an inductor, which is sized according to procedures known per se and is interposed between the radiating rod and the ground so as to discharge the static charges towards the ground.

[0004] Therefore, the presence of the inductor allows to eliminate the danger that may arise from the conduction of the charges towards devices connected to the antenna, i.e. downstream of the feeder cable, and on which several personnel performing various tasks work.

[0005] Since static charges are rather weak, the inductor does not have to withstand strong currents, because as the charges reach the antenna they are immediately dissipated to the ground before they can accumulate thus become potentially dangerous to personnel.

[0006] For this reason, the inductors currently used to eliminate static charges are generally constituted by a wire that has a rather small cross-section, and they are sized so as to generally withstand the flow of a current comprised between 2 and 100 amperes according to the type and size of antenna being considered.

[0007] However, antennas used on trains may be subjected not only to static charges but also to dynamic voltages or currents, such as those carried by high-voltage cables suspended from electric power line pylons or by electric lines that supply power to the trains.

[0008] Moreover, it should be noted that this risk is increased by the fact that the antennas used on trains are generally located in the uppermost regions and possibly at regions that are clear of obstacles.

[0009] From the above description it is evident that currently an antenna for trains is particularly exposed to the danger of electrical shock, which is extremely dangerous not so much for the possible destruction of the antenna but rather because of the consequences that such shocks can cause to the personnel using the services of the antenna on board the trains.

[0010] If an antenna accidentally makes contact, for example, with a high-voltage line, the current carried by the line, in contact with the antenna, in fact immediately fuses the grounding inductor and therefore discharges along the antenna feeder.

[0011] It is evident that this phenomenon entails as a consequence, the carrying of high-voltage to the vicinity of operators, with great danger for their safety.

[0012] In order to solve the drawback noted above, antennas have been devised in which an attempt has been made to increase so-called robustness.

[0013] However, in the application described above these solutions are difficult to use, essentially because of the fact that in order to ensure indestructibility of the inductor, since high-voltage lines can carry currents with tens of thousands of amperes, it would be necessary to size such inductor with wire diameters of approximately ten centimeters.

[0014] It is immediately evident that such an approach is difficult to provide, first of all because of the highly problematic dimensions of the inductor and secondly because of the fact that by working frequently with antennas operating at a frequency around 900 MHz (for example in the GSM band), the dimensions of the inductor would no longer allow resonance of the antenna, since they would be physically larger than the wavelengths related to these frequencies.

[0015] Accordingly, antennas are commercially available which are also used as train antennas and are provided with safety devices constituted by "compromise" inductors, which however cannot ensure safety to the operator.

[0016] The aim of the present invention is to eliminate or at least drastically reduce the drawback noted above in known types of train antennas.

[0017] Within this aim, an object of the present invention is to provide a train antenna that ensures operator safety even if it is subjected to intense electrical shocks.

[0018] Another object of the present invention is to provide a train antenna that has a very simple structure and a competitive production cost.

[0019] This aim and these and other objects that will become better apparent hereinafter are achieved by a train antenna according to the invention, comprising a radiating element that is connected to a feeder cable and to a grounding inductor, characterized in that it comprises an unbreakable protective enclosure for said radiating element, a fuse element provided with a first end for connection to a first end portion of said radiating element and a second end for connection to said inductor and to said feeder cable, said fuse element being adapted to disconnect said first connection end from said second connection end upon flow of a current whose intensity exceeds a limit current, said first end portion of said radiating element being connected to at least one spark-gap unit connected to the ground.

[0020] Advantageously, an antenna according to the invention is characterized in that the spark-gap unit comprises a spark gap provided with two electrodes facing each other.

[0021] Conveniently, an antenna according to the present invention is characterized in that it comprises means for adjusting the distance between said pair of facing electrodes according to the critical trigger voltage.

[0022] Further characteristics and advantages of the invention will become better apparent from the description of preferred but not exclusive embodiments of an antenna according to the invention, illustrated by way of non-limiting example in the accompanying drawings,

wherein:

Figure 1 is an electrical diagram of a train antenna according to the present invention;
Figure 2 is a partially sectional side elevation view of an example of embodiment of a train antenna according to the invention;and
Figure 3 is a rear elevation view of the train antenna according to the invention shown in Figure 2.

[0023] In the examples of embodiment that follow, individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other examples of embodiment.

[0024] With reference to the figures, an antenna according to the invention, generally designated by the reference numeral 1, comprises a radiating element 2, constituted for example by a rod, which is connected to a feeder cable 3 that is meant to connect the antenna 1 to devices that use said antenna 1.

[0025] The radiating element 2 is connected to a grounding inductor 4.

[0026] Furthermore, the antenna 1 is provided with an unbreakable protective enclosure 10 for the radiating element 2.

[0027] Moreover, according to the present invention, an antenna 1 has a fuse element 6 that is interposed between the radiating element 2 and the feeder cable 3.

[0028] In practice, according to a preferred embodiment, the fuse element 6 has a first connecting end 6a that is connected to a first end portion 2a of the radiating element 2 and a second connecting end 6b that is connected to the feeder cable 3.

[0029] Conveniently, as clearly shown in the electrical diagram illustrated in Figure 1, connection to the inductor 4 is provided at a connecting region that is located substantially proximate to the second connecting end.

[0030] According to a further important aspect of the invention, the first end portion 2a of the radiating element 2 is connected to at least one grounding spark-gap unit 7.

[0031] According to a preferred embodiment, the spark-gap unit 7 can be constituted by a spark gap that is provided with two electrodes 8a and 8b facing each other.

[0032] Conveniently, the antenna 1 is provided with means 9 for adjusting the distance between the pair of facing electrodes 8a and 8b.

[0033] For example, as shown in Figures 2 and 3, one of the two electrodes, for example electrode 8a, can be supported by a threaded element that is coupled to a bracket 10: screwing or unscrewing the threaded element moves electrode 8a closer to electrode 8b.

[0034] Advantageously, according to a preferred embodiment the fuse element 6 can be constituted by a microfuse supported by a printed circuit.

[0035] In particular, it has been found that the antennas 1 described above may operate in single-band mode at a frequency comprised between 440 and 470 MHz or at a frequency comprised between 870 and 960 MHz. However, an antenna 1 may also be of the multi-band type and more precisely may operate in dual-band or tri-band mode.

[0036] Operation of an antenna according to the present invention is as follows.

[0037] Practically simultaneously with the flow of current, the fuse element 6 fuses and vaporizes.

[0038] If the antenna 1, or rather its radiating element 2 (or the unbreakable protective enclosure 10) collides with a high-voltage line, the current flows through the antenna 1 following the path constituted by the radiating element 2, the fuse element 6, and the inductor 4.

[0039] Due to vaporization of the fuse element 6, an electric arc is established which in any case limits the current that will flow through the inductor 4.

[0040] The current that flows through the inductor is further reduced by the action of the spark gap.

[0041] The distance between the electrodes 8a and 8b is in fact advantageously shorter than the length of the electric arc generated at the vaporized fuse element 6, and this entails the triggering of an additional electric arc between the tips of the electrodes 8a and 8b.

[0042] This subsequent triggering divides the current into two arcs, with a consequent further limitation of the current that flows through the inductor 4, preventing its fusing.

[0043] All the characteristics of the invention that are described above as being advantageous, convenient or the like, may also be omitted or replaced by equivalents.

[0044] Thus, for example, the fuse element 6 can be replaced by a low-voltage capacitor, which when subjected to a high voltage is destroyed, simulating the fusing of the fuse element 6.

[0045] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0046] In practice it has been found that in all the embodiments the invention has achieved the intended aim and objects.

[0047] In particular, it has been found experimentally that an antenna according to the invention can withstand the flow of intense currents for times on the order of one tenth of a second without voltages that are dangerous for users appearing on the feeder cable.

[0048] This result appears to be highly satisfactory also in relation to the fact that the safety devices (such as disconnectors) that operate on high-voltage lines have reaction times on the order of hundredths of a second.

[0049] In practice, the materials used, as well as the dimensions and contingent shapes, may be any according to requirements.

[0050] All the details may further be replaced with other technically equivalent elements.

[0051] Where technical features mentioned in any claim are followed by reference signs, those reference

signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A train antenna comprising a radiating element that is connected to a feeder cable and to a grounding inductor, **characterized in that** it comprises an unbreakable protective enclosure for said radiating element, a fuse element provided with a first end for connection to a first end portion of said radiating element and a second end for connection to said inductor and to said feeder cable, said fuse element being adapted to disconnect said first connection end from said second connection end upon flow of a current whose intensity exceeds a limit current, said first end portion of said radiating element being connected to at least one spark-gap unit connected to the ground.

2. The antenna according to one or more of the preceding claims, **characterized in that** said at least one spark-gap unit comprises a spark gap provided with two facing electrodes.

3. The antenna according to one or more of the preceding claims, **characterized in that** it comprises means for adjusting the distance between said pair of facing electrodes according to the critical trigger voltage.

4. The antenna according to one or more of the preceding claims, **characterized in that** said radiating element comprises a radiating rod.

5. The antenna according to one or more of the preceding claims, **characterized in that** said fuse element comprises a microfuse that is supported by a printed circuit.

6. An antenna, **characterized in that** the distance between said facing electrodes is shorter than the length of said fuse element.

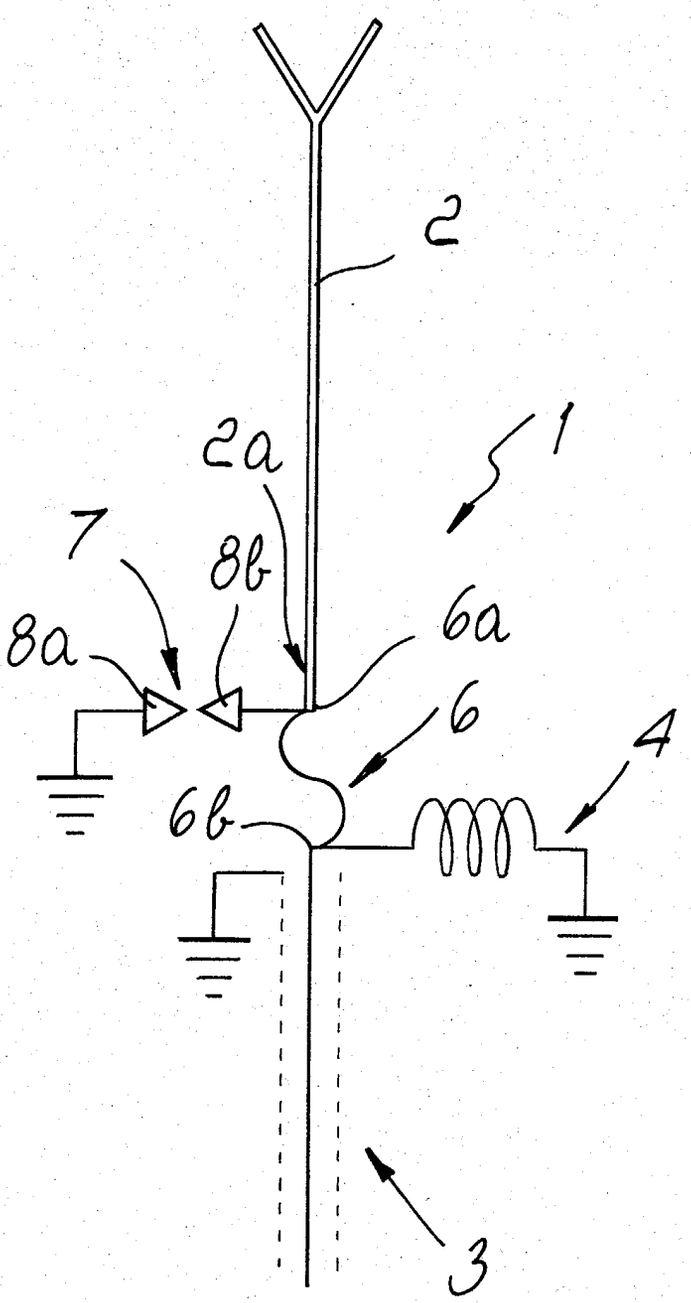

Fig. 1

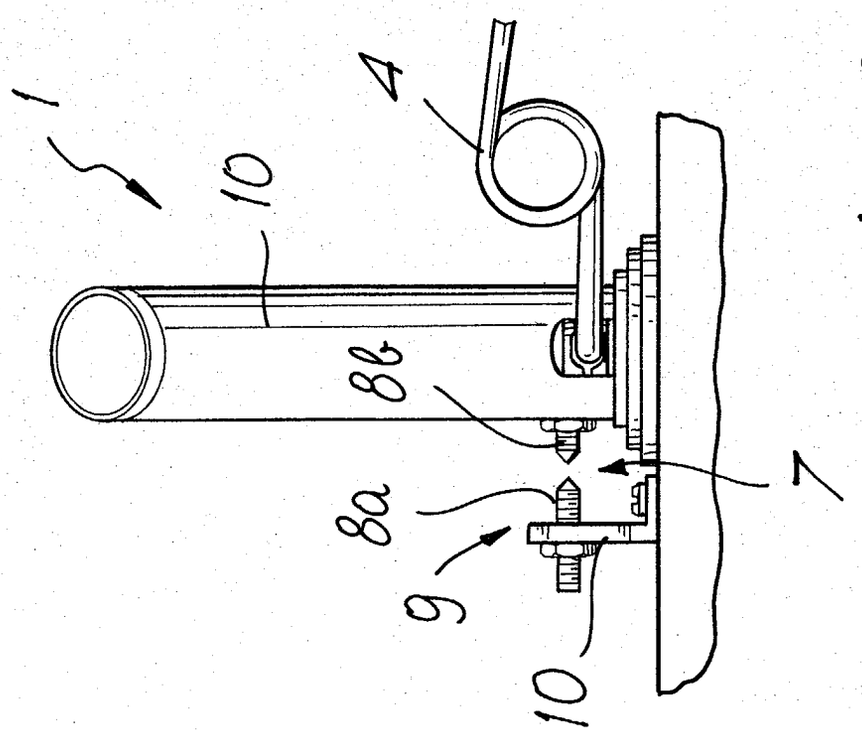

Fig. 3

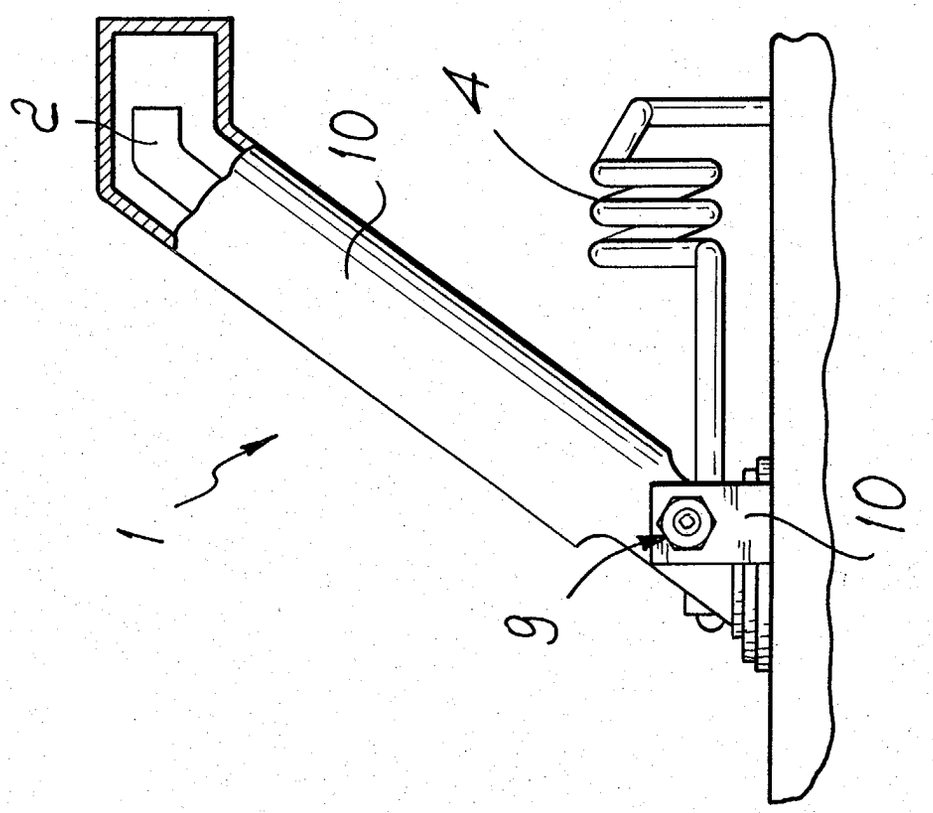

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5759

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 25 50 915 A (LICENTIA GMBH) 18 May 1977 (1977-05-18) * pages 2-4; figure *	1-6	H01Q1/50 H01Q1/42 H01Q1/32
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A	DE 201 06 188 U (DEUTSCHE BAHN AG) 19 July 2001 (2001-07-19) * pages 3,4; figures 3,4 *	1	
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A	"RESETTABLE FUSES" AUTOMOTIVE ENGINEERING, SOCIETY OF AUTOMOTIVE ENGINEERS. WARRENDALE, US, vol. 104, no. 9, 1 September 1996 (1996-09-01), pages 137-139, XP000627074 ISSN: 0098-2571 * the whole document *	5,6	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H01Q H02H
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 April 2004	Angrabeit, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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