

A SOLVENT RESPONSIVE SIGNAL-CARRYING DEVICE

This invention relates to a signal-carrying device, in particular for a security or detector system, which is responsive to the presence of a solvent.

The invention is applicable, in one sense, to a signal-carrying cable provided with a security system which is designed to protect against interference with the cable. The invention is applicable, in another sense, to a fluid-containing system, such for example an oil pipeline, having a sensor for sensing leakage of the fluid from the container.

The words 'conductor' and 'conductive' when used hereinafter should be read as including 'semi-conductor' or 'semi-conductive' whenever the context permits.

According to the one aspect of the present invention there is provided a signal-carrying device for a security or detector system comprising a conductor extending along a non-conductive surface, said conductor being composed of particulate conductive material held in a carrier medium which is soluble in at least one solvent, such that when the carrier medium

is contacted by a said solvent, it will release conductive material therefrom sufficient to interrupt the conductive path through the conductive material.

According to another aspect, the present invention provides a signal-carrying device for a security or detector system comprising at least two conductors extending along a non-conductive surface in side-by-side spaced apart relationship, at least one of said conductors being formed of particulate conductive material held in a carrier medium which is soluble in at least one solvent, such that when the carrier medium is contacted by a said solvent, it will release conductive material therefrom sufficient to interrupt the conductive path through the conductive material and/or form a short circuit between said two conductors.

According to a further aspect, the present invention provides a signal-carrying device for a security or detector system comprising at least two conductors extending in spaced-apart side-by-side relationship and insulated from each other by non-conductive material, a layer containing conductive material in a non-conductive carrier medium so printed over, or otherwise applied over, said conductors that the said conductors are not thereby electrically short

circuited, the non-conductive carrier medium being soluble in a solvent such that when said solvent is applied to the layer the non-conductive carrier will dissolve and permit the conductive material to migrate between said conductors and short circuit therebetween.

Preferably, the signal carrying device has a jacket surrounding the conductors and secured in position by adhesive, said adhesive and said carrier medium being soluble in a common solvent.

Some embodiments of the invention will now be particularly described, by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic illustration of the process of manufacture of a security cable.

Figure 2 is a section through the completed cable showing a pattern of printed conductors beneath the jacket of the cable, and

Figure 3 is a development of part of the cable of Figure 2.

The security cable shown in Figure 1 forms the subject of our copending patent application No. GB 2212644 A to which

attention is directed for a detailed explanation. For the purpose of the present invention, it is sufficient to say that a core 10 is over-wrapped by alternating layers 11, 12 of conductive tape and insulating tape 13, 14. A fifth layer 15 can be wrapped which comprises conductive strips 16 embedded in a layer of insulating material 17. The conductive layers are of a fibrous nature such that, when penetrated by a sharp instrument, conductive fibres will be carried through the intervening insulating layer and cause short-circuiting between adjacent conductive strip, and this short-circuiting can be detected by sensing apparatus connected at a selected position on the cable.

This cable, as shown, is enclosed within a jacket 18 which will be bonded to the outermost layer by a suitable adhesive.

In accordance with the first embodiment of the invention shown in Figures 2 and 3, the outermost layer 15 of the cable, which in this case is a composite layer of conductive strips 16 embedded in plastics material 17, is coated with a printed conductive coating 19. This coating, as illustrated, comprises a plurality of parallel-spaced lines 20 printed in conductive ink so that they form an electrically-conductive path which can carry a signal. The conductive ink used to form the coating (and which is described in greater detail below) comprises a

conductive filler carried in a carrier medium which is soluble in one or more solvents such that if this coating is contacted by such a solvent, one or more of the printed lines will dissolve or go into suspension. This will permit the conductive particles which it comprises to migrate and so interrupt the conductive path through the printed line or complete a short circuit with an adjacent printed line or between two conductors 16. In this event, a signal passed through the printed lines or conductors 16 will be interrupted or otherwise varied, and this variation can be detected by a sensor connected at a selected position along the cable.

It will be apparent from this specific description of a cable that the invention can be utilised in a broader aspect.

As a first example, a tape or film of non-conductive material bearing conductive strips, printed from the material described above, can be wrapped around or otherwise applied to the outside of a liquid container such as a tank or pipeline, to detect leakage of liquid from the container. The printed film will be printed by use of a conductive ink of which the carrier component is soluble in the liquid contained within the container.

As a second example, a tape or film of non-conductive material along which conductors extend in parallel-spaced relationship, (the conductors having been printed or otherwise formed) is covered with a layer of carrier medium free from conductive material, so that it forms a thin insulating layer over the conductors. A conductive layer is then printed over the insulating layer using the conductive ink.

The conductive layer can be an uninterrupted layer or printed in a pattern of lines or dots or in a random pattern. In the event of a solvent coming into contact with the printed layer it will dissolve through this layer and the insulating layer beneath it and allow conductive particles of the ink to migrate into contact with the conductors and produce short circuiting between adjacent conductors.

As a third example, a tape or film of non-conductive material along which conductors extend in parallel-spaced relationship (the conductors having been printed or otherwise formed), is overprinted with the above-described conductive ink. The ink is applied so that it does not short circuit the conductors but such that upon contact with a said solvent, conductive material will be released from, or will migrate from,

the ink to short circuit adjacent conductors. By way of example, the ink can be printed in a series of dots superimposed on the conductors and insulation such that the dot diameter is less than the insulation spacing the conductors.

The conductive printing material, referred to herein as 'ink', can comprise a particulate conductive material or filler, such as graphite, or other carbon, or a mixture thereof, and in particular is known as carbon black and foliac graphite. The conductive material will be carried in a carrier medium which is soluble in at least one solvent, and preferably in a wide range of solvents. The carrier medium can be a short chain polyester resin such as that sold under reference No. 49001 by Dupont. In order that the mixture of the conductive filler and the carrier medium may be printed, a solvent is added such as acetone.

The ink is preferably applied to a tape or film of insulating material, such as a membrane of expanded polytetrafluoroethylene, for example that sold under the registered trade mark GORE-TEX by W. L. Gore & Associates, Inc. The ink can be printed by conventional transfer printing methods on to a tape or film to which conductive terminal elements had already

been attached. The ink can be applied in straight parallel- spaced lines or in any other selected pattern from a roller or wheel on which the pattern had been etched. The lower part of the roller is arranged in a bath containing the ink, and the film to be printed is caused to move in contact with the top of the roller so that ink is picked up from the bath and transferred to the film.

CLAIMS

1. A signal-carrying device for a security or detector system comprising a conductor extending along a non-conductive surface, said conductor being composed of particulate conductive material held in a carrier medium which is soluble in at least one solvent, such that when the carrier medium is contacted by a said solvent, it will release conductive material therefrom sufficient to interrupt the conductive path through the conductive material.

2. A signal-carrying device for a security or detector system comprising at least two conductors extending along a non-conductive surface in side-by-side spaced apart relationship, at least one of said conductors being formed of particulate conductive material held in a carrier medium which is soluble in at least one solvent, such that when the carrier medium is contacted by a said solvent, it will release conductive material therefrom sufficient to interrupt the conductive path through the conductive material and/or form a short circuit between said two conductors.

3. A signal-carrying device for a security or detector system comprising at least two conductors



extending in spaced-apart side-by-side relationship and insulated from each other by non-conductive material, a layer containing conductive material in a non-conductive carrier medium so printed over, or otherwise applied over, said conductors that the said conductors are not thereby electrically short circuited, the non-conductive carrier medium being soluble in a solvent such that when said solvent is applied to the layer the non-conductive carrier will dissolve and permit the conductive material to migrate between said conductors and short circuit therebetween.

4. A signal-carrying device according to any preceding claim having a jacket surrounding the conductor or conductors and secured in position by adhesive, said adhesive and said carrier medium being soluble in a common solvent.

5. A signal-carrying device comprising a plurality of elongate conductors which have been printed in a side-by-side relationship on a non-conductive layer by the use of a conductive ink or other conductive fluid, the printed conductors being soluble in a solvent such that when contacted by the solvent, one or more conductors will be rendered fluid thereby varying the electrical properties of said one



or more conductors.

6. A signal-carrying device substantially in accordance with any one of the embodiments described herein.

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