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(54) Monitoring an electric cable core

(57) A method of, and apparatus for, continuously monitoring an advancing core having a continuous covering comprises directing X-ray radiation laterally towards the advancing covered core; continuously forming an X-ray image pattern of the advancing covered core and translating the image pattern into a visible image pattern; continuously transforming the visible pattern into a digital bit pattern; and processing the digital bit pattern using a microprocessor with interfacing electronics to provide an image profile of the advancing covered core and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the covered core and of the thickness of the covering.

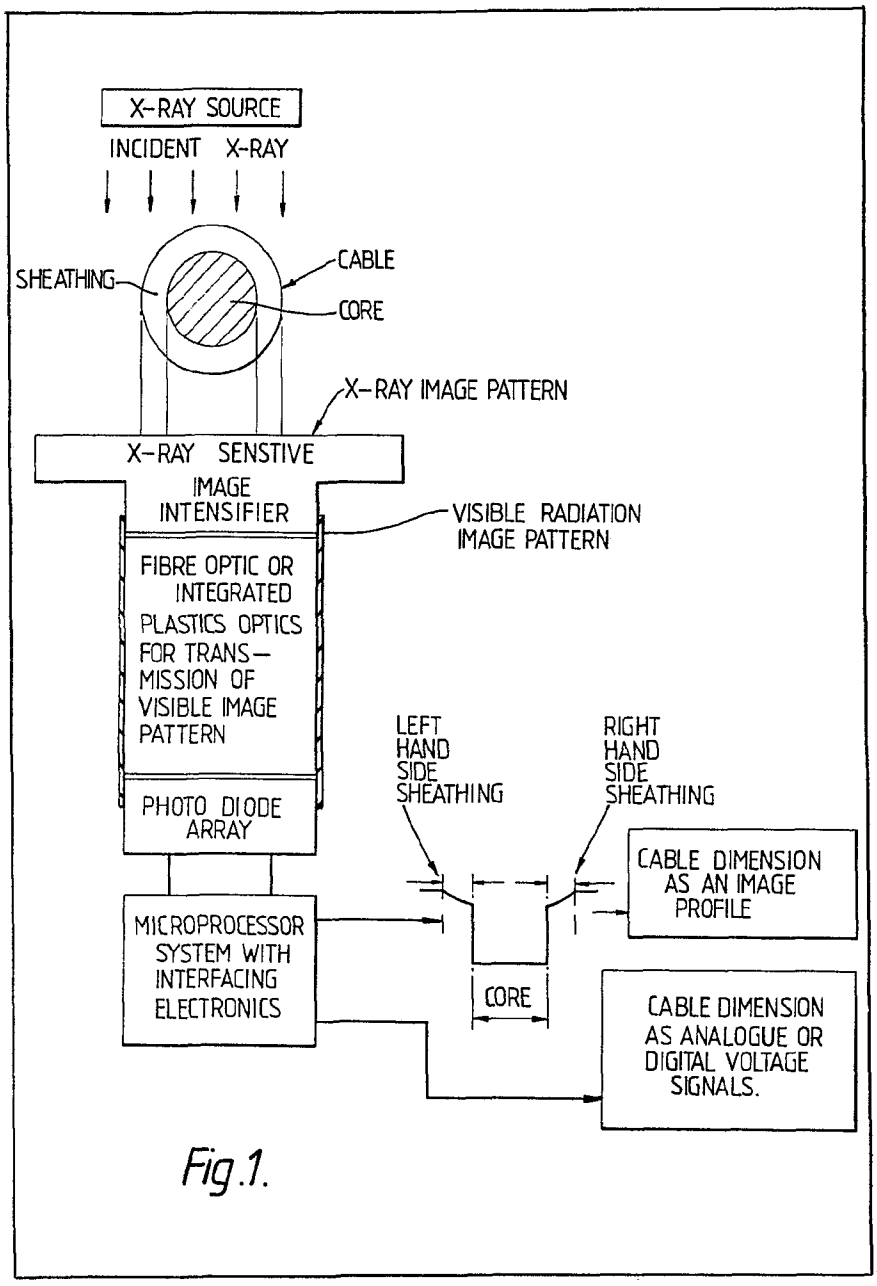

Fig.1.

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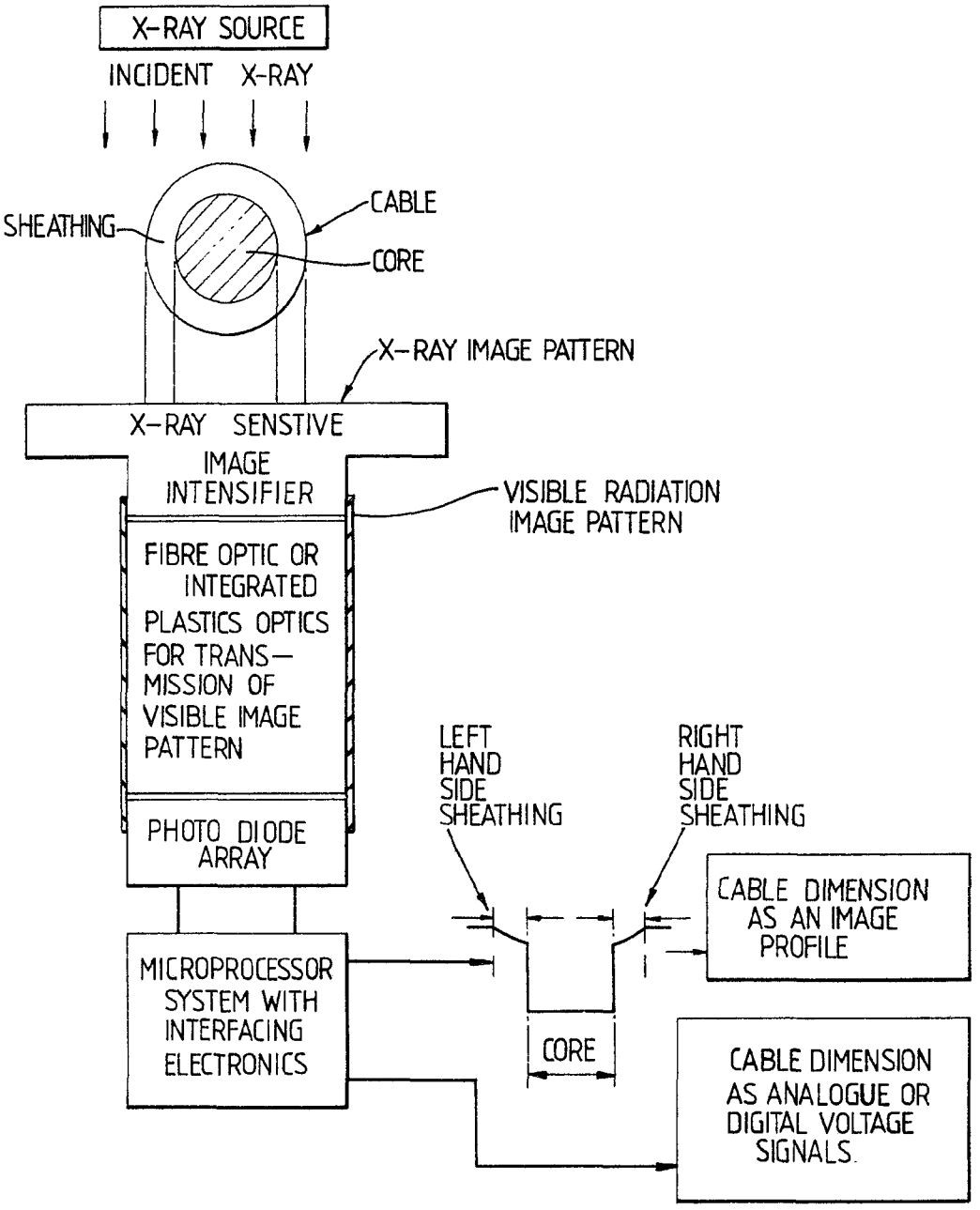
X-RAY SOURCE
INCIDENT X-RAY
SHEATHING
CABLE
CORE
X-RAY IMAGE PATTERN
X-RAY SENSTIVE IMAGE INTENSIFIER
VISIBLE RADIATION IMAGE PATTERN
FIBRE OPTIC OR INTEGRATED PLASTICS OPTICS FOR TRANS-MISSION OF VISIBLE IMAGE PATTERN
PHOTO DIODE ARRAY
MICROPROCESSOR SYSTEM WITH INTERFACING ELECTRONICS
LEFT HAND SIDE SHEATHING
RIGHT HAND SIDE SHEATHING
CORE
CABLE DIMENSION AS AN IMAGE PROFILE
CABLE DIMENSION AS ANALOGUE OR DIGITAL VOLTAGE SIGNALS.

Fig.1.

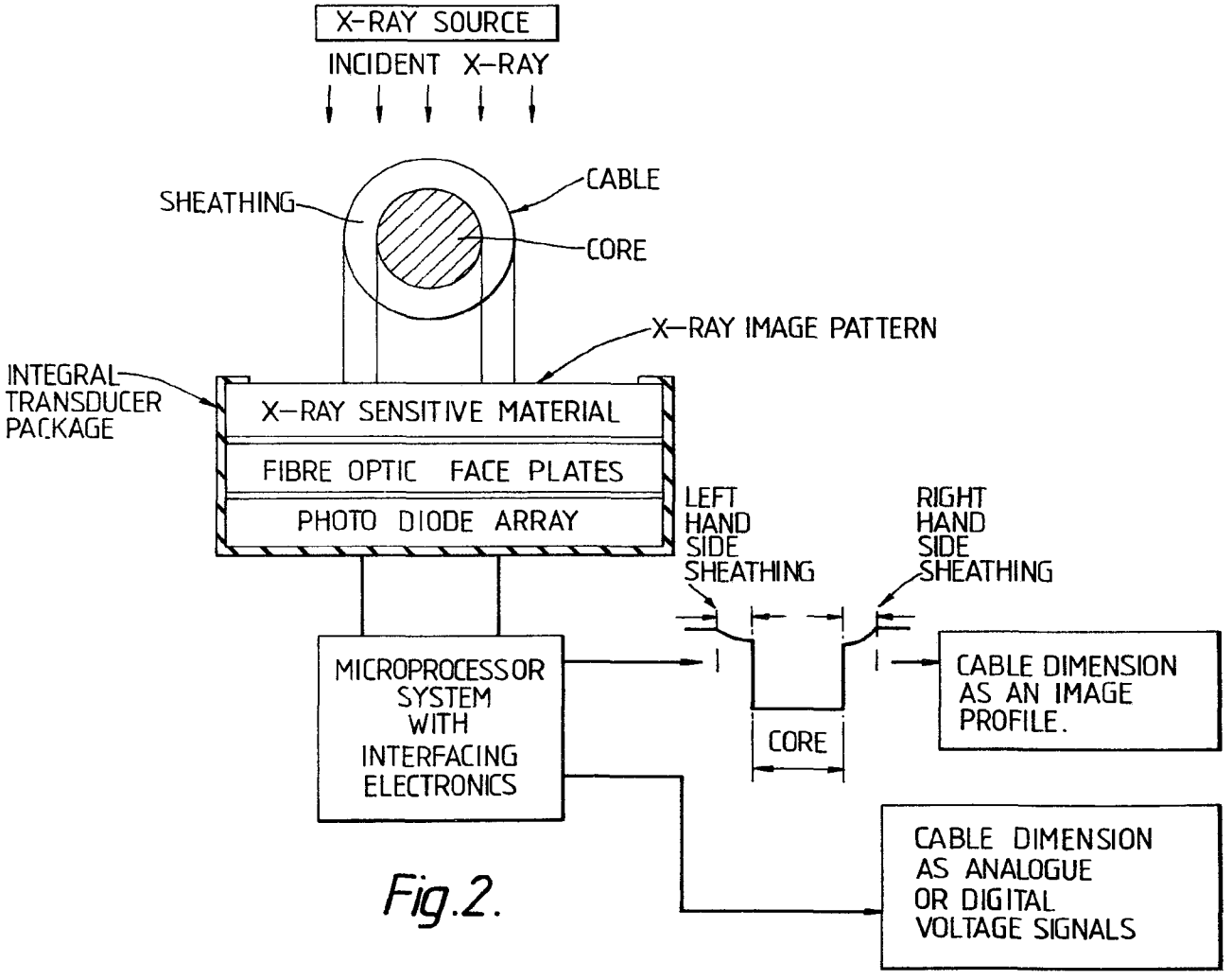

Fig.2.

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SPECIFICATION

Monitoring an electric cable core

This invention relates to the manufacture of electric cables and wires of the kind in which a layer of covering material is extruded or otherwise applied directly or indirectly on the cable or wire, which covering material may or may not incorporate additives to render it electrically conductive.

The cable or wire on to which a layer of covering material is extruded or otherwise applied may be a bare or previously covered wire or strand, or a group of bare or previously covered wires or strands constituting a cable and, for convenience, all such cables and wires will hereinafter be included in the term "core".

It is an object of the present invention to provide an improved method of continuously monitoring an advancing core on to which a continuous layer of covering material has been extruded or otherwise applied.

According to the invention, the improved method comprises directing X-ray radiation laterally towards the advancing covered core; continuously forming an X-ray image pattern of the advancing covered core and translating the image pattern into a visible radiation image pattern; continuously transforming the visible radiation image pattern into a digital bit pattern; and processing the digital bit pattern using a microprocessor with interfacing electronics to provide an image profile of the advancing covered core and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the covered core and of the thickness of the covering.

Preferably, the analogue and digital signals are employed to control, through a feedback loop, automatic adjustment of at least one of extrusion apparatus extruding the covering on the core (e.g. the speed of the extruder screw), the extrusion orifice and a haul-off device drawing the core through the extrusion apparatus, the correct for any variation of the diameter and eccentricity of the covered core and/or thickness of the covering from a predetermined value or predetermined values.

The invention also includes improved apparatus for continuously monitoring a covered core to which the covering has been applied, which monitoring apparatus comprises means for directing X-ray radiation laterally towards the covered core as it advances in the direction of its length; means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern; means for continuously transforming the visible radiation image pattern into a digital bit pattern; and a microprocessor with inter-facing electronics for processing the digital bit pattern to provide an image profile of the advancing covered core and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the covered core and of the thickness of the covering.

The means for continuously transforming the visible radiation image pattern into a digital bit pattern preferably comprises a photo-diode array.

In one preferred apparatus that can be used in conjunction with low-energy X-ray sources, the means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern comprises an X-ray sensitive image intensifier which is coupled to an optical link which may comprise either optical fibres and/or integrated plastics optics.

In a second preferred apparatus, the means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern comprises a layer of X-ray sensitive material which is coupled to at least one fibre optic face-plate. Where a photo-diode array is present, preferably the X-ray sensitive material, said at least one fibre-optic faceplate and the photo-diode array are integrated into a single component. The second preferred apparatus is a more compact package than the first preferred apparatus but needs a higher level of X-ray energy for excitation.

The invention is further illustrated, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic representation of a first preferred apparatus for continuously monitoring an advancing covered core; and

Figure 2 is a schematic representation of a second preferred apparatus for the same purpose.

The apparatus shown in Figure 1 comprises a low energy X-ray source from which X-rays are directed laterally towards an advancing cable comprising a central core and outer sheathing. An X-ray image pattern of the advancing cable is continuously formed and translated into a visible image pattern by an X-ray sensitive image intensifier which is coupled to an optical link. A photo diode array continuously transforms the visible image pattern in to a digital bit pattern, and is coupled to a microprocessor with interfacing electronics. The microprocessor processes the digital bit pattern to provide an image profile of the advancing cable and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the cable and of the thickness of the sheath.

In the alternative apparatus shown in Figure 2 a higher energy X-ray source is used. In this case an X-ray sensitive material, a number of fibre-optic face plates and a photo-diode array are packaged together as a single component. This package continuously forms the X-ray image pattern, translates it into a visible image pattern, and transforms the visible pattern into a digital bit pattern.

CLAIMS

1. A method of continuously monitoring an advancing core on to which a continuous layer of

covering material has been extruded or otherwise applied, which method comprises directing X-ray radiation laterally towards the advancing covered core; continuously forming an X-ray image pattern of the advancing covered core and translating the image patern into a visible radiation image pattern; continuously transforming the visible radiation image pattern into a digital bit pattern; and processing the digital bit pattern using a microprocessor with interfacing electronics to provide an image profile of the advancing covered core and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the covered core and of the thickness of the covering.

2. A method as claimed in Claim 1, wherein the analogue and digital signals are employed to control, through a feedback loop, automatic adjustment of at least one of extrusion apparatus extruding the covering on the core, the extrusion orifice, and a haul-off device drawing the core through the extrusion apparatus, to correct for any variation of the diameter and eccentricity of the covered core and/of thickness of the covering from a predetermined value or predetermined values.

3. Apparatus for continuously monitoring a covered core to which the covering has been applied, which monitoring apparatus comprises means for direction X-ray radiation laterally towards the covered core as it advances in the direction of its length; means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern; means for continuously transforming the visible radiation image pattern into a digital bit pattern; and a microprocessor with interfacing electronics for processing the digital bit pattern to provide an image profile of the advancing covered core and/or to provide analogue and/or digital signals indicative of the overall diameter and eccentricity of the covered core and of the thickness of the covering.

4. Apparatus as claimed in Claim 3, wherein the means for continuously transforming the visible radiation image pattern into a digital bit pattern comprises a photo-diode array.

5. Apparatus as claimed in Claim 3 or Claim 4, wherein the means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern comprises an X-ray sensitive image intensifier which is coupled to an optical link which may comprise either optical fibres and/or integrated plastics optics.

6. Apparatus as claimed in Claim 3 or Claim 4, wherein the means for continuously forming an X-ray image pattern of the advancing covered core and for translating the image pattern into a visible radiation image pattern comprises a layer of X-ray sensitive material which is coupled to at least one fibre optic face-plate.

7. Apparatus as claimed in Claim 6 in which the means for continuously transforming the visible radiation image pattern into a digital bit pattern comprises a photo-diode array, wherein the photo-diode array, the layer of X-ray sensitive material and said at least one fibre optic face-plate are integrated into a single component.

8. Apparatus for continuously monitoring a covered core to which the covering has been applied substantially as illustrated in Figure 1 or Figure 2 of the accompanying drawings.

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