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(54) **FLAT CABLE WITH SIGNALLING EFFECT**

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EP-A1- 2 444 230

EP-A1- 2 701 139

US-A1- 2005 092 517

US-A1- 2010 164 409

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Description

Technical Field

[0001] The present invention relates to flat cables with a longitudinal dimension and a lateral dimension, in particular with loading capacity and signalling means. The present invention further relates to methods for manufacturing such flat cables and uses thereof, all according to the preambles of the independent claims.

Background of the Invention

[0002] Safety barriers and delimitations exist for a variety of purposes. In its most basic and archaic form, a fence delimits a terrain and signals an explicit desire of an entitled party to not have third parties cross a certain boundary. One of the simplest ways of arranging a fence is to draw a cord along a perimeter defined by a plurality of posts driven into the ground. The cord itself does not impose an actual, physical hindrance to most persons trespassing, but confers the intended purpose nonetheless, namely by means of being itself an optical and perceptible signal easily understood.

[0003] In modern applications and industrial environments, such delimitations more often than not are intended at safeguarding people's health by preventing them from interacting with or moving into a zone where operations by machines or robots may pose a health risk for the said person. Visibility and the potential to actually physically constrain from trespassing, also with machines or vehicles, is thus of paramount importance in industrial areas. To ensure clear visibility around the clock, at night or in otherwise only dimly lit environments, the lighting is kept operational way beyond actual operation hours. This is costly though.

[0004] There is thus a need for a rugged and robust means for delimiting an area and/or providing a readily perceptible optical signal.

[0005] US 7'645'939 B2 describes a retroreflecting metal wire product. The document discloses a rope with an elongated, cylindrical structure. The wire product shown is intended to be used in a wide scope of possible applications: as spoke for bicycle wheels, to delimit motorways or even for advertising purposes. The cable consists of a metal wire, possibly a stranded rope, and one or more coating polymers, that covers said metal wires. In the coating layers, retroreflective beads are incorporated. The thus resulting metal wire product has only a limited surface area available for coating and equally, the surface area directly facing an observer at any time is limited. The circumferentially round structure can also pose a security threat if the cable is approached with high velocity, such as it might be the case for the use in delimiting roadways when an accident happens.

[0006] DE 10 2004 021 002 A1 describes an electrical cable that is supplemented with light emitting elements for increased visibility. The electrical cable is further

equipped with illuminating leads or enwrapped in illuminating sheets. The document further proposes advanced materials, such as plastics that can be excited by applying tension as illuminants. The intended application is the electronics industries and is particularly useful in dim server rooms or for distinguishing cables in environments with a complex wiring. Further, the lighting can be used as an indicator on whether the power is on for a particular cable. The cables shown have no load bearing capacity whatsoever though and are not well suited for rugged environments or any applications requiring stability of the cable. The round circumference of the cables shown is further disadvantageous for increasing perceptibility on a large scale.

[0007] EP 2 701 139 A1 discloses a light-emitting device which has a generally flat shape. The light-emitting units are arranged in a row at regular intervals. Leads which serve as a first conduction path for supplying electric power to the light-emitting units are flexible. All parts are entirely sealed by a flexible band-shaped light-transmitting sealing sheet.

[0008] US 2005/092517 A1 discloses a flexible LED cable light which has a flat insulation body, at least two wires embedded in parallel in the insulation body, multiple LEDs connected in parallel electrically to the two wires and a protective layer covering the insulation body. Each wire has high flexibility, good conductivity and large current-resistant that is suitable to decorate over long distances.

[0009] EP 2 444 230 A1 discloses a LED-band which is produced with the help of an extruding tool. It comprises a LEDs mounted on a carrier band comprising conductor paths. This equipped carrier band is embedded in a transparent plastic body.

[0010] US 2010/ 164 409 A1 discloses an integrally formed LED light wire containing a plurality of LEDs that are connected on a mounting base. The mounting base provides electrical connection and a physical mounting platform or a mechanical support for the LEDs. The mounting base and LEDs are encapsulated in a transparent or semi-transparent encapsulant which may contain light scattering particles. The encapsulant provides protection against environmental elements, such as water and dust, and damage due to loads placed on the integral LED light wire.

Summary of the Invention

[0011] It is an object of the present invention, to provide a cable, a method for manufacturing a cable and uses thereof, all pertaining to the above referenced technical field, that solves at least one of the problems noted above. It is a further particular object of the present invention to create a cable with a loading capacity that provides an improved perceptibility and is easy and cost efficient to manufacture. It is another particular object of the present invention to provide a cable that is stress resistant and highly visible.

[0012] One aspect of the present invention is a flat cable with a longitudinal dimension and a lateral dimension. The flat cable comprises a polymeric carrier material which essentially defines the outer shape of the flat cable and is arranged such that the flat cable features at least one planar surface. The polymeric carrier material can also be a composite, comprising itself a number of different polymers. In a particular embodiment, the polymeric carrier material comprises a single, homogenous polymer. In an alternative embodiment, the polymeric carrier material comprises two or more, heterogeneous polymers, such as for instance a layered structure where successive layers of polymers form the polymeric carrier material. In a further particular embodiment of the present invention, the polymeric carrier material is further reinforced, for instance reinforced with fibres. Suitable fibres would be fibres of glass. Suitable polymers for forming the polymeric carrier material are known to the skilled artisan and can be selected from the group consisting of: epoxies, thermoplastics and/or thermosetting plastics. In a preferred embodiment, the polymeric material comprises a thermoplastic material which retains a certain degree of elasticity in solid state, preferably in the temperature range of between - 50 °C up to 100 °C. This elastic modulus is preferably chosen such that an elastic bending is possible in the longitudinal direction of the flat cable. In a particular embodiment, the polymeric carrier material comprises a polymer with a shore A hardness of between 20 and 100.

[0013] The flat cable of the present invention further comprises at least one load bearing element. These load bearing element(s) extend in the longitudinal direction of the flat cable and, in the case of more than one of them, are preferably arranged essentially parallel to each other. The load bearing element(s) are embedded into the polymeric carrier material. In the context of the present invention, embedded shall be understood as at least partially covered by the polymeric carrier material. For instance, a load bearing element can extend in the longitudinal dimension of the flat cable and be embedded in the polymeric carrier material, such that at least 10% of its circumference is covered by polymeric carrier material, preferably at least 50% of its circumference is covered by polymeric carrier material and even more preferred, the load bearing element is entirely or almost entirely except for maybe one or two end pieces, covered by the polymeric carrier material. The load bearing element may comprise interstices on its circumferential surface. In this scenario, the embedding into the polymeric carrier material can encompass the polymeric carrier material permeating the said interstices. This would result in a particularly stable flat belt.

[0014] A load bearing element in the sense of the invention is a flexible, elongated and designed to have at least a given load bearing capacity. The tensile strength in longitudinal direction of the load bearing element is preferably higher than the tensile strength of the carrier material. The load bearing element elongates less than

the carrier material when subject to the same pulling force. The load bearing element of the cable carries the load on the cable, while carrier material, and preferably also the means for emitting or reflecting light, are carried by the load bearing element. The load on the cable can be its own weight between its suspension points and/or additional pulling forces transmitted by the cable.

[0015] In a particular embodiment of the present invention, cable has a load bearing capacity of at least 1000 N/mm², in particular from 1000 to 2100 N/mm², even more particularly from 1300 to 1700 N/mm². In a preferred embodiment, at least one of load bearing elements, preferably all load bearing elements, is selected such as to exhibit the said load bearing capacities, especially a tensile strength of at least 100 N/mm², in particular at least 500 N/mm², even more particularly at least 1000 N/mm², especially at least 2000 N/mm². In another embodiment, the load bearing element has a tensile strength from 1000 to 2100 N/mm², in particular from 1300 to 1700 N/mm². In a preferred embodiment, the wire cable is selected such as to exhibit the said load bearing capacities.

[0016] In one embodiment, the flat cable comprises a plurality of load bearing elements: This has the advantage, that there is a larger contact area between the polymeric carrier material and the load bearing elements and therefore an improved contact.

[0017] In another embodiment, the flat cable comprises only one load bearing element. This makes the production easier and reduces therefore the costs.

[0018] In one embodiment of a cable with a plurality of load bearing elements, every one of the load bearing elements runs in parallel to the longitudinal dimension of the cable. In this way, there is a redundancy given for the case of a failure in one of the load bearing elements.

[0019] In an embodiment of a cable with a plurality of load bearing elements, at least one of the load bearing elements runs in an angle of greater than 0° with respect to the longitudinal dimension of the cable. If there are shear forces along the longitudinal dimension of the cable acting on the carrier material, these forces push the carrier material again parts of the load bearing element with a certain angle towards other load bearing elements. A connection subject to pushing forces is in most cases less likely to fail compared to a connection subject to shear forces. Therefore, this embodiment can improve stability of the cable with respect to shear forces.

[0020] In an embodiment of a cable with a plurality of load bearing elements, at least one of the load bearing elements runs in an angle of greater than 0° towards at least one of the other load bearing elements. Such an arrangement can also show an improved stability of the cable with respect to shear forces but lowers at the same time the tensile forces acting on the carrier material when a not-parallel running load bearing element is subject to a tension force.

[0021] The at least one load bearing element comprises a fibre. A fibre is a flexible and, compared to its length,

thin element. The ratio of length to thickness of a fibre should be at least 3:1, but it is typically much larger like e.g. 1000:1 and there are also essentially endless fibres which are directly produced in any desired length. A fibre cannot take a compressive force very well as it bends. However, fibres can handle tensile forces. Preferably, a wire is stiffer and therefore less flexible than a fibre and can be produced in arbitrary lengths.

[0022] In particular, in the present context, a fibre predominately consists of a non-metallic material and/or of an organic material, especially a polymeric material. Especially, a fibre consists of more than 50 wt.-%, particularly of more than 75 wt.-%, advantageously completely, of a non-metallic material and/or of an organic material, especially a polymeric material.

[0023] Particularly, in the present context, a wire predominately consists of a metallic material, a metallic alloy or of a metal. Especially, a wire consists of more than 50 wt.-%, particularly of more than 75 wt.-%, advantageously completely, of a metallic material, a metallic alloy or of a metal. Both, wires and fibres can handle tensile forces and can have tensile strengths as required for a load bearing element. In one embodiment, the load bearing element consists only of a wire, a fibre or of a plurality of wires and/or fibres which are independent of each other. In another embodiment, the load bearing element comprises wires and/or fibres which are at least partially in contact with each other. This contact can be established by contact means like interconnecting bridges or clamps or additional wires or fibres connecting the wires and/or fibres running in longitudinal dimension with each other, or by arranging the wires and/or fibres running in longitudinal dimension in a suitable manner like for example stranding or braiding or weaving.

[0024] In another embodiment, the load bearing element is realised as one or more chains of flexibly connected, but in itself stiff parts.

[0025] In one embodiment, at least one of the fibres or the wires is of essentially the same length as the longitudinal dimension of the cable. This has the advantage that there are no connection regions inside the cable, where the tension applied on one fibre or wire has to be transmitted to other fibres and/or wires.

[0026] In one embodiment, all fibres or wires are of essentially the same length as the longitudinal dimension of the cable. In this case, a redundancy is given without the need for connection regions between shorter fibres and/or wires.

[0027] In another embodiment, all fibres and wires which are part of the load bearing element are shorter than the longitudinal dimension of the cable. This has the advantage that fibres and wires can be produced independently of the dimension of the cable and/or that leftover pieces of other productions can be reused. Further, some fibres can only be produced in a maximum length and this embodiment allows the use of such fibres in cables of arbitrary length.

[0028] In one embodiment, the at least one load bear-

ing element is at least partially stranded. Stranding wires and/or fibres allows distributing the tensile forces between them while preserving at least some of the flexibility of the single wires or fibres.

[0029] In another embodiment, the load bearing element consists only of parallel running wires and/or fibres. This has the advantage that there is less friction between the wires and/or fibres which increases their lifetime.

[0030] In one embodiment, the flat cable of the present invention further comprises at least one, preferably a plurality, of wire ropes, in particular metallic wire ropes. These, in particular metallic, wire ropes extend in the longitudinal direction of the flat cable and, in the case of more than one of them, are arranged essentially parallel to each other. The, in particular metallic, wire rope(s) are embedded into the polymeric carrier material. In the context of the present invention, embedded shall be understood as at least partially covered by the polymeric carrier material. For instance, a metallic wire rope can extend in the longitudinal dimension of the flat cable and be embedded in the polymeric carrier material, such that at least 10% of its circumference is covered by polymeric carrier material, preferably at least 50% of its circumference is covered by polymeric carrier material and even more preferred, the metallic wire rope is entirely or almost entirely subject to maybe one or two end pieces, covered by the polymeric carrier material. A metallic wire rope according to the present invention comprises two or more strands of metal wire that are twisted around each other, such that a rope structure ensues. The number of strands used, as well as the exact pattern of laying the rope can be made subject on the final load capacity intended for the flat cable thus equipped and is therefore mostly discretionary for the person skilled in the art. For the present invention, metallic wire ropes consisting of between 2 to 300 metallic wire strands have been proven particularly suitable. The stranded rope most probably will comprise interstices on its circumferential surface, due to the single strands being helically wound or twisted around each other. In this scenario, the embedding into the polymeric carrier material can encompass the polymeric carrier material permeating the said interstices. This would result in a particularly stable flat belt. Preferably the metallic wire ropes are from a metallic material such as iron or steel, preferably steel.

[0031] A fibre rope according to the present invention comprises two or more strands of fibres that are twisted around each other, such that a rope structure ensues.

[0032] A mixed rope according to the present invention comprises two or more strands of fibres and wires or at least one strand of fibres and one strand of wires or at least one strand of fibres and wires and one strand of only fibres or only wires that are twisted around each other, such that a rope structure ensues.

[0033] In one embodiment, the flat cable of the present invention further comprises at least one, preferably a plurality, of fibre ropes and/or mixed ropes and/or fibres and wires. These fibre ropes and/or mixed ropes and/or fibres

and wires extend in the longitudinal direction of the flat cable and, in the case of more than one of them, are arranged essentially parallel to each other. The fibre ropes and/or mixed ropes and/or fibres and wires are embedded into the polymeric carrier material. In the context of the present invention, embedded shall be understood as at least partially covered by the polymeric carrier material. For instance, a fibre rope and/or a mixed rope and/or a fibre and a wire can extend in the longitudinal dimension of the flat cable and be embedded in the polymeric carrier material, such that at least 10% of its circumference is covered by polymeric carrier material, preferably at least 50% of its circumference is covered by polymeric carrier material and even more preferred, the fibre rope and/or mixed rope and/or fibre and wire is entirely or almost entirely subject to maybe one or two end pieces covered by the polymeric carrier material. The number of strands of the wire or fibre rope used, as well as the exact pattern of laying the rope can be made subject on the final load capacity intended for the flat cable thus equipped and is therefore mostly discretionary for the person skilled in the art. For the present invention, fibre or mixed rope consisting of between 2 to 300 wires, fibres or mixed strands have been proven particularly suitable. The stranded rope most probably will comprise interstices on its circumferential surface, due to the single strands being helically wound or twisted around each other. In this scenario, the embedding into the polymeric carrier material can encompass the polymeric carrier material permeating the said interstices. This would result in a particularly stable flat belt.

[0034] The flat cable of the present invention further comprises at least one means for emitting and/or for reflecting light. A means for emitting light is, in the context of the present invention, a source that emits electromagnetic radiation in the spectrum visible to the human eye. A means for reflecting light is not a source of light by itself, but a device that is adapted by its structure and components to reflect light from a source. The reflection can be either back to the source, for instance with a retroreflector, or in a particular determined angle. The reflection can comprise a certain degree of scattering, or be adapted such as to minimize scattering. The flat cable can comprise either, means for emitting and means for reflecting light, as well as just one of the two. It can also comprise a multitude of means for reflecting light combined, or for emitting light, respectively.

[0035] The flat cable of the present invention provides several advantages over a standard, round circumference cable. The dimensions of the flat cable and the construction principle with the polymeric carrier material make it more durable than a conventional cable with a round circumference. The flat cable can be utilized for a wide range of purposes and is equally well suited for static applications, such as delimiting an area, as for dynamic applications, such as in a conveyor arrangement. The flat cable according to the present invention is particularly useful, when an increased visibility and optical percepti-

bility is required. The resulting flat cable is a self-luminous belt that is mechanically resistant to shocks or other forms of mechanic stress.

[0036] In a particular embodiment, the means for emitting light of the flat cable according to the present invention is an illuminant.

[0037] In the context of the present invention, an illuminant shall be understood as any source capable of emission of light such as, for example, a lamp, such as an incandescent lamp, a light emitting diode, or a fluorescent, such as a fluorescent lamp or a luminescent.

[0038] In a particular embodiment of the present invention, the means for reflecting light is a retroreflector. A retroreflector is a particular form of reflecting device or surface that reflects light back to its source. An electromagnetic wave is reflected back along a vector that is parallel to, but opposite in direction, to a vector that stems from a source of the wave and is directed at the retroreflector. The retroreflector can be comprised of different structures adapted at providing the desired effect. Suitable structures can be formed with polished glass beads (so called cat's eyes), cube corner reflectors, varying prismoid forms etc. Very suitable retroreflective coatings can be derived from US 2011/043914 A, where corner cubes, microsphere retroreflectors, or wide angle exposed retroreflective lenses are thermally bonded to a flexible polymeric sheet and finally applied on a rope. A retroreflective structure can comprise a light access surface at a front side, a reflection surface and a coating at a rear side. One or more of these structures can be embedded as outlined above into the polymeric carrier material in one particular embodiment. In this embodiment, the polymeric carrier material could be chosen such as to comprise an essentially translucent polymer layer on its most peripheral layer, if counting from the middle of the flat cable.

[0039] In one particular embodiment of the present invention, the metallic wire rope is a stranded rope. In the context of the present invention, a stranded rope shall be understood as a rope following a certain base assembly of wire strands. For stranded ropes, a multitude of wire strands are laid helically in one or more layers around a core wire. The core wire can be a wire strand itself, or can be a hollow tube for a fibre core. Alternatively, the core wire can be from a different material, for instance a different metal than the rest of the stranded core. In one particular example, the core wire has a different elasticity than the rest of the stranded rope. In another particular example, the core wire is replaced with a fibre core. In the resulting flat cable according to this particular embodiment of the present invention, one or more of the wire ropes can be stranded types in any configuration.

[0040] In one particular embodiment of the present invention, the fibre rope or mixed rope is a stranded rope. In the context of the present invention, a stranded rope shall be understood as a rope following a certain base assembly of fibre or mixed strands. For stranded ropes, a multitude of fibre or mixed strands are laid helically in

one or more layers around a core wire or a core fibre. The core wire can be a wire strand or a fibre strand or a mixed strand itself, or can be a hollow tube for a fibre core. Alternatively, the core wire can be from a different material, for instance a metal or a fibre not used in the rest of the stranded rope. In one particular example, the core wire has a different elasticity than the rest of the stranded rope. In another particular example, the core wire is replaced with a fibre core. In the resulting flat cable according to this particular embodiment of the present invention, one or more of the fibre ropes or mixed ropes can be stranded types in any configuration.

[0041] In a particular embodiment, the load bearing elements, in particular a plurality of fibre ropes and/or mixed ropes and/or fibres and wires, are distributed evenly in a cross section of the polymeric carrier material, e.g. they are all equally distanced towards another.

[0042] In a particular embodiment, the metallic wire ropes are distributed evenly in a cross section of the polymeric carrier material, e.g. they are all equally distanced towards another.

[0043] In a particular embodiment, the means for emitting and/or reflecting light is embedded into the polymeric carrier material.

[0044] In a particular embodiment of the present invention, the means for emitting and/or reflecting light is arranged on or in the at least one planar surface of the flat cable. In the context of the present invention, the means above can be arranged on the planar surface, when they protrude at least partially from the polymeric carrier material. This can be the case, for instance, when beads are partly embedded in the polymeric carrier material, such that they are at least a part of the bead protrudes from the polymeric carrier material. For such an exemplary embodiment, the polymeric carrier material can be supplemented with a matrix material that provides the background for the beads, i.e. can act as a coating at a rear side, as described above already. Alternatively or additionally, a tape comprising a retroreflecting coating can be adhered on the planar surface, without any immersion or embedding into the polymeric carrier material. This would also qualify as being arranged on the planar surface. A means for reflecting and/or emitting light would be arranged in the at least one planar surface, when the said means is embedded into the polymeric carrier material, as described above for the metallic wire ropes and in analogous manner, but such that the light can be either reflected or emitted through the said planar surface.

[0045] In a particular embodiment, the flat cable is arranged such that there exist at least two planar surfaces, preferably exactly four planar surfaces. In a further preferred embodiment of this embodiment, two planar surfaces have a surface area that is larger than the surface area of the other two planar surfaces.

[0046] In a particular embodiment, the flat cable further comprises at least one wire for electrical signal transmission, in particular, the flat cable further comprises at least one copper cable. The wire for electrical signal transmis-

sion can be arranged end to end, i.e. such that the signal transmission is performed from terminal end of the flat cable to terminal end of the flat cable, or such that energy sinks along the longitudinal extension of the flat cable can be served. In one particular example, the energy sinks are means for emitting light, such as for instance light sources such as incandescent or fluorescent lamps, light emitting diodes etc. Alternatively, the further wire for electrical signal transmission can be arranged such as to transmit signals or electricity from points along the longitudinal extension of the flat cable to the terminal ends of the flat cable. With this embodiment, it is possible to manufacture smart flat cables with enhanced safety purposes, for instance delimiting areas or operating conveyors. Such cables provide the further advantage of failure mode detection along their longitudinal extension or can be controlled in the functionality, the emission of light, for instance, by peripheral systems that are connected to the terminal ends of the flat cable. In one particular embodiment, sensors can be installed either on the peripheral terminal ends of the flat cable or along the flat cable's longitudinal extension, which can be functionally connected with one or more further wires for electrical signal transmission. In a particular embodiment, the further wire for electrical signal transmission comprises an isolation such as, for instance, a polymeric coating. In another particular embodiment, the flat cable comprises a bundle of further wires for electrical signal transmission and/or a multitude of further wires for signal transmission. In a particular embodiment, the said further wire is a twisted pair cable such as, for instance, an ethernet cable, preferably a cable according to ISO/IEC 11801.

[0047] In a particular embodiment of the flat cable, the said further wire for electrical signal transmission is further adapted at providing electrical energy to the at least one means for emitting light.

[0048] In a particular embodiment of the present invention, the flat cable comprises at least one further wire for electro optical signal transmission, in particular it comprises a fibre cable. Such a fibre cable can be a waveguide as known to the skilled artisan for transmitting light between the two ends of a fibre, which can protrude from the terminal ends of the flat cable, or along the longitudinal extension of the flat cable at any predetermined point. The waveguide itself can thus be used as a means for emitting light. The fibres can be bundled, coated or impregnated and be installed within a jacket, as common in the industry. In a particular embodiment, a tube defining a hollow shaft traverses the flat belt in longitudinal direction and serves at accommodating the fibre cable(s). In a particularly preferred embodiment, the tube is a steel tube or an aluminium tube. In a particular embodiment, the fibre cable can also be used to transmit electrical energy along the longitudinal extension of the flat cable, either from points along the longitudinal extension of the flat cable to the terminal ends or any energy sinks along the longitudinal extension of the flat cable, or vice versa, from the peripheral terminal ends of the flat cable to points

along the longitudinal extension of the flat cable. It is also possible to arrange the fibre cables such that these two features can be combined. In these particular embodiments, where the fibre cables can further serve at transmitting electrical energy, the flat cable comprises photovoltaic cells, for converting light into electrical energy. It would be thus be further possible, to feed sources of light, i.e. means for emitting light, along the flat cable with photovoltaic cells arranged on the flat cable, such as for instance on or next to the planar surface formed by the polymeric carrier material. This would be possible without the need of optical fibre cables. In a further particular embodiment, the waveguide would be adapted to provide illumination.

[0049] An embodiment of the present invention with optical fibre cables would be particularly advantageous for operating and providing safety delimitation of areas, where immunity to electromagnetic interference would be important. This would be the case in, near or around MRI (magnetic resonance imaging) equipment or also for various military and defence usages. For this particular application, it would be favourable to replace the metallic wire ropes with steel-like polymeric cables or to use other fibres as load bearing elements.

[0050] In a further particular embodiment of the present invention comprising a fibre cable, the fibre cable is arranged for distributed sensing of fire detection, strain detection, leak detection, thermal measurement, etc. Distributed sensing optical cables are known in the art and suitable sensors could be the ones described in "Truly distributed strain and temperature sensing using embedded optical fibres" (Thévenaz, L., et al., Structures and Materials 1998: Sensory Phenomena and Measurement Instrumentation for Smart Structures and Materials, Richard O. Claus; William B. Spillman; Eds., pp.301-314, 1998.).

[0051] In a particular embodiment, the polymeric carrier material is selected out of polymers that remain stable under prolonged environmental exposure, preferably the said polymers remain stable while under constant UV exposure. Preferably the polymeric carrier material is selected such, that it essentially maintains elasticity and does not become brittle for a time span of at least 5 years, preferably elasticity does not decrease for more than 5% per year.

[0052] In a particular embodiment of the present invention, the at least one means for emitting and/or for reflecting light are coated onto the surface of the flat cable, in particular are coated onto the at least one planar surface. This could be achieved, for instance, by a coating that contains granulated or powdered reflective elements such as a glitter material. In a further particular embodiment, the flat cable is coated with luminous paint. Such paints are known to the skilled artisan and are often either of the glow or afterglow type. They emit light when and eventually for a certain amount of time after being exposed to electromagnetic waves, most particularly to UV radiation. Suitable paint can be fluorescent, phosphores-

cent or radioluminescent. In an even more particular embodiment, the luminous paint is applied with a layer of resin on at least one of the planar surfaces of the flat cable. Different types, colours or chroma of luminous paint can be combined, such as to confer further information out of resulting markings on the flat cable.

[0053] In a particular embodiment of the present invention, the at least one means for emitting and/or for reflecting light are adhered onto the surface of the flat cable, in particular onto the at least one planar surface. Adhesion as herewith used, can be permanent, by utilizing a bonding agent which reacts with the surface of the polymeric carrier material, or reversible, by utilizing a velcro type hook and loop fastening. In a particular embodiment, the means for emitting and/or for reflecting light are part of an adhesive tape that is glued onto the surface of the flat cable. An alternative and also reversible way of adhering the least one means for emitting and/or for reflecting light is the use of magnets in either or at least one of the flat cable and the means for emitting and/or for reflecting light. In the case only the at least one of the flat cable and the means for emitting and/or for reflecting light, the metallic wire rope could act as ferromagnetic material attracting the magnet. In the case of a load bearing element without or with only little ferromagnetic material, the carrier material can comprise ferromagnetic particles. In its simplest embodiment, a tape band with a retroreflective surface on one side, and an adhesive surface on the other side is adhered onto the at least one planar surface of the flat cable. In a particular embodiment of the present invention the at least one means for emitting and/or for reflecting light comprises a strip with a longitudinal and a lateral dimension.

[0054] In a particular embodiment of the present invention, the at least one means for emitting light is a thread which runs in parallel to the longitudinal dimension of the flat cable. In a further particular embodiment, these threads are LED films or strips that are at least partially embedded in the polymeric carrier material.

[0055] In a particular embodiment of the present invention, the at least one means for emitting light comprises at least one light emitting diode.

[0056] In a particular embodiment of the present invention, the metallic wire ropes are steel wire ropes. Steel wires ropes and their properties are well known and trusted. They can have ferromagnetic properties and can be constructed to transmit electrical signals.

[0057] In the present invention, the fibre is a synthetic high tensile strength fibre, in particular an aramid fibre, glass fibre, carbon fibre, polyethylene, ultra-high molecular weight polyethylene, polyester, polyamide or mixed fabric of said fibres. Ultra-high molecular weight polyethylene is also called UHMWPE. By the choice of the fibres used, properties like the tensile strength and the elongation as well as resistance to heat, cold, chemicals, radiation and other environmental conditions can be chosen.

[0058] In a particular embodiment of the present invention, the flat cable has an essentially rectangular, i.e. ob-

long cross-section. For the purpose of this feature, the cross-section shall be defined as a plane that cuts the longitudinal dimension of the flat cable in a right angle, i.e. is perpendicular to the longitudinal dimension of the flat cable.

[0059] In a particular embodiment of the present invention, the polymeric material is arranged such as to allow transmission of light, in particular the polymeric material is selected from a group of polymeric materials which are essentially translucent. This would allow an embedded light source such as a thread comprising means for emitting light, for instance an LED strip, to illuminate the surroundings or provide a signal, while the source itself is well protected inside the polymeric carrier material. This is particularly useful, if the light source requires protection from the environment, such as harsh environments. Particularly seaside or aquatic environments, i.e. environments on or close to bodies of water with, for instance, high salinity, suffer from an accelerated deterioration of metallic elements, due to corrosion and benefit from being embedded into a polymeric carrier material.

[0060] In a particular embodiment of the present invention, the polymeric carrier material is at least partly translucent with opaque and translucent regions.

[0061] In a particular embodiment of the present invention, the polymeric material is essentially opaque.

[0062] In a particular embodiment of the present invention, the polymeric material itself is adapted to provide a reflection of light.

[0063] It is evident for the skilled artisan that all the above embodiments can be implemented in a flat cable according to the present invention in any combination, provided they are not mutually exclusive.

[0064] A further aspect of the present invention is a method for manufacturing a flat cable as outlined above.

[0065] The method comprises a step of providing at least one load bearing element. The method further comprises the step of providing a polymeric material. For this step, the polymeric material can be provided as a melt, in the case of a thermosetting polymeric material, granules, chips or flakes, all depending on the intended purpose and based on the discretion of the person skilled art. Facultatively it can be supplemented with additives that provide further features. For instance, a master batch can be supplemented such that it provides the polymeric carrier material with means for emitting and/or reflecting light. The method of the present invention further requires the step of jacketing the at least one load bearing element with the polymeric material, such that a flat, belt-like cable is produced with the at least one load bearing element embedded in the polymeric material and with at least one planar surface. The method further comprises the step of providing at least one means for emitting and/or for reflecting light and combining it with the polymeric material. This step, as stated above, can be provided simultaneously with the providing of the polymeric carrier material.

[0066] In a particular embodiment, the method com-

prises a step of providing a plurality of metallic wire ropes and arranging them such that they run essentially in parallel to each other. The method further comprises the step of providing a polymeric material. For this step, the polymeric material can be provided as a melt, in the case of a thermosetting polymeric material, granules, chips or flakes, all depending on the intended purpose and on based on the discretion of the person skilled art. Facultatively it can be supplemented with additives that provide further features. For instance, a master batch can be supplemented such that it provides the polymeric carrier material with means for emitting and/or reflecting light. The method of the present invention further requires the step of jacketing the plurality of metallic wire ropes with the polymeric material, such that a flat, belt-like cable is produced with the metallic wire ropes embedded in the polymeric material and with at least one planar surface. The method further comprises the step of providing at least one means for emitting and/or for reflecting light and combining it with the polymeric material. This step, as stated above, can be provided simultaneously with the providing of the polymeric carrier material.

[0067] In a particular embodiment, the method comprises a step of providing a plurality of fibre ropes and/or mixed ropes and/or fibres and/or wires and arranging them such that they run essentially in parallel to each other. The method further comprises the step of providing a polymeric material. For this step, the polymeric material can be provided as a melt, in the case of a thermosetting polymeric material, granules, chips or flakes, all depending on the intended purpose and on based on the discretion of the person skilled art. Facultatively it can be supplemented with additives that provide further features. For instance, a master batch can be supplemented such that it provides the polymeric carrier material with means for emitting and/or reflecting light. The method of the present invention further requires the step of jacketing the plurality of fibre ropes and/or mixed ropes and/or fibres and/or wires with the polymeric material, such that a flat, belt-like cable is produced with the fibre ropes and/or mixed ropes and/or fibres and/or wires embedded in the polymeric material and with at least one planar surface. The method further comprises the step of providing at least one means for emitting and/or for reflecting light and combining it with the polymeric material. This step, as stated above, can be provided simultaneously with the providing of the polymeric carrier material.

[0068] In a particular embodiment of the method of the present invention, an extrusion with a nozzle adapted at extruding a polymeric material and thus shaping the at least one planar surface is comprised by said method.

[0069] In a particular embodiment of the method of the present invention, the step of providing at least one means for emitting and/or for reflecting light and combining it with the polymeric material comprises a co-extrusion, in particular the at least one means for emitting and/or for reflecting light is co-extruded with the polymeric material and the at least one load bearing element,

which is in particular a fibre rope and/or a mixed rope and/or a fibre and/or a wire.

[0070] In a particular embodiment of the method of the present invention, the step of providing at least one means for emitting and/or for reflecting light and combining it with the polymeric material comprises a co-extrusion, in particular the at least one means for emitting and/or for reflecting light is co-extruded with the polymeric material and the wire ropes.

[0071] In a particular embodiment of the method of the present invention, the combining with the polymeric material step comprises an adhesion step.

[0072] In a particular embodiment of the method of the present invention, the combining with the polymeric material step comprises a welding step.

[0073] Another aspect of the present invention is the use of the flat cable as detailed above for signalling purposes, in particular for signalling purposes of static installations delimiting areas.

[0074] A further aspect of the present invention is the use of the flat cable as detailed above for signalling purposes, in particular for signalling purposes of dynamic installations.

[0075] The use of the flat cable of the present invention is particularly advantageous, where dim lighting and strict safety requirements collide. The flat cables of the present invention provide an improved stability compared to solid profiles, barriers or railings. Use of the flat cable of the present invention is particularly advantageous, inter alia, as safety barrier, for parking systems, in architecture, transportation, handling and conveying of goods, border security, security and defence, aviation and road construction.

[0076] In a particular embodiment of the present invention, the flat cable is used as a smart cable, i.e. a cable comprising either one or both of at least one further wire for electro optical signal transmission, in particular a fibre cable, and/or at least one further wire for electrical signal transmission, in particular at least one copper cable.

[0077] The flat cables of the present invention are stress and shock resistant and provide increased perceptibility. They can be further upgraded as smart systems that enable collection and distribution of signals and data along its length.

[0078] In a particular embodiment, the use comprises the use of a cable as above with at least one distributed sensing optical cable. This embodiment has the advantage of allowing a discreet signal distribution and/or collection along the entire length of the flat cable. Another aspect of the present invention is a barrier for delimiting an area. The barrier comprises a plurality of posts for staking the said area to be delimited and one or more cables according as outlined above. In the simplest embodiment, the cables comprise one or more wire ropes, particularly metallic wire ropes, embedded into a polymeric carrier material, onto which a retroreflective tape is adhered on a planar surface of the polymeric carrier material. The cables are mounted on the said posts such

as to extend in their longitudinal dimension from one pole to the next.

[0079] In a preferred embodiment, the cables are mounted such that planar surfaces on the cables onto which either or both, illuminant and/or reflector, are applied are perpendicular to the ground, i.e. mounted such that the planar surfaces are easily perceptible.

[0080] In the following, the present invention will be further explained by means of figures and concrete examples, without being limited thereto.

Brief description of the drawings

[0081] The drawings used to further outline the embodiments show:

Fig. 1 is a schematic representation of a flat cable according to the present invention with a cross-section perpendicular to the longitudinal extension;

Fig. 2 is a schematic representation of an alternative flat cable according to the present invention in cross-section;

Fig. 3 is a schematic representation of a further flat cable according to the present invention in cross-section;

Fig. 4 is a schematic model of a method according to the present invention.

[0082] In the figures, the same components are given the same reference figures, where appropriate.

[0083] Fig. 1 shows a schematic depiction of a flat cable 1 according to the present invention in its simplest set-up. The flat cable 1 is shown in a schematic perspective view and with a cross-section perpendicular to a longitudinal dimension l of the flat cable 1. The flat cable 1 has a longitudinal dimension l and a lateral dimension b , perpendicular to each other, so that the flat cable 1 has a rectangular flat belt shape. This outer form is defined by a polymeric carrier material 2, in the present example, a polymer with elastic properties. For the present example, a thermoplastic polyurethane polymer has been utilized. The material was selected such as to exhibit a certain resistance to environmental influences and maintain its elasticity over an extended period of time while being exposed to atmospheric effects. This flat cable 1 is arranged such as to extend 10 cm in the lateral dimension b and have a thickness of 3 cm. The longitudinal extension l is purely discretionary and restricted only by transportation or storage requirements and the intended application. One advantage of delimitations that are equipped with flat cables according to the present invention, is that the flat cable 1 can be rolled up and transported or stored on a roll. This further facilitates mounting of the flat cable 1.

[0084] The flat cable 1 is traversed in the longitudinal dimension l by three metallic wire ropes 3. The metallic wire ropes 3 are not shown in scale, but for the present example, a diameter of between 4 and 14 mm would be appropriate. The metallic wire ropes 3 are steel ropes consisting of seven steel strands helically wound around themselves. Such metallic wire ropes come in a wide range of configurations and setting, comprising more or less strands. The final choice of metallic wire rope is left to the skilled artisan and will be chosen depending on, for example, intended load capacity, weight constraints, or material requirements such as magnetic shielding. In the present example, the metallic wire ropes 3 are embedded in the polymeric carrier material 2 such that the interstices between the single strands in the winding are filled with polymeric carrier material 2. The metallic wire ropes 3 are arranged in parallel.

[0085] Alternatively, the metallic wire ropes can be equipped with a coating layer. The coating layer can, for instance, be formed around the outermost section of wire strands, or around sections of wire strands in complex stranded ropes or stranded ropes that are themselves constituted by stranded ropes helically wound around each other.

[0086] The metallic wire ropes 3 are examples of a load bearing element. They are, according to the invention, at least replaced partially by fibre ropes, mixed ropes, or fibres in all embodiments shown in Figures 1 to 4. Fibre and mixed ropes can have similar diameters as the metallic wire ropes 3. Fibre and wire ropes can be for example stranded ropes with six strands helically wound around a central strand. However, fibre and mixed ropes come in a wide range of configurations and setting, comprising more or less strands. Single fibres and wires can be used in the place of the metallic wire ropes 3, too, but their diameter is preferentially smaller, for example up to 4 mm. To achieve higher load capabilities, a bundle of fibres or wires can replace the metallic wire ropes 3. It is for example possible to use metallic wires or fibres of the same dimensions as disclosed for the example shown in Figure 1. The final choice of the fibre rope or mixed rope or arrangement of fibres and wires is left to the skilled artisan and will be chosen depending on, for example, intended load capacity, weight constraints, or material requirements such as magnetic shielding.

[0087] The polymeric carrier material 2 defines the outer shape of the flat cable 1. The flat cable 1 has a first planar surface A, facing the viewer and a second planar surface on the underside (not visible in the present Fig. 1). The planar surface A is a vector space spanned by vectors parallel to the longitudinal dimension l and the lateral dimension b , and, presently, not the thickness of the flat cable. Thus, the comparatively largest available planar surfaces of the flat cable 1 are used for the planar surface A. On the planar surface A, means for reflecting light, i.e. in the present example retroreflecting spots 4 are applied on the planar surface A. The retroreflecting spots 4 are formed of adhesive tape with microprismatic

reflecting film. The film is retroreflecting due to prismatic lenses. This type of prism and lens system is manufactured of highly translucent plastic and welded onto a carrier film. The backside of the carrier film is coated with a self-adhesive plastic film, which is adhered onto the planar surface A. The tapes are retroreflecting - which results in a cat's eye effect, where the light is reflected back to its source. Such tapes are available to the skilled artisan and are preferably chosen with any of the following properties: good water repellence, resistant to environmental influences, friction resistance etc.

[0088] In the present example, incoming light 10 is reflected back along a vector that is parallel to but opposite in direction from the incoming light's 10 source, thereby reflecting light 11.

[0089] Of course, the planar surface opposite to the planar surface A on the underside of the flat cable 1, can be equally equipped with means for emitting or reflecting light, the same as above or of a different kind, depending on the intended use.

[0090] The flat cable just described is a robust means for delimiting spaces in areas, for which increased perceptibility is advantageous. It can also be used in fields of applications, where belts are normally applied, such as dynamic conveyance or lifting. A skilled artisan would know, if necessary, how to adapt the flat cable 1 for such applications.

[0091] Fig. 2 shows a further implementation of the flat cable 1 of the present invention. The flat cable 1 has a rectangular cross-section, analogous to the one shown in Fig. 1. The lateral dimension b is, for the present example, 40 mm and the thickness (not indicated in the figure) 10 mm. Three metallic wire ropes 3 are embedded in a translucent polymeric carrier material 2. Further, the flat cable 1 comprises means for emitting light 4.x in the form of two light emitting cables 4.x. These can be formed by a cable that is coated with material which can be excited to emit light 12 by applying an electric tension. Alternatively, LED strips or sheets can be used. Products which would be adaptable for use in the present invention as means for emitting light 4.x are produced by the company Lumitec AG, Gais in Switzerland. The electrical energy is supplied to the light emitting cables 4.x by means of a transformation- and/or controller device at either one or both of the end parts of the flat cable 1 (not shown).

[0092] The polymeric carrier material 2 can also be pigmented, which affects the colour of the perceived light 12 emitted from the cable. Alternatively, the polymeric carrier material 2 can comprise a multitude of polymers and be layered or segmented such as to be provided with translucent and opaque regions, thereby enabling the emitting of light 12 to exit the flat cable 1 in a predetermined pattern. With an appropriate transformation and/or controller device, the flat cable 1 of the present invention can be adapted to be dimmable, change in colour, frequency and/or spectrum of light for a wide range of purposes.

[0093] The example of Fig. 2 shows two means for

emitting light 4.x, though the number of such strands is not limited to two. Implementations with one, three or any other number of means for emitting light are also conceivable and all dependent on the end size of the flat cable in question and the intended use. It would also be possible to stack cables as shown in Fig. 2 such that the emitting of light 12 would be easily achieved on both planar surfaces, or even on the smaller sides (i.e. the thickness side) of the flat cable 1. The means for emitting light 4.x can also be applied onto the flat cable 1, such that they are not embedded into the polymeric carrier material 2.

[0094] Fig. 3 shows a further implementation of the flat cable 1 of the present invention. The flat cable 1 comprises an analogous polymeric carrier material 2, into which three metallic wire ropes 3 are embedded. The flat cable 1 of Fig. 3 is further enhanced with various functionalities. On the top planar surface A, a retroreflecting film 4, comprising an adhesive tape with an embedded layer of glass microbeads (aluminum-coated barium titanate glass beads), was applied. Further, two light emitting strands 4.x traverse the flat cable 1 in longitudinal direction and parallel to the metallic wire ropes 3. The light emitting strands 4.x are in the present example polymer cables, such as PVC cables, that have been wrapped or coated into a phosphorescent sheet or layer (strontium aluminate based) for an afterglow effect, emitting light 12 after having been excited with light themselves. The polymeric carrier material 2 is translucent, such that the light emitting 12 of the phosphorescent cables 4.x can pass it.

[0095] The flat cable 1 depicted exemplarily in Fig. 3 is further equipped with two conductor cables 6, presently copper cables 6. The copper cables 6 are isolated with a polymer tubing towards the polymeric carrier material. They can be used for transmission of signals and/or electrical energy either from end to end of the flat cable 1, or alternatively, by splicing with devices along the length of the flat cable in longitudinal extension.

[0096] Further, a pair of steel tubes with glass fibres 5 are embedded into the polymeric carrier material. These function as wires for optical signal transmission and can also work for distributed sensing purposes. The steel tubes with glass fibres 5 traverse the longitudinal extension of the flat cable 1 end to end in the present instance. Optionally, the optical fibre cables 5 can also be spliced for devices along the length of the flat cable with splicing techniques for fibre cables known in the art.

[0097] Such flat cables 3 as shown in Fig. 3 can be used to provide smart safety systems with passive and active components such as shock or stress feedback, warning signals, perimeter control etc.

[0098] Summarizing, it can be said that the polymeric carrier material embedded ropes provides a rugged, robust basis with nonetheless measures of flexibility and at the same time load capacity for signalling elements in a wide scope of applications.

[0099] Fig. 4 gives a schematic summary of an exem-

plary method for manufacturing a flat cable according to the present invention. First, a plurality of wire ropes is provided I and the wire ropes are arranged such that they run in parallel to each other. A polymeric material is the provided II. The polymeric carrier material is provided in the form of granules, is heated and melted in an extruder and the plurality of wire ropes is jacketed with the polymeric material, such that a flat, belt-like cable is produced with the wire ropes embedded in the polymeric material by means of co-extruding the wire ropes with the polymeric carrier material III melt and solidifying it. The at least one planar surface is the result of a respective extruder nozzle. Downstream, the at least one means for emitting and/or for reflecting light is provided and combined with the planar surface of the polymeric carrier material IV. In this particular example, this is done by removing a protective sheet from an adhesive tape, such as for instance a 3M 983-10 ECE 104 yellow reflective self-adhering tape roll, and adhering it to the polymeric carrier material. This step is performed after the polymeric carrier material is sufficiently cooled.

[0100] Alternatively, the at least one means for emitting and/or for reflecting light is co-extruded with the polymeric material and the wire ropes.

Claims

1. A cable (1), in particular a flat cable (1), with a longitudinal dimension (l) and a lateral dimension (b), comprising:
 - a) a polymeric carrier material (2) which essentially defines the outer shape of the cable (1);
 - b) at least one load bearing element, which runs in parallel to the longitudinal dimension (l) of the cable (1) and is embedded into the polymeric carrier material (2), and
 - c) at least one means for emitting (4.x) light or a retroreflector (4), wherein
 - d) the outer shape of the cable (1) is arranged such that the cable (1) features at least one planar surface (A)

characterized in that

 - e) the at least one load bearing element comprises a fibre, which is a synthetic high tensile strength fibre.
2. A cable, according to claim 1, comprising a plurality of wire ropes (3), which run in parallel to the longitudinal dimension (l) of the cable (1) and are embedded into the polymeric carrier material (2).
3. A cable, according to any one of claims 1 to 2, whereby the load bearing element is a plurality of fibre ropes and/or mixed ropes and/or fibres and wires, which run in parallel to the longitudinal dimension (l) of the cable (1) and are embedded into the polymeric

carrier material (2).

4. The cable (1) according to claim 1, whereby the means for emitting light (4.x) is an illuminant (4.x).
5. The cable (1) according to any one of claims 2 to 3, whereby the wire rope (3) is a stranded rope (3).
6. The cable (1) according to any one of claims 1 to 5, further comprising at least one wire for electrical signal transmission (6), in particular further comprising at least one copper cable (6) for electrical signal transmission.
7. The cable (1) according to claim 6, whereby the said further wire (6) for electrical signal transmission is further adapted at providing electrical energy to the at least one means for emitting light (4.x).
8. The cable (1) according to any one of claims 1 to 7, further comprising at least one wire for electro optical signal transmission (5), in particular comprising a fibre cable for electro optical signal transmission (5).
9. The cable (1) according to any one of claims 2 to 8, whereby the wire ropes are metallic wire ropes (3), in particular steel wire ropes (3).
10. The cable (1) according to any one of claims 2 to 9, whereby the fibre is an aramid fibre, glass fibre, carbon fibre, polyethylene, ultra-high molecular weight polyethylene, polyester, polyamide or mixed fabric of said fibres.
11. Method for manufacturing a flat cable according to claim 1, comprising the steps of:
 - a) providing at least one load bearing element which comprises a fibre which is a synthetic high tensile strength fibre;
 - b) providing a polymeric material (II);
 - c) jacketing the at least one load bearing element with the polymeric material (III), such that a flat, belt-like cable is produced with the at least one load bearing element embedded in the polymeric material and with at least one planar surface;
 - d) providing at least one means for emitting light and/or a retroreflector (4) and combining it with the polymeric material (IV).
12. Use of the flat cable according to any one of claims 1 to 10 for signalling purposes.
13. Barrier for delimiting an area, comprising a plurality of posts for staking the area to be delimited and one or more cables according to any one of claims 1 to 10 mounted on the said posts, such as to extend

their longitudinal dimension from one pole to the next.

5 Patentansprüche

1. Kabel (1), insbesondere ein Flachkabel (1), mit einer Längsabmessung (I) und einer Querabmessung (b), das Folgendes umfasst:
 - a) ein polymeres Trägermaterial (2), das im Wesentlichen die äußere Form des Kabels (1) definiert;
 - b) mindestens ein tragendes Element, das parallel zu der Längsabmessung (I) des Kabels (1) verläuft und in das polymere Trägermaterial (2) eingebettet ist, und
 - c) mindestens ein Mittel zum Emittieren (4.x) von Licht oder einen Retroreflektor (4), wobei
 - d) die äußere Form des Kabels (1) so angeordnet ist, dass das Kabel (1) mindestens eine ebene Fläche (A) aufweist,**dadurch gekennzeichnet, dass**
 - e) das mindestens eine tragende Element eine Faser umfasst, die eine synthetische Faser mit hoher Zugfestigkeit ist.
2. Kabel nach Anspruch 1, das mehrere Drahtstränge (3) umfasst, die parallel zu der Längsabmessung (I) des Kabels (1) verlaufen und in das polymere Trägermaterial (2) eingebettet sind.
3. Kabel nach einem der Ansprüche 1 bis 2, wobei das tragende Element mehrere Faserstränge und/oder gemischte Stränge und/oder Fasern und Drähte sind, die parallel zu der Längsabmessung (I) des Kabels verlaufen (1) und in das polymere Trägermaterial (2) eingebettet sind.
4. Kabel (1) nach Anspruch 1, wobei das Mittel zum Emittieren von Licht (4.x) ein Leuchtmittel (4.x) ist.
5. Kabel (1) nach einem der Ansprüche 2 oder 3, wobei der Drahtstrang (3) ein Litzenstrang (3) ist.
6. Kabel (1) nach einem der Ansprüche 1 bis 5, das ferner mindestens einen Draht zur elektrischen Signalübertragung (6) umfasst, wobei es insbesondere ferner mindestens ein Kupferkabel (6) zur elektrischen Signalübertragung umfasst.
7. Kabel (1) nach Anspruch 6, wobei der weitere Draht (6) zur elektrischen Signalübertragung ferner angepasst ist, um dem mindestens einen Mittel zum Emittieren von Licht (4.x) elektrische Energie bereitzustellen.
8. Kabel (1) nach einem der Ansprüche 1 bis 7, das

ferner mindestens einen Draht zur elektrooptischen Signalübertragung (5) umfasst, wobei es insbesondere ein Faserkabel zur elektrooptischen Signalübertragung (5) umfasst.

9. Kabel (1) nach einem der Ansprüche 2 bis 8, wobei die Drahtstränge metallische Drahtstränge (3), insbesondere Stahldrahtstränge (3) sind.

10. Kabel (1) nach einem der Ansprüche 2 bis 9, wobei die Faser eine Aramidfaser, Glasfaser, Kohlefaser, Polyethylen, Polyethylen mit ultrahohem Molekulargewicht, Polyester, Polyamid oder ein Mischgewebe dieser Fasern ist.

11. Verfahren zur Herstellung eines Flachkabels nach Anspruch 1, das die folgenden Schritte umfasst:

- a) Bereitstellen mindestens eines tragenden Elements, das eine Faser umfasst, die eine synthetische Faser mit hoher Zugfestigkeit ist;
- b) Bereitstellen eines polymeren Materials (II);
- c) Ummanteln des mindestens einen tragenden Elements mit dem polymeren Material (III), so dass ein flaches, riemenförmiges Kabel mit dem mindestens einen in das polymere Material eingebetteten tragenden Element und mit mindestens einer ebenen Oberfläche hergestellt wird;
- d) Bereitstellen mindestens eines Mittels zum Emittieren von Licht und/oder eines Retroreflektors und Kombinieren dieses mit dem polymeren Material (IV).

12. Verwendung des Flachkabels nach einem der Ansprüche 1 bis 10 zu Signalzwecken.

13. Barriere zum Abgrenzen eines Bereichs, die mehrere Pfosten zum Abstecken des zu begrenzenden Bereichs und ein oder mehrere an den Pfosten angebrachte Kabel gemäß einem der Ansprüche 1 bis 10 umfasst, sodass sich ihre Längsabmessung von einem Stab zu dem nächsten erstreckt.

Revendications

1. Câble (1), en particulier câble plat (1), avec une dimension longitudinale (1) et une dimension latérale (b), comprenant :

- a) un matériau de support polymère (2) qui définit essentiellement la forme extérieure du câble (1) ;
- b) au moins un élément porteur, qui court parallèlement à la dimension longitudinale (1) du câble (1) et est incorporé dans le matériau de support polymère (2) ; et
- c) au moins un moyen d'émission de lumière

(4.x) ou rétroreflecteur (4), dans lequel d) la forme extérieure du câble (1) est agencée de telle sorte que le câble (1) présente au moins une surface plane (A),

caractérisé en ce que

e) l'au moins un élément porteur comprend une fibre, qui est une fibre synthétique à forte résistance à la traction.

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2. Câble selon la revendication 1, comprenant une pluralité de câbles en fils (3), qui courent parallèlement à la dimension longitudinale (1) du câble (1) et sont incorporés dans le matériau de support polymère (2).

3. Câble selon l'une quelconque des revendications 1 et 2, dans lequel l'élément porteur est une pluralité de câbles en fibres et/ou de câbles mixtes et/ou de fibres et de fils, qui courent parallèlement à la dimension longitudinale (1) du câble (1) et sont incorporés dans le matériau de support polymère (2).

4. Câble (1) selon la revendication 1, dans lequel le moyen d'émission de lumière (4.x) est un dispositif d'éclairage (4.x).

5. Câble (1) selon l'une quelconque des revendications 2 et 3, dans lequel le câble en fils (3) est un câble à torons (3).

6. Câble (1) selon l'une quelconque des revendications 1 à 5, comprenant en outre au moins un fil pour la transmission de signaux électriques (6), en particulier comprenant en outre au moins un câble en cuivre (6) pour la transmission de signaux électriques.

7. Câble (1) selon la revendication 6, dans lequel ledit fil supplémentaire (6) pour la transmission de signaux électriques est en outre adapté pour fournir de l'énergie électrique à l'au moins un moyen d'émission de lumière (4.x).

8. Câble (1) selon l'une quelconque des revendications 1 à 7, comprenant en outre au moins un fil pour la transmission de signaux électrooptiques (5), en particulier comprenant un câble à fibres optiques pour la transmission de signaux électrooptiques (5).

9. Câble (1) selon l'une quelconque des revendications 2 à 8, dans lequel les câbles en fils sont des câbles en fils métalliques (3), en particulier des câbles en fils d'acier (3) .

10. Câble (1) selon l'une quelconque des revendications 2 à 9, dans lequel la fibre est une fibre d'aramide, une fibre de verre, une fibre de carbone, du polyéthylène, du polyéthylène à ultrahaut poids moléculaire, du polyester, du polyamide ou un tissu mixte desdites fibres.

11. Procédé de fabrication d'un câble plat selon la revendication 1, comprenant les étapes suivantes :

- a) obtention d'au moins un élément porteur qui comprend une fibre qui est une fibre synthétique à forte résistance à la traction ; 5
- b) obtention d'un matériau polymère (II) ;
- c) enrobage de l'au moins un élément porteur avec le matériau polymère (III), de telle sorte qu'un câble plat, en forme de courroie est produit avec l'au moins un élément porteur incorporé dans le matériau polymère et avec au moins une surface plane ; 10
- d) obtention d'au moins un élément d'émission de lumière et/ou rétroreflecteur et combinaison de celui-ci avec le matériau polymère (IV). 15

12. Utilisation du câble plat selon l'une quelconque des revendications 1 à 10 à des fins de signalisation. 20

13. Barrière destinée à délimiter une zone, comprenant une pluralité de poteaux destinés à définir la zone à délimiter et un ou plusieurs câbles selon l'une quelconque des revendications 1 à 10 montés sur lesdits poteaux, de manière à étendre leur dimension longitudinale d'un poteau au suivant. 25

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Fig. 1

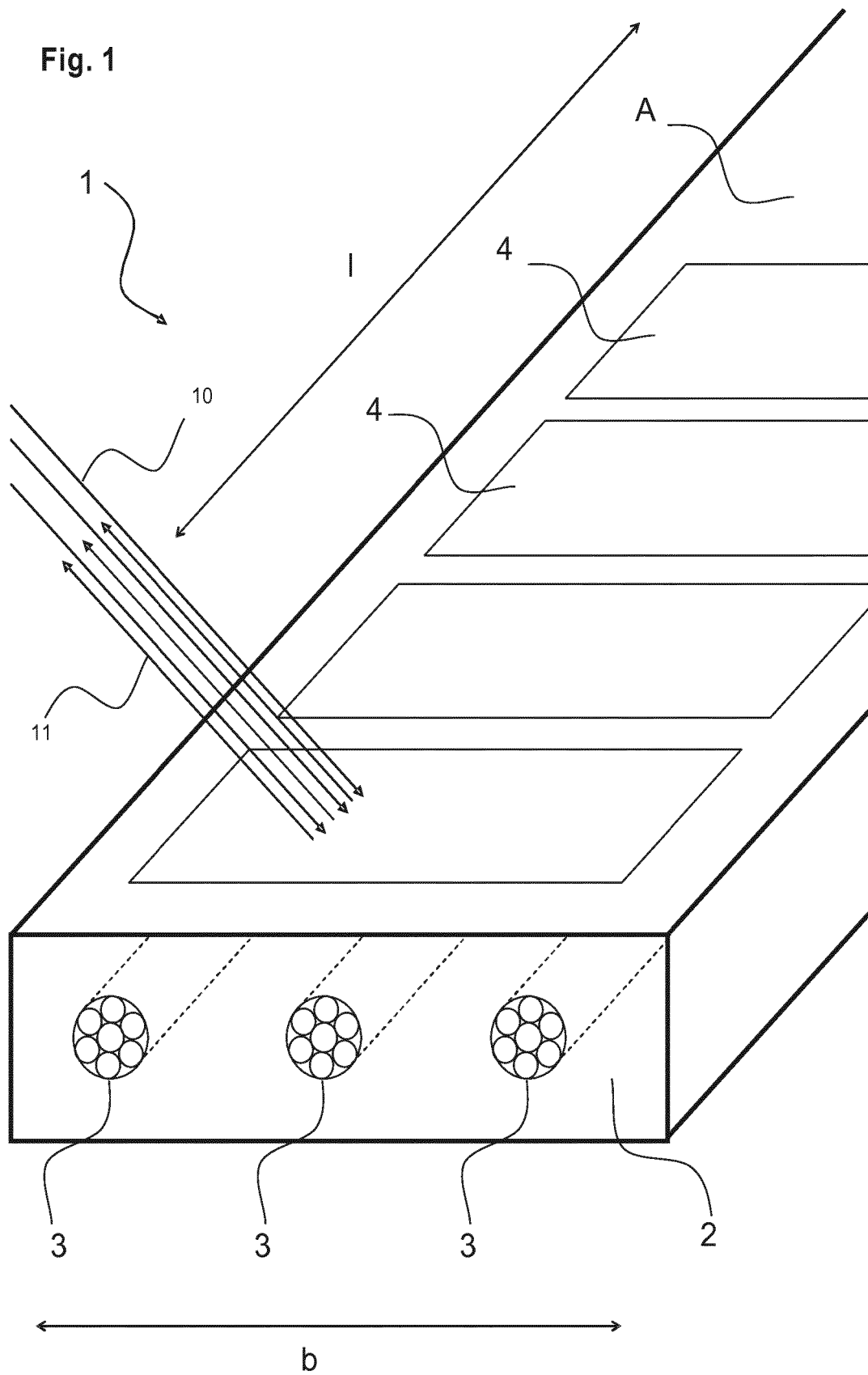


Fig. 2

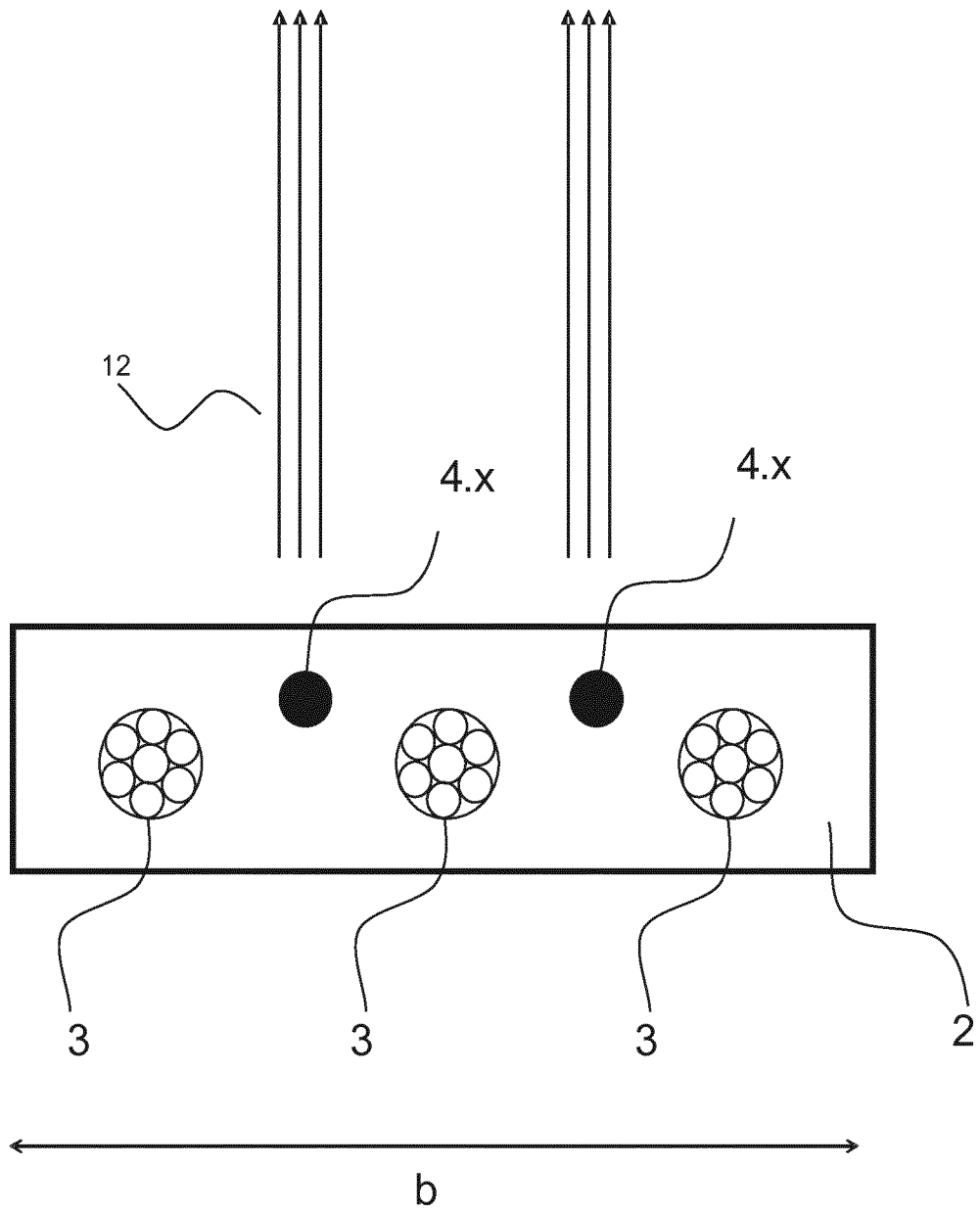


Fig. 3

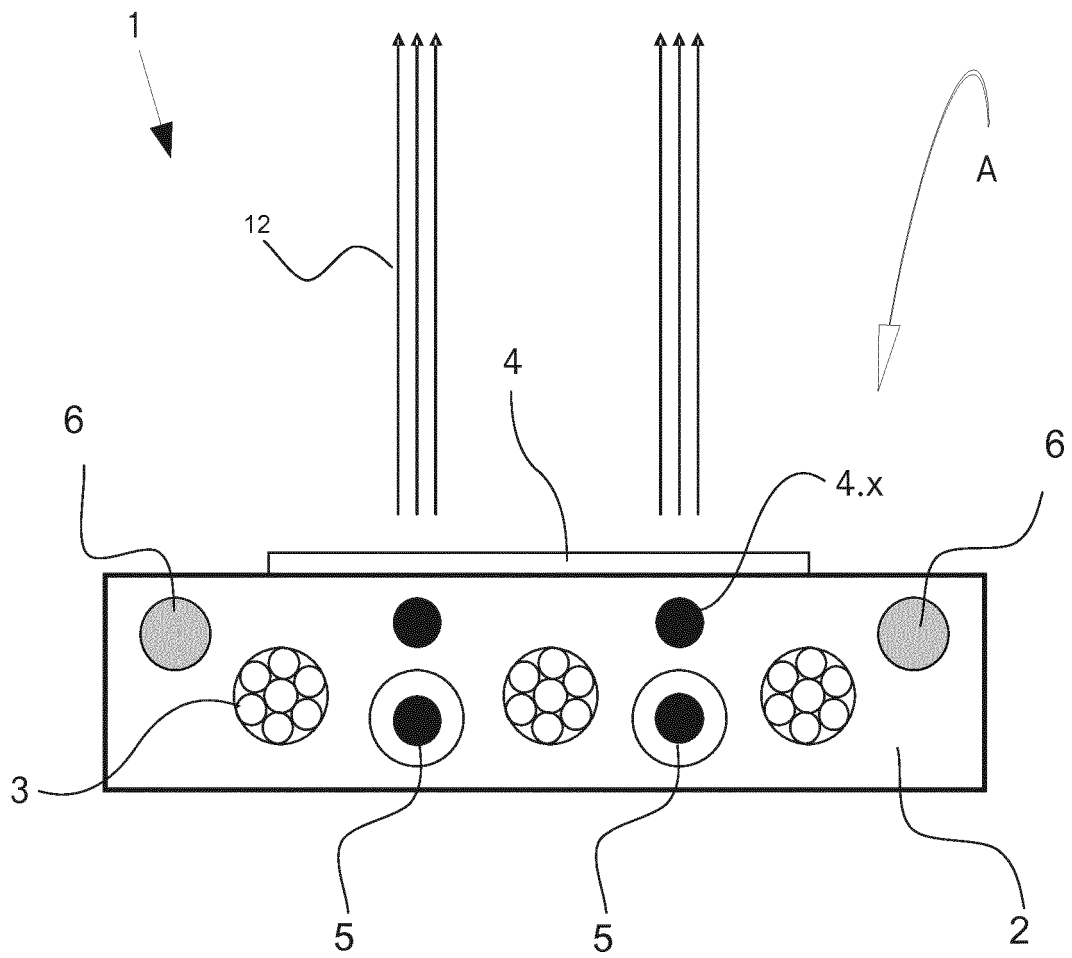
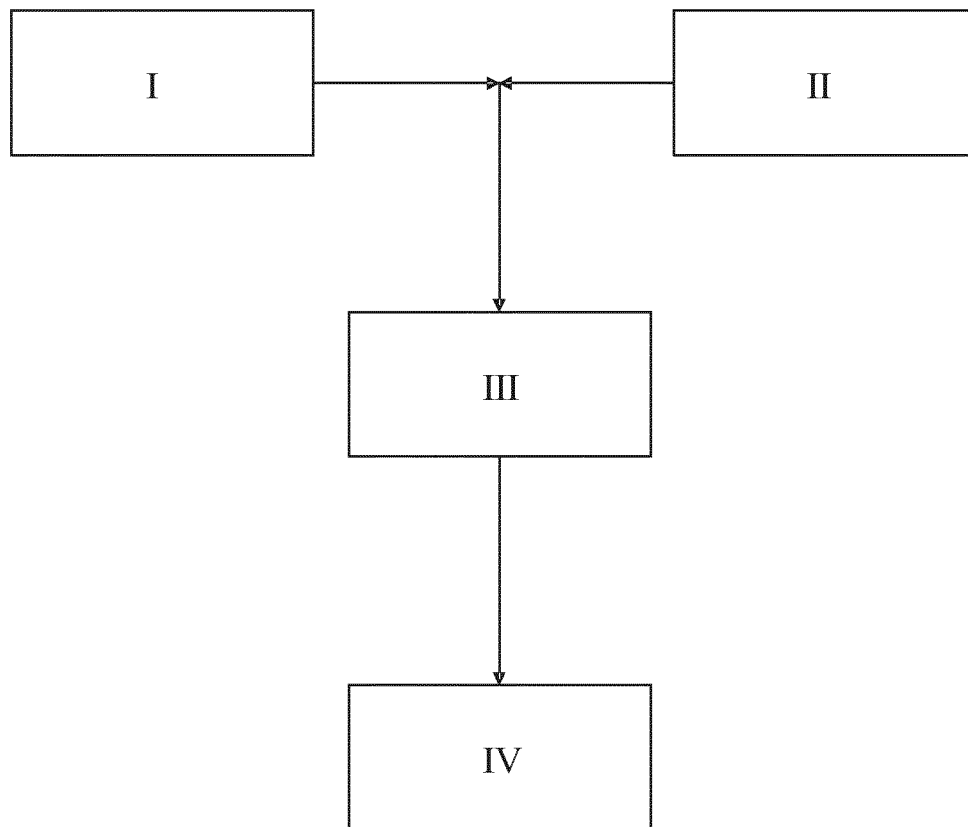


Fig. 4



REFERENCES CITED IN THE DESCRIPTION

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