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(54) DEVICE FOR DETECTING INTRUSION ON SECURITY FENCES

(57) The invention relates to a device for detecting intrusion on security fences, which is especially designed to be mounted on already existing security fences used to protect transportation infrastructure, although it can also be applied to other types of security fence, and allows detection of the site where the intrusion occurs, with the advantage of a practically zero percentage of false alarms. The device basically consists of: a plurality of multimodal fibre optic cables camouflaged by the metal mesh of the security fence, a series of signal analyzers housed in tight casings, with which at least a pair of fibre optic cables is associated; a variety of concentrators having a similar technology to that of the signal analyzers, housed in tight casings, with which at least a pair of fibre optic cables is associated, and provided with a connectivity module; a communication line for the signal analyzers and the concentrators; and a control centre with which the communication line communicates.

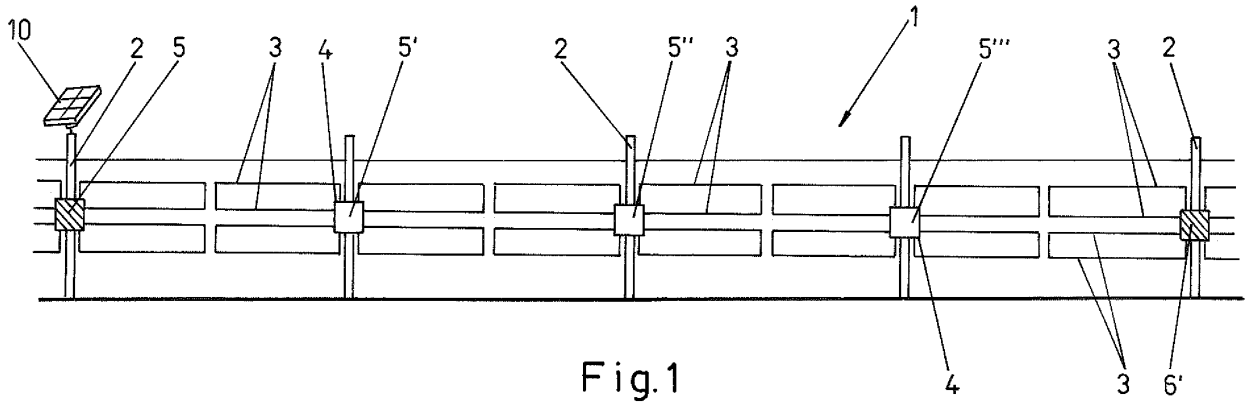

Fig.1

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Description

OBJECT OF THE INVENTION

[0001] The following invention, as expressed in the title of this specification, relates to a device for detecting intrusion on security fences, whose security fences delimit a perimeter to be protected, with the object of detecting any attempt of intrusion or destruction of the fencing with absolute reliability and, additionally, detecting the specific site where it occurs, for which purpose the device is based on the constant monitoring of a plurality of optical signal transmission lines.

[0002] A significant advantage of the device is that it is immune to vibrations, strong wind, blows, noise and adverse weather conditions, including electrical discharges, avoiding false alarms.

[0003] To this end the security fence includes, along its length, a plurality of multimodal fibre optic cables camouflaged by the metal mesh that configures the perimeter to be protected, whose plurality of multimodal fibre optic cables are assembled in association with a series of signal analyzers and concentrators, said concentrators being based on the same technology as the signal analyzers with the addition of a connectivity module for communicating with a control centre or other places, such that the plurality of fibre optic cables form a redundant communication ring to guard against eventual breaks in the multimodal fibre optic cable.

[0004] Another important object of the invention is that the device for detecting intrusion may be installed both on security fences to be installed and those already existing formed by a plurality of posts anchored to the ground and between which mainly, simple-torsion metal mesh is arranged and fixed, although other types of metal mesh may be used and fences which lack added elements that provide authentic security.

FIELD OF APPLICATION

[0005] This specification describes a device for detecting intrusion on security fences, which is applicable for assembling both on security fences to be installed and those already existing consisting of a plurality of posts anchored to the ground and whereon metal mesh is arranged and fixed for protecting long perimeter layouts, enclosures and roads that must have a certain level of security and whose detection device is especially applicable to the protection of long-distance and high-speed railway line layouts.

BACKGROUND OF THE INVENTION

[0006] As is known, in today's society, the threats to which both people and property are exposed are multiple and varied. That is why both modern-day society and industry demand security systems that will allow them to protect, control and supervise their facilities in a simple and effective manner, both locally and remotely.

[0007] In order to protect property and/or persons within a delimited zone, the first threat to be avoided are intrusion attempts.

[0008] Furthermore, we can indicate that perimeter protection solutions is the name given to the set of systems and equipment which, acting in a coordinated manner, minimise the possibility of intrusion in the confinement zone, protecting the persons and/or property located inside the perimeter.

[0009] Perimeter protection solutions are based mainly on:

- ◦ Delimiting the confinement zone of the facility (define the perimeter).
- ◦ Guaranteeing a high level of security throughout the enclosure, providing the perimeter with detection zones that will alert us as to a possible intrusion.
- ◦ Visually controlling the entire perimeter zone, both locally and remotely.
- ◦ Controlling and supervising, both locally and remotely, the entire system implemented.
- ◦ Efficiently and simply managing the set of systems, guaranteeing quick and easy access to the information generated by said systems.

[0010] In order to solve the problem of detecting intrusion attempts, sensors of different types and technologies are used in accordance with the facility to be protected and the type of intrusion to be avoided.

[0011] Moreover, it should be taken into consideration that one of the main problems of current sensors is their performance in the presence of animal, plant or weather-related external phenomena, which give rise to a large number of "false alarms".

[0012] Therefore, for example, sensors based on microwaves or microphonic cables are highly sensitive to external phenomena, such that in order to discriminate between a real alarm and a false alarm they use complex algorithms that analyse and discriminate the signals obtained by the sensor in order to compare it with a pattern and ascertain whether or not it is a real alarm.

[0013] The signals are analysed according to their intensity or vibration pattern, which requires onsite calibration in order to adapt the sensor to the terrain and environmental conditions of the site where it will be installed. Even so, the rate of false alarms can be high.

[0014] Furthermore, as is known, optical fibre is immune to weather conditions and is not affected by the action of external elements, so that once installed it does not require calibration or learning patterns, endowing the installation with a series of advantages, such as:

- ✓ Flexibility
- ✓ Lightness
- ✓ Immunity to electromagnetic disturbances
- ✓ Absence of interferences
- ✓ Easy repair in the event of an intentional cut

✓ Long distance to be covered

[0015] Additionally, the installation of optical fibre is extremely simple and fast, as it is stapled to the simple-torsion mesh and it cannot be sabotaged, since it cannot be cut to execute a bypass.

[0016] Likewise and in accordance with the foregoing, reference can be made to the fact that there are currently a large variety and number of zones protected by simple security fencing based on a plurality of posts anchored to the ground and whereon metal mesh is arranged and fixed until covering the entire perimeter to be protected, such that said fencing provides a minimum degree of security on not having any minimum intrusion detection means, such that the control of the fencing can only carried out visually.

[0017] Therefore, this type of fencing is frequently used in the protection, for example, of land communication routes such as roads, motorways and railways, with the drawback of not being able to detect any type of intrusion other than visually, due to which, in practice, it lacks security and, additionally, has the added drawback that this type of fencing covers large extensions, due to which it is becoming increasingly necessary to have a stricter control with which to detect any intrusion at the time and place where it occurs.

DESCRIPTION OF THE INVENTION

[0018] With the aim of solving the aforementioned drawbacks, the present specification describes a device for detecting intrusion on security fences, which is especially applicable for assembling on already existing security fences for protecting communication routes, although, obviously, it may also be applied to other types of security fences, such that the device object of the invention, of low economic cost, makes it possible to detect the site where the intrusion occurs with the significant advantage of having, practically, 0 % of false alarms, which is a very significant advantage.

[0019] Therefore, the present specification describes a device for detecting intrusion on security fences, whose security fences are of the type consisting of:

➢ a plurality of posts anchored to the ground, delimiting the security perimeter; and
➢ metal mesh fixed between the posts, having the corresponding wire tensioners;

such that the device to be incorporated is useful for detecting possible intrusion attempts on cutting or exerting pressure onto the metal mesh and consisting of:

➢ a plurality of multimodal fibre optic cables camouflaged with the metal mesh that forms the security fence, along the length thereof;
➢ a series of signal analyzers housed in tight casings, with which, at least, one pair of fibre optic cables is associated;
➢ a diversity of concentrators with technology similar to that of the signal analyzers, being equally housed in tight casings, with which, at least, one pair of fibre optic cables is associated and provided with a connectivity module;
➢ a communication line of the signal analyzers and of the concentrators laid along the perimeter to be protected; and
➢ a control centre with which the communication line communicates;
such that the signal analyzers comprise:

- an electronic detection module having the corresponding electronic control unit and connections of the pairs of fibre optic cables and digital inputs and outputs;
- a data communication module with the corresponding control unit, communicated with the electronic detection module and with the adjacent analyzers and/or concentrator;
- a weather management module having the corresponding control unit, communicated with the data communication module, and which controls the weather control elements; and
- a power supply management module fed by the mains or by an alternative source and which supplies power to the different analyzer modules.

[0020] Therefore, a data flow is transmitted via the plurality of multimodal fibre optic cables, whose mere interruption is indicative of a break in the multimodal fibre optic cable and, consequently, of intrusion.

[0021] The weather control elements are defined by a temperature sensor and a humidity sensor associated with a resistor, with an automatic internal pressure relief valve and with a fan, controlling fast rises and falls in temperature in the interior of the tight casing with the object of maintaining an adequate temperature in order to ensure the proper operation of the elements housed inside the tight casings.

[0022] Furthermore, a concentrator will be installed every certain number of signal analyzers, which is the signal interface between the entire sector of signal analyzers associated therewith and the control centre or place of communication.

[0023] Therefore, in the event of a break in a multimodal fibre optic cable, the signal analyzer or concentrator with which it is associated detects the interruption of the flow and, upon being communicated to the control centre, the site of interruption of the data transmission flow due to the breakage of the multimodal fibre optic cable is determined such that it is possible to act accordingly.

[0024] In order to supply power to the constituent elements of the signal analyzers and concentrators, along the security perimeter, the corresponding power source from the mains or from an alternative energy source, such as solar panels, is available.

[0025] Likewise, at least one battery may be installed in each of the tight casings of the signal analyzers and of the concentrators, so that, in the event of a failure in the power mains or alternative energy source, a power supply is available which continues to function adequately, also allowing said supply to come from individual solar panels per each analyzer, in those cases where it is deemed necessary.

[0026] Likewise, respective lights and/or vision cameras may be installed in association with all or part of the tight casings wherein the signal analyzers and concentrators are housed, enabling visual control over the immediate surroundings within a certain action radius.

[0027] In short, a significant advantage is that, due to the plurality of multimodal fibre optic cables, whose mechanical resistance has been designed so as to break in accordance with an intrusion condition, a data flow whose mere interruption is indicative of a break in the multimodal fibre optic cable and, consequently, of intrusion, is transmitted, i.e. it does not analyse the signal transmitted, allowing the number of false alarms to be reduced practically to 0%.

[0028] As a complement to the description made below, and for the purpose of helping to make the characteristics of the invention more readily understandable, said description is accompanied by a set of drawings whose figures, by way of illustration and not limitation, represent the most characteristic details of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Figure 1 shows a view of a section of security fence wherein posts can be observed between which the corresponding metal mesh (not represented) is strung, wherein the plurality of multimodal fibre optic cables associated with the signal analyzers and concentrators are mounted and camouflaged, defining a redundant communication ring along the fence;

Figure 2 shows a view of a schematic block diagram relating to the signal analyzers.

Figure 3 shows a schematic view relating to the protection of a section of fence layout on both sides of a railway line.

Figure 4 shows a view of a schematic block diagram relating to a concentrator, showing how it incorporates a technology similar to the signal analyzers in addition to having a connectivity module.

DESCRIPTION OF A PREFERRED EMBODIMENT

[0030] In view of the aforementioned figures and in accordance with the numbering adopted, it can be observed how the security fence 1 is of the type of widely known fences consisting of a plurality of posts 2 anchored to the ground between which metal mesh, not represented, is strung, fixed to the posts 2 with the corresponding wire tensioners delimiting the security perimeter and which, in principle, lack any means for detecting possible actions therein, such as cuts to access the protected zone.

[0031] These types of fences are widely known and, thus, for example, are installed as security fences in land communication routes such as roads, dual carriageways, motorways and railway lines. However, on lacking means for detecting possible actions on the fence for accessing the zone to be protected they do not adequately fulfil their function, such that, with the aim of solving this drawback, this specification describes a device for detecting intrusion attachable to said type of fences, which allows the detection of any intrusion action or destruction of the fence with practically a 0 % number of false alarms.

[0032] Therefore, the device for detecting intrusion is based on a plurality of multimodal fibre optic cables 3 camouflaged with the metal mesh that constitutes the security fence, along its entire length, as well as a series of signal analyzers 5, 5', 5", 5"',... and concentrators 6, 6', 6", 6"',... whose concentrators are based on the same technology as the signal analyzers, in addition to being connected by means of a communication line 7 communicated with a control centre 8, whose communication line 7 may be based on a fibre optic cable.

[0033] The signal analyzers 5, 5', 5",... and the concentrators 6, 6', 6",... will be housed inside respective tight casings 4 and with which the plurality of fibre optic cables 3 is associated for the continuous monitoring thereof in order to control the continuous transmission of optical signal since, otherwise, i.e. lack of signal transmission, it will be indicative of a cut or break of the fibre optic cable. The aforementioned tight casings 4 that house the technology of the signal analyzers and the concentrators may be fixed to the posts 2 themselves.

[0034] The signal analyzers 5, 5', 5",... and the concentrators 6, 6', 6",... housed inside the tight casings 4, are fed by the mains 9 laid out along the perimeter to be protected. Likewise, the analyzers and concentrators may be fed by means of solar panels 10.

[0035] Therefore, the plurality of multimodal fibre optic cables associated with the signal analyzers 5, 5', 5", 5"',... and the concentrators 6, 6', 6", 6"',... define corresponding redundant communication rings along the security fence 1, detecting the site of a possible intrusion or destruction of the fence.

[0036] In order to adequately control the entire facility to be protected, which may encompass many kilometres in length, a concentrator 6, 6', 6", 6"',... will be installed every certain number of signal analyzers 5, 5', 5", 5"',...

[0037] Furthermore, making mention of figure 1 of the drawings, it can be observed how four fibre optic cables 3 are associated with the signal analyzers and with the concentrators forming a redundant ring that can encompass a length of 500 metres, such that in the event of any cut or breakage of one of these, the signal analyzer or concentrator with which it is associated will detect that an interruption has occurred in the data transmission, indicative of breakage, said information being communi-

cated to the control centre 8 and locating the exact point thereof.

[0038] As reflected in the plurality of multimodal fibre optic 3 cables, a data flow is transmitted, whose mere interruption is indicative of breakage and, consequently, of intrusion, i.e. it does not analyse the signal obtained, but rather the signal analyzers and the concentrators with the control electronics associated therewith, only detect whether or not the data flow arrives, communicating any incident via the communication line 7 connected to the signal analyzers 5, 5', 5",... and with the concentrators 6, 6', 6",... to the control centre 8.

[0039] Making mention of the technology of the analyzers 5, 5', 5",... and in accordance with figure 2 of the drawings, these are based on:

➢ an electronic detection module 11 provided with the corresponding electronic control unit and, basically, with:

✓ fibre optic connections 12 with capacity for eight detection rings based on redundant rings of pairs of optic fibre cables 3; and
✓ digital inputs and outputs 13 for receiving commands or events, such as temperature and humidity, and actuating on other installed elements, such as, for example, video surveillance cameras, external lights, etc.

➢ a data communication module 14, provided with the corresponding control unit, communicated with the electronic detection module 12, and with the adjacent signal analyzer and/or concentrator, and whose data communication module 14 transmits:

✓ the events that have occurred;
✓ the status of each signal analyzer or concentrator module; and
all the data collected in the interior of the signal analyzer or concentrator (for example, temperature and humidity).

➢ a weather management module 15, provided with the corresponding control unit, communicated with the data communication module 14 and which controls the weather control elements 16 in the interior of the tight casing 4; and
➢ a power supply management module 17 fed by the mains 9 or by the alternative power supply and which supplies power to the electronic detection module 11, to the data communication module 14 and to the weather management module 15.

[0040] As regards the technology of the concentrators 6, 6', 6",..., as mentioned earlier, it corresponds to the technology related to the signal analyzers 5, 5', 5",... in addition to a connectivity module 21 which enables communication with the control centre 8 or other places such as alarm centres or infrastructure centres.

[0041] In this manner, a block diagram of a concentrator can be observed in figure 4 and it can be observed how the connectivity module has a plurality of outputs 22 for communication and, likewise, the two-way data transmission line 23 can also be observed, for example, with an alarm centre.

[0042] Therefore, in accordance with the foregoing, the electronic detection module 11 monitors the continuity of the eight fibre optic loops, such that each fibre optic line extends along a maximum two-way layout of one thousand metres, offering protection, on being a loop or ring of 500 linear metres, with two fibre optic lines.

[0043] Additionally, at least one battery may be installed in each of the tight casings 4 of the signal analyzers 5, 5', 5", 5"',... and of the concentrators 6, 6', 6", 6"',..., which will make it possible to maintain the power supply under possible circumstances in which power is not supplied by the mains or solar panels.

[0044] Furthermore, the weather management module 15 controls the weather control elements 16, which can be based on a temperature and humidity sensor associated with a resistor and a fan, making it possible to maintain an adequate temperature in the interior of the tight casings 4 when faced to fast falls and rises in temperature.

[0045] This execution is of great importance in places where sudden temperature changes occur, such as desert areas with temperature differences between day and night that vary from more than 65 °C to -20 °C, whose changes in temperature cause the components housed in the interior of the tight casings to stop functioning properly, such that, on being able to maintain the ideal temperature in the interior the components can function properly.

[0046] Likewise, there may be respective vision cameras and/or lights associated with all or part of the tight casings 4 that house the signal analyzers and the concentrators, allowing the control centre 8 to visualise everything that occurs in the immediate surroundings thereof.

[0047] Furthermore, figure 3 of the drawings represents a possible layout protection diagram related to a sector section, such that we can observe how the corresponding security fence 1 and 1' is installed on both sides of a railway line 18, such that each of the signal analyzers 5, 5', 5",... and of the concentrators 6, 6', 6",... is connected by means of a cable 19 channelled beneath the railway line 18, with respective switch boxes 20 of redundant fibre optic rings or loops 3' arrangements. Thus, it can be observed how eight breakage detection redundant loops or rings are associated to each concentrator and to each analyzer, although the number may vary.

[0048] In this manner, the signal analyzers 5, 5', 5",... and the concentrators 6, 6', 6",... are installed on only one side of the layout, in the practical example on the security fence 1, and the associated fibre optic cables 3-3' forming a breakage detection redundant loop are

arranged such that two loops or rings are arranged on both sides and on the security fence 1' on the other side of the railway line 18, equally, the associated switch boxes 20 have two loops or rings on both sides, whereby each signal analyzer and each concentrator controls eight zones of up to 500 metres.

[0049] Thus, the security fences installed on both sides of the railway line 18 are arranged symmetrically and identically to each other.

[0050] Likewise, it can be observed how the facility has the corresponding power line 9 that feeds the signal analyzers and the concentrators, as well as the communication line 7 between the signal analyzers and concentrators, as well as with the control centre 8.

[0051] Focusing on the fibre optic cable, we can indicate that it is sufficiently resistant not to break in the event of manipulation of the fence (blows, pulling, pushing), while the fence does not break or give, such that it breaks when it is either cut exerting an action intended to cut the mesh or breaks when the forces acting thereupon are already likewise breaking the mesh.

[0052] Furthermore, with regard to camouflaging the fibre optic cable, it can be indicated that the appearance of the outer sheath of the fibre, i.e. diameter and appearance as well as touch, are identical to those of the wire rods that compose the fence and, additionally, the colour is also the same as that of the wire rods. That is, if the wire rods are galvanised, fibre cable whose outer appearance is that of the galvanised wire rods is laid and, if the wire rods are painted, the fibre cable is the same colour as that of the wire rods.

[0053] Lastly, it should be noted that the tight casings that contain the elements relative both to the analyzers and to the concentrators have a microswitch for detecting that they have been opened, as a protection against possible sabotage.

Claims

1. **A device for detecting intrusion on security fences,** being of the type of fencing consisting of:

   ➢ a plurality of posts anchored to the ground delimiting the perimeter to be protected, and
   ➢ metal mesh fixed between the posts having the corresponding wire tensioners;

   being of use for preventing access to the zone to be protected, **characterised in that** the security fence (1) incorporates:

   ➢ a plurality of multimodal fibre optic cables (3) camouflaged with the wire mesh composing the security fence, along its entire length;
   ➢ a series of signal analyzers (5, 5', 5",...) housed inside tight casings (4) with which at least one pair of fibre optic cables (3) is associated, each forming a redundant ring when assembled;
   ➢ a diversity of concentrators (6, 6', 6",...) with technology similar to that of the signal analyzers with the incorporation of a connectivity module (21), being equally housed in respective tight casings (4) and with which, at least, one pair of fibre optic cables (3) is associated, each forming a redundant ring when assembled;
   ➢ a communication line (7) of the signal analyzers and of the concentrators laid out along the perimeter to be protected;
   ➢ a control centre (8) with which the communication line communicates (7), such that the signal analyzers (5, 5', 5",...) comprise:

   • an electronic detection module (11) with the corresponding electronic control unit and connections (12) of the pairs of fibre optic cables (3) and digital inputs and outputs (13);
   • a data communication module (14) with the corresponding control unit, communicated with the electronic detection module (11) and with the adjacent signal analyzers and/or concentrator;
   • a weather management module (15) with the corresponding control unit, communicated with the data communication module (14), and which controls the weather control elements (16);
   • a power supply management module (17) which is fed by the mains (9) or by an alternative source (10) and which supplies power to the different analyzer modules.

2. **The device for detecting intrusion on security fences,** according to claim 1, **characterised in that** a data flow is transmitted via the plurality of fibre optic cables (3), whose mere interruption is indicative of a break in the fibre optic cable.

3. **The device for detecting intrusion on security fences,** according to claim 1, **characterised in that** the weather control elements (16) are defined by a temperature sensor and a humidity sensor associated with a resistor, with an automatic internal pressure relief valve and with a fan, controlling fast falls and rises in temperature in the interior of the tight casings (4).

4. **The device for detecting intrusion on security fences,** according to claim 1, **characterised in that** a concentrator (6, 6', 6",...) will be installed every certain number of signal analyzers (5, 5', 5",...).

5. **The device for detecting intrusion on security fences,** according to claim 1, **characterised in that**

the signal analyzers (5, 5', 5",...) and concentrators (6, 6', 6",...), along the security perimeter, are fed by the corresponding mains (9) or from an alternative power supply.

6. **The device for detecting intrusion on security fences,** according to claim 6, **characterised in that** the alternative power source that feeds each of the analyzers and concentrators is defined by solar panels (10).

7. **The device for detecting intrusion on security fences,** according to claim 1, **characterised in that** each of the tight casings (4) that house the signal analyzers (5, 5', 5",...) and the concentrators (6, 6', 6",...) has, at least, one battery.

8. **The device for detecting intrusion on security FENCES,** according to claim 1, **characterised in that** there may be respective lights and/or vision cameras associated with all or part of the tight casings (4) that house the signal analyzers (5, 5', 5",...) and the concentrators (6, 6', 6",...).

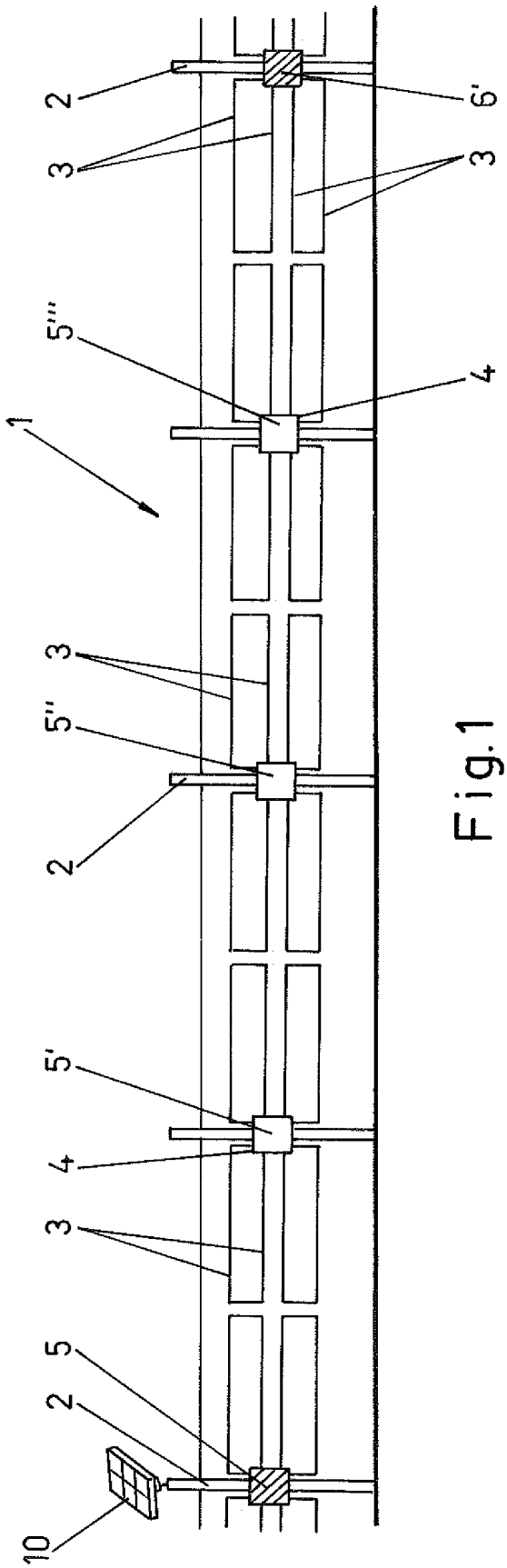

Fig.1

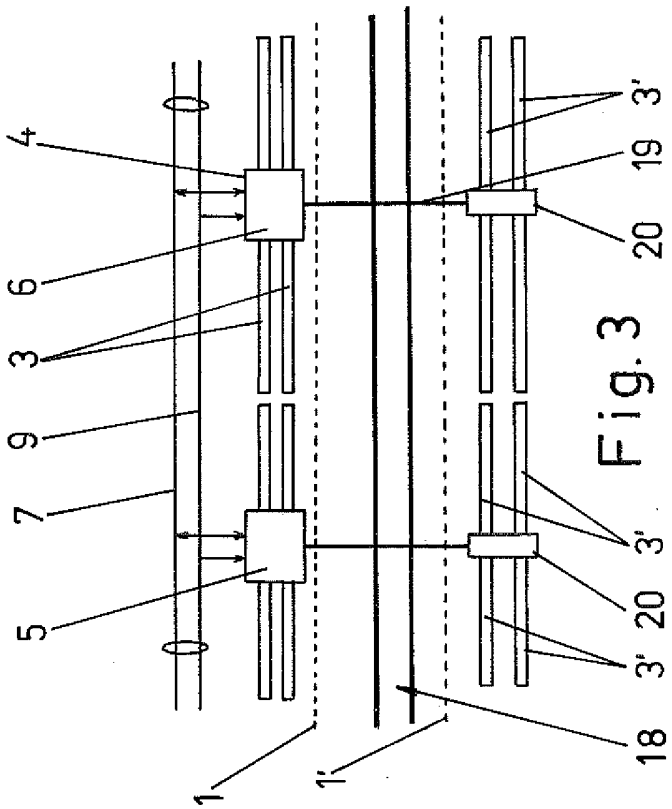

Fig. 3

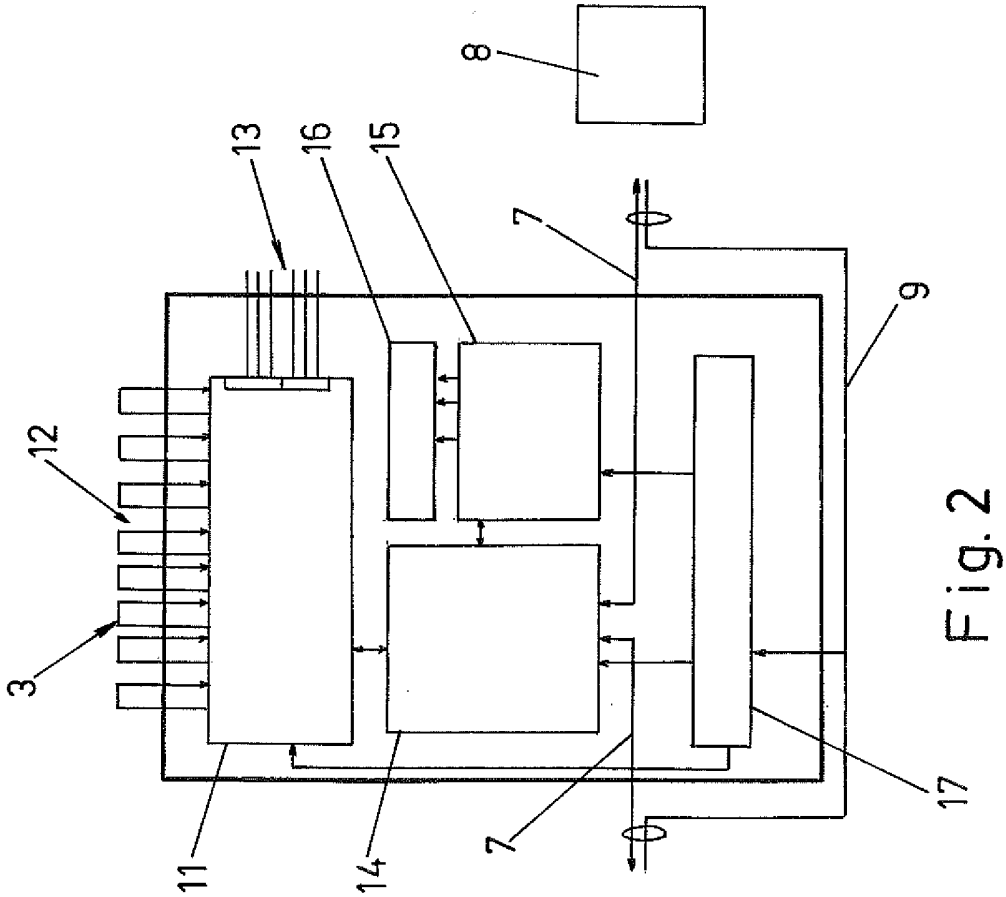

Fig. 2

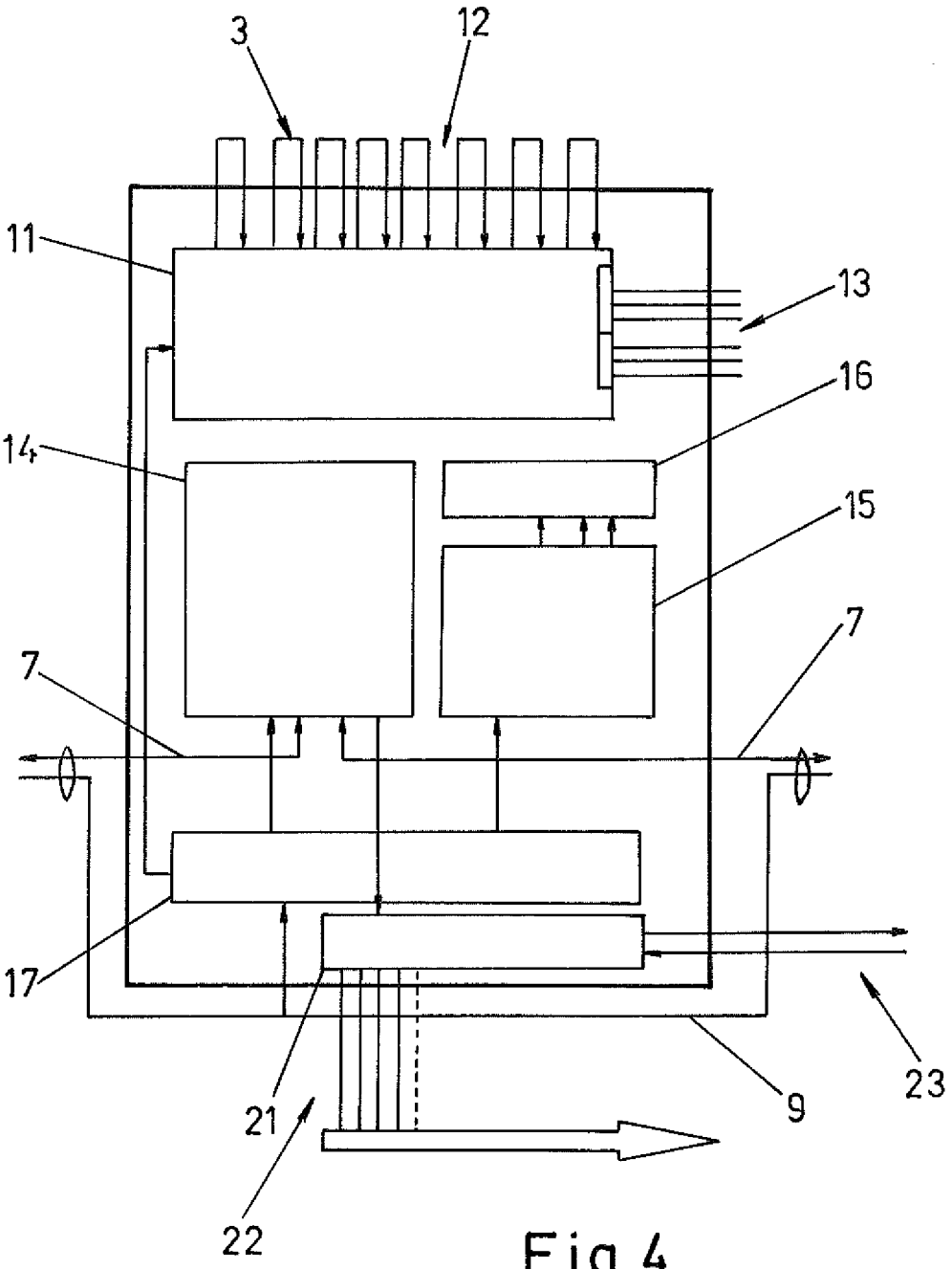

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2014/070341

A. CLASSIFICATION OF SUBJECT MATTER

G08B13/12 (2006.01)
E04H17/14 (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G08B, E04H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2396694 B (SENSTAR STELLAR CORP) 28/12/2005, page 2, line 30-page 3, line 12; page 13, line 6-page 22, line 16; page 23, lines 17-26; figures 1-6.	1-2, 4-8
A	WO 2010027462 A2 (SOLARBEAM SECURITY LLC ET AL.) 11/03/2010, page 11, line 23-page 12, line 29; page 15, line 21-page 16, line 8; page 20, line 17-page 21, line 12; page 22, line 28-page 23, line 24; figures 1, 6-9, 11, 35, 36.	1-3, 5-8
A	US 2007194915 A1 (CHUN HONG-GI) 23/08/2007, paragraphs 20-31; figures 1, 2.	1, 2, 5-8
A	US 5801632 A (OPAL ANTHONY P) 01/09/1998, column 2, line 45-column 4, line 12; figures.	1, 3, 5-7

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
14/07/2014	**(15/07/2014)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer M. Lloris Meseguer Telephone No. 91 3495494

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2014/070341

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4931771 A (KAHN WALTER K) 05/06/1990, column 2, lines 4-35; column 3, lines 14-55; figure 1.	1, 2
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