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(54) **Road mirror with heating and alarms**

(57) Device and method for the confident working and management of the reflecting mirror used for the extension of the visibility in critical areas of the road runs. The reliability is obtained through the supervision of the possible environment conditions critical for temperature and humidity, through supervision of the possible failures of the heating system (4) and through supervision of the possible drift of the orientation of the optics (3). Such supervisions are interlaced with alarms (11,12) towards the user to alert him about the non reliability of the apparatus and/or towards the body involved in the road signals so that he proceeds with the proper interventions. As well the proper functioning can be pointed out. This is obtained through a microprocessor whose inputs are constituted by signals coming from: temperature sensor, humidity sensor, compass, x inclinometer, y inclinometer, electric supply and set points and whose outputs are constituted by site luminous alarms and remote alarms via modem or via radio.

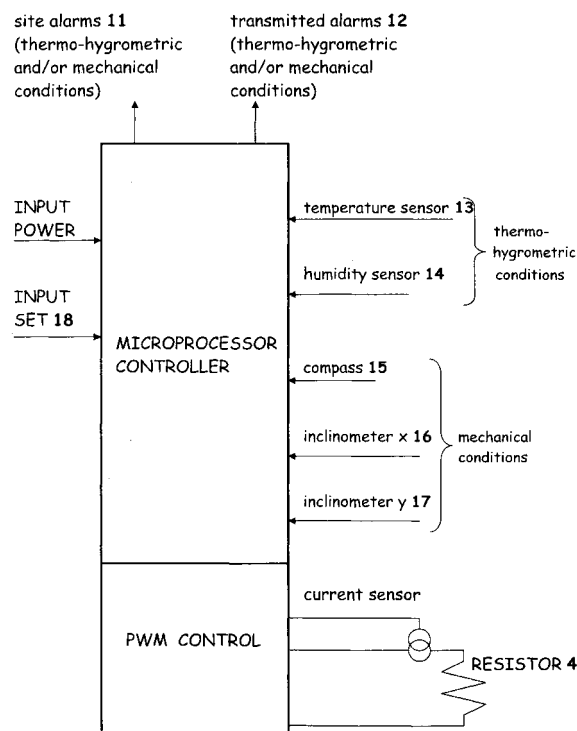


Figure 3

Description

DESCRIPTION

[0001] Device and method for the confident management of the reflecting mirror used for the extension of the visibility in critical areas of the roads runs.

BACKGROUND OF THE INVENTION

[0002] Nowadays the use of reflecting mirrors, generally circular but as well sometime rectangular, located in correspondence of crossings, connections, feeder-lines junctions or sharp curves to allow the driver having visibility over zones which otherwise should be non-reachable or masked due to the natural site conformation. Such extension of visibility, other than regarding the places, above all presents to the driver the state of the traffic and particularly the coming of vehicles from the zone with interdicted visibility. Since decennia the installation of such known reflectors has contributed indeed to the limitation of the road accidents. Such auxiliary apparatus developed exponentially, as well as the increasing of the roads net and of the traffic.

[0003] The state of the art, regarding such reflectors, both as base configuration and as advanced devices, is typically constituted by the following patent applications:

[0004] FR 2 884 837 A1 co-applicant and inventor Jean Francois LENOIR dated 26.04.2005, which is now cited as state of the art relative to the modality of heating for the elimination of the water condensation (known as dew) and for the elimination of the ice (known as frost or quite ice).

[0005] EP 1 475 767 A3 applicant and inventor Lee Kil-Suo with Korean priority 09.05.2003, which is now cited as state of the art relative, other than to the known optic reflection, to the modality of displaying luminous messages/icons.

[0006] Such inventions, by the way recent (so confirming the non-crowded sector in terms of patents) , and the relative embodiments, teach respectively only:

[0007] FR 2 884 837 A1: the heating happens by means of the electric energy coming from electric system or from photovoltaic accumulator, which feeds an electric resistance constituted by a wire in adhesion or screen printed on the inside surface of the reflector or constituted by an electricity conductive coating sputtered on the same face. The heating control is obtained through a switch actuated by means of an electronic card interfaced with a thermal sensor and with an hygrometric sensor. The embodiment modes are left to the reader interpretations as not enough described.

[0008] EP 1 475 767 A3: the inventive step is limited to the system management constituted by a photovoltaic accumulator or an electric system and an electronic card used to supply leds (light emitting diodes) to visualize messages/icons across the road reflector.

[0009] Other state of the art, constituted by non-pat-

ented disclosures, is identified on the same manufactures developed in terms of shapes (circular or rectangular or different shapes); of materials and finishing [painted steel, galvanised steel, stainless steel, chromed or non chromed plastic materials; glass (mirror) etc.]; of supports types (fixed, hinged, etc.); but non containing anything of innovative and/or inventive.

[0010] The issues and lacks of the known techniques above described are that, in one or more of the following conditions:

missing or altered visibility with determined thermo-hygrometric conditions conducting to condensation (dew);

missing or altered visibility with determined thermo-hygrometric conditions conducting to ice (frost);

failure of the heating system (if installed) ;

altered optic reflection due to the drift of the fastening set;

altered optic reflection due to the failure or the damage of the support;

the user thinks the reflector free from failures and assumes as true the information coming from the observation of the reflector.

[0011] In any case of failure, either due to the thermo-hygrometric conditions or due to the not proper geometric trim of the reflector, the function of the reflectors is dangerously worsened in comparison with the non-existence of the same as deceives the driver showing a wrong provenance or quite a non-provenance of vehicles which at the contrary are present. Moreover, in such conditions of optical aberrance or ,anomalies, as well the driver coming from the road having precedence right is not alarmed or aware of the presence of vehicles waiting for flowing or entering and so he is not induced, as for sake of safety it would happen even if with right of precedence, to reduce his speed or at least to increase his level of attention due to the potential risk situation.

[0012] As summary the heavy troubles that we can find on the existing installations are: wrong or missing indication due to the formation of condensation (dew) or of ice (frost), in spite of the presence of a heating apparatus (the same apparatus becoming insufficient in climate conditions very cold or the same apparatus becoming damaged), or due to the alteration or the drift of the geometric trim and above all: missing of alarms indicating one or more of the above listed possible failures, both towards the road user and towards the body charged for the installation, the management and the maintenance of the apparatus.

[0013] Main aim of the object of the present application is therefore that to solve the listed technical issues, eliminating all the inconveniences of the cited state of the art and therefore to contrive a device and a method that allows to alarm the drivers about the malfunctioning or possible malfunctioning of the optics of the reflector, either due to the consequences of the thermo-hygrometric con-

ditions or to the failure of the heating system or to the failure of the geometric trim referred to the site conditions.

[0014] Further aim is that to alarm in real time the bodies involved in the road signals management about the possible failures so that the intervention for the re-establishment or for the interdiction is prompt or anyhow programmable.

[0015] Further aim is that of optimise / improve the mode of anti-dew and anti-frost heating in comparison with the poor situation of the patent state of the art, from the energy saving point of view.

[0016] Such aims are achieved through the following concepts:

installation of a site alarms assembly each one indicating respectively:

-- the presence of thermo-hygrometric conditions which could have caused condensation (dew);

-- the presence of thermo-hygrometric conditions which could have caused ice (frost);

-- the lack of efficiency or the failure of the heating system;

-- the lack of the correct optical geometric trim;

-- in case, the normality of the situation (even if with the reserve, to be implemented on the Road Circulation Code, about the non-responsibility of the management body of the apparatus and about the non-replacement of the user attention with auxiliary means as the road reflectors).

installation of a GSM modem transmitter which duplicates the site alarms above described sending signals about the state of the same towards the bodies supervising the safety of the road circulation;

optimisation of the energy consumption through an algorithm elaborating: the physical magnitudes (interlaced in the J-X diagram of the humid air or in correspondent excel sheets and memorised into a microprocessor, as the dry bulb temperature, the wet bulb temperature, the enthalpy, the relative humidity, the water content, etc.); the site thermo-hygrometric conditions; the modulation of the electric power to the heating apparatus.

[0017] The synthetic description of the drawings and the detailed description of a preferred embodiment will clarify how the invention object of the present application can be carried out by the skilled man of the art.

BRIEF DESCRIPTION OF THE FIGURES

[0018]

Figure 1 represents schematically the device both regarding its parts in prevalence known as the support 1, the fastening 2, the convex mirror 3, one of

the possible heating means 4, the equalisation means 5, the insulating means 6 and one of the possible energy supply 7, 7' for the heating, and regarding its inventive parts like the site alarm systems 11 relative to a possible inefficiency of the optics having thermo-hygrometric origin (condensation or ice or possibility of condensation or ice) or having mechanical origin (drift of setting) and like the corresponding remote transmission systems for the remote alarms (modem GSM) 12.

Figure 2 represents the functions for the heating optimisation algorithm, as summarized in the psychrometric diagram of the humid air J-X (interlacing between dry bulb temperature, wet bulb temperature, relative humidity, water content, enthalpy, etc.). In such diagram points like "A" relative to the environment thermo-hygrometric conditions and "S" relative to the saturation thermo-hygrometric conditions, which involve formation of condensation or ice in function of the temperature, have been put in evidence.

Figure 3 represents the flow chart of the inventive part constituted by the alarms system (site 11 and remote 12) relative to a possible lack of efficiency of the optics having thermo-hygrometric origin (condensation or ice) or mechanical origin (drift of setting) managed by a microprocessor elaborating the signals coming from the temperature sensor 13, from the humidity sensor 14, from the inclinometer sensors 16 and 17 and represents the flow chart of the known part constituted the heating control system (PWM type) tuning the power to the resistance 4 (but still with an important inventive component described hereunder), as well represents the input system 18.

Figure 4 represents the scheme of the electronic circuit, managed by a microprocessor, for the thermo-hygrometric type alarm, for the mechanical type alarm, for the temperature control and for the remote transmission of the same alarms by means of GSM modem. The correspondence with the numbering used in the other figures, in the description and in the claims is the following: R1 = 4; ALARM 1, ALARM 2 = 11; GSM MODEM = 12; IC3 = 13; IC2 = 14; IC6 = 15; IC4 = 16; IC5 = 17; S1 = 18; +12V = 7'.

PREFERRED EMBODIMENT

[0019] Hereunder a detailed description of a preferred embodiment of the invention.

[0020] The numbering with one digit is used for the generic known components, the numbering with two digits is used for the inventive components.

[0021] To describe such embodiment, which extends to all the equivalent embodiments, reference is made mainly to the exhaustive figures 1, 2, 3, and for some details to the figure 4.

[0022] The innovative principle is constituted by the

heating control logic and by the alarm control logic and particularly the alarm logic is useful and sometimes vital to signalize danger / risk situations or failure situations which at the contrary, as it happen nowadays, are not expected by the users even if present. Parameters like temperature and humidity, coming from respective sensors 13 and 14 as (for example) millivolt signals and once elaborated by the microprocessor, are identifying the coordinates of the thermo-hygrometric conditions "A" in the J-X diagram of humid air (figure 2). The same microprocessor is then identifying the distance, in terms of temperature difference Δt , between the point "A" and the correspondent point "S" intersection of the iso-enthalpic line crossing the point "A" with the $\phi = 100\%$ curve (relative humidity). The heating control is carried out through PWM modulation, known by itself, but using as PID parameters respectively the following: for the proportional term P the value $1/\Delta t$ (or an equivalent value), for the derivative term D the value $-\Delta t/\Delta \tau$ or better $-dt/d\tau$ (or an equivalent value), for the integrative term I a value settable by means of a trimmer (the used nomenclature being that of the automatic control principles and of the differential mathematic analysis and τ being the time). In such a way as much as near to the "S" saturation conditions the environment conditions are and as quicker the approaching to the saturation conditions is, either conducting to condensation or conducting to ice, and as much intensive the heating power, modulated to the resistance 4 is. All times the PWM modulation is functioning, at the same time the site alarms 11 and the transmitted alarms 12 are activated, carrying into effect the alert for the site alarm 11 and the transmitted alarms 12 above described. An alternative algorithm can be that, by using two sensors respectively measuring the ambient temperature t_A and the reflector temperature t_R , to control the electric power to the resistance 4 or by means of ON/OFF switching or by means of SCR diodes or power transistors which trimming signal is constituted by $1/(t_A - t_R)$ (or an equivalent value) for the proportional P term and by $-d(t_A - t_R)/d\tau$ (or an equivalent value) for the derivative D term. The parameters orientation 15, inclination x 16, inclination y 17, sent to the microprocessor as (for example) millivolt signals are compared with the range of set point values 18 as set during the original and correct installation. Once such comparison reveals one or more parameters out of range, site alarm 11 and remote alarms 12 are activated. The microprocessor managing all the functions described in the present paragraph being as example the PIC16F877P in whose programmable memory the humid air psychrometric diagram J-X (Figure 2) data and heating trimming power algorithms are resident. The site alarm 11 can be flashing indicators, rotating indicators or leds (light emitting diodes), which location has to be visible from the different users.

[0023] An ideal combination of the sizes and patterns of the device is the following: reflector 4 diameter 500 mm; reflector 4 material chromed plastic as ABS, chromed steel, stainless steel; insulating material ex-

panded polyurethane or expanded polystyrene; equalising material 5 rubber or other material having high thermal capacity or gel contained between membranes and possibly communicating with a volumetric expansion chamber (having in this case the function of augment the thermal capacity).

[0024] The present invention is suitable of a number of embodiments variants, (in comparison with what disclosed with the figures, which details are evident and eloquent, and disclosed with the description), particularly regarding type and functions of the microprocessor, all variants belonging to the equivalence with the inventive step that is that one to alarm the user and the management body about the state of the reflector, either thermal or mechanic, and that one to minimise the electric energy consumption.

INDUSTRIAL USE

[0025] The industrial use is certainly successful as nowadays every enterprise turned to the safety (in this case the reduction or the elimination of the road accidents) or to the environment (in this case the energy saving) raises a dominant position also in comparison with the economic aspects so to become a reason for getting financial assignments, sometimes without return or sometimes at least with favourite rate, from governmental and non-governmental bodies either central or peripheral. Moreover the interventions to carry out such improvements in the field of safety and environment can be split to a site dimension with easy tolerance of the costs of some thousands Euros in situations where budgets and balances are in the order of millions of Euros. Moreover, as well in the use in private situation, for example to help the paths in private residential areas, the cost of some thousands of Euros, particularly taking advantage from the above mentioned contributions, is justified and tolerable, especially such a cost being shareable between several users.

Claims

1. A device for the managing of the road reflectors with anti-condensation and anti-frost heating system, such reflectors being fundamentally constituted by a support (1), an hinged fastening (2), a convex mirror (3), an heating system by means of electrical resistance either wired or screen printed or sputtered (4), an insulating system (6) and an electrical energy source (7, 7') **characterised in that** at least one alarm or typically various and different alarms (11, 12) point out to the user and/or to the management body respectively: the presence of thermo-hygrometric conditions which could cause or could have caused condensation; the presence of conditions which could cause or could have caused ice; the failure of the heating system; the drift of the right

optic trim.

2. The device as per claim 1 **characterised in that** the communication to the user is carried out through more visual alarms (11), each one identifying one type of failure. 5
3. The device as per claim 2 **characterised in that** such communication is carried out through an only one generic visual alarm (11) having a continuous or flashing light, for example with orange colour light. 10
4. The device as per claim 1 **characterised in that** the alarms (11, 12) include as well the case of communication of the normality of the thermo-hygrometric conditions not requiring heating, and/or the proper functioning of the heating when the thermo-hygrometric conditions require heating, and/or the proper trim of the geometry of the apparatus, for example with green colour light. 15
5. The device as per one or more of the above claims **characterised in that** the alarms (12) transmission towards the body managing the road mirrors is carried out by means of modem GSM signal. 25
6. The device as per one or more of the above claims **characterised in that** the insulation system (6) is integrated with a means (5), fluid or gel typically, having thermal capacity and equalising property, possibly extended by means of a volumetric reservoir, for the heat accumulation during the mild climate conditions t_A and for the heat return during the rigorous climate t_A . 30
7. The device as per one or more of the above claims **characterised in that** the electric power supply for the heating (4); for the electronic card logic; for the communication (11); for the remote transmission (12) is supplied by electric net or by accumulator (7') fed by photovoltaic panel (7). 35 40
8. The device for the managing of the road reflectors with anti-condensation and anti-frost heating system, such reflectors being fundamentally constituted by a support (1), an hinged fastening (2), a convex mirror (3), an heating system by means of electrical resistance either wired or screen printed or sputtered (4), an insulating system (6) and an electrical energy source (7, 7') **characterised in that** the heating control is obtained modulating the PWM power by means of a PID control whose proportional mode P is $1/\Delta t$ or an equivalent parameter, whose derivative mode D is $-\Delta t/\Delta \tau$ ($-dt/d\tau$) or an equivalent parameter, whose integrative mode I is adjusted by means of a trimmer; where Δt (dt) is the difference between the ambient temperature t_A and the corresponding dew (or frost) temperature t_S [obtained through the mi-

croprocessor elaborating the signals of the thermal sensor (13) and hygrometric sensor (14) by means of an algorithm containing the relationship of the psychrometric diagram J-X of the humid air] and $\Delta \tau$ (dt) the corresponding variation on time.

9. The device as per claim 8 **characterised in that** the heating control is obtained modulating the PWM power by means of an ON/OFF or a SCR diodes or a power transistors control whose input proportional signal P is $1/(t_A - t_R)$ or an equivalent parameter, whose input derivative signal D is $-\Delta(t_A - t_R)/\Delta \tau$ [$-d(t_A - t_R)/d\tau$] or an equivalent parameter, where t_A is the ambient temperature, t_R is the reflector temperature and $\Delta \tau$ (dt) the corresponding variation on time.
10. A method for the control and the survey of the heating of the road reflectors provided with anti-condensation and anti-ice heating system arranged on the inside surface of the reflector 3 as wired resistor or screen printed resistor or sputtered resistor 4 **characterised in that** a microprocessor logic manages one or more of the following functions: elaboration of the inputs: temperature (13), humidity (14), orientation (15), inclination x (16), inclination y (17); heating control, with energy saving optimisation based on the psychrometric J-X diagram of the humid air and elaboration algorithms; site alarms (11) towards the user monitoring the state of failure and/or the state of normality; remote alarms (12) towards the body monitoring the state of failure and/or the state of normality.

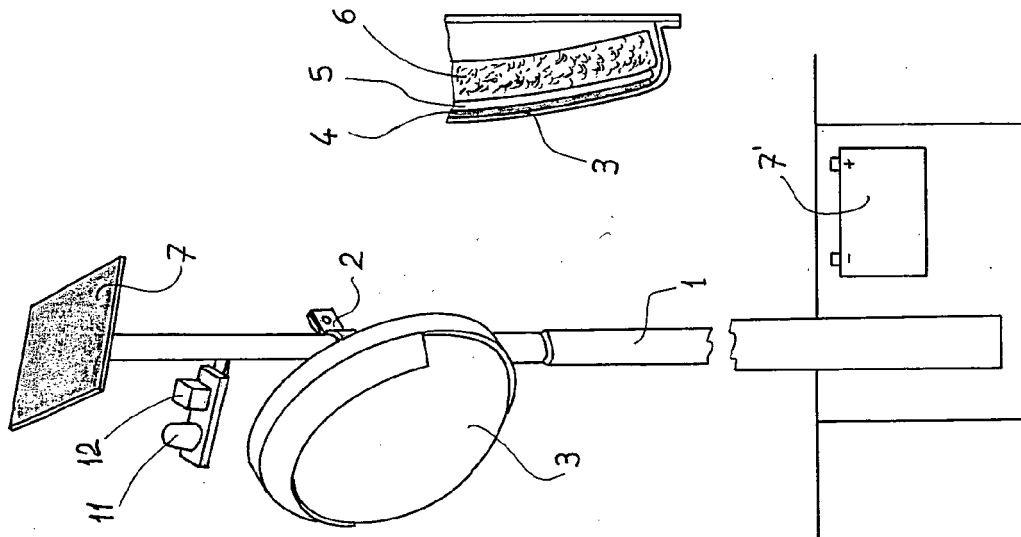


Figure 1

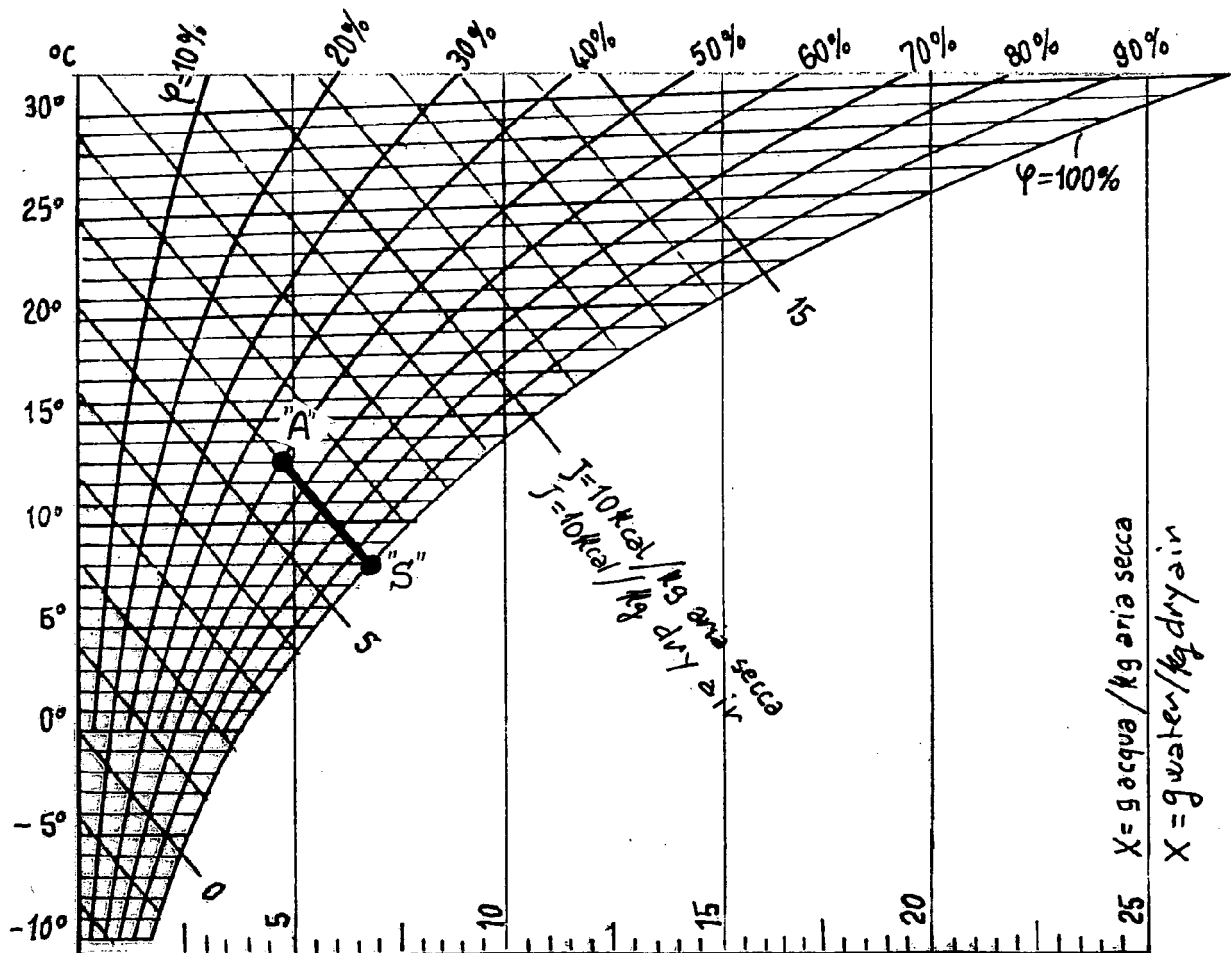


Figure 2

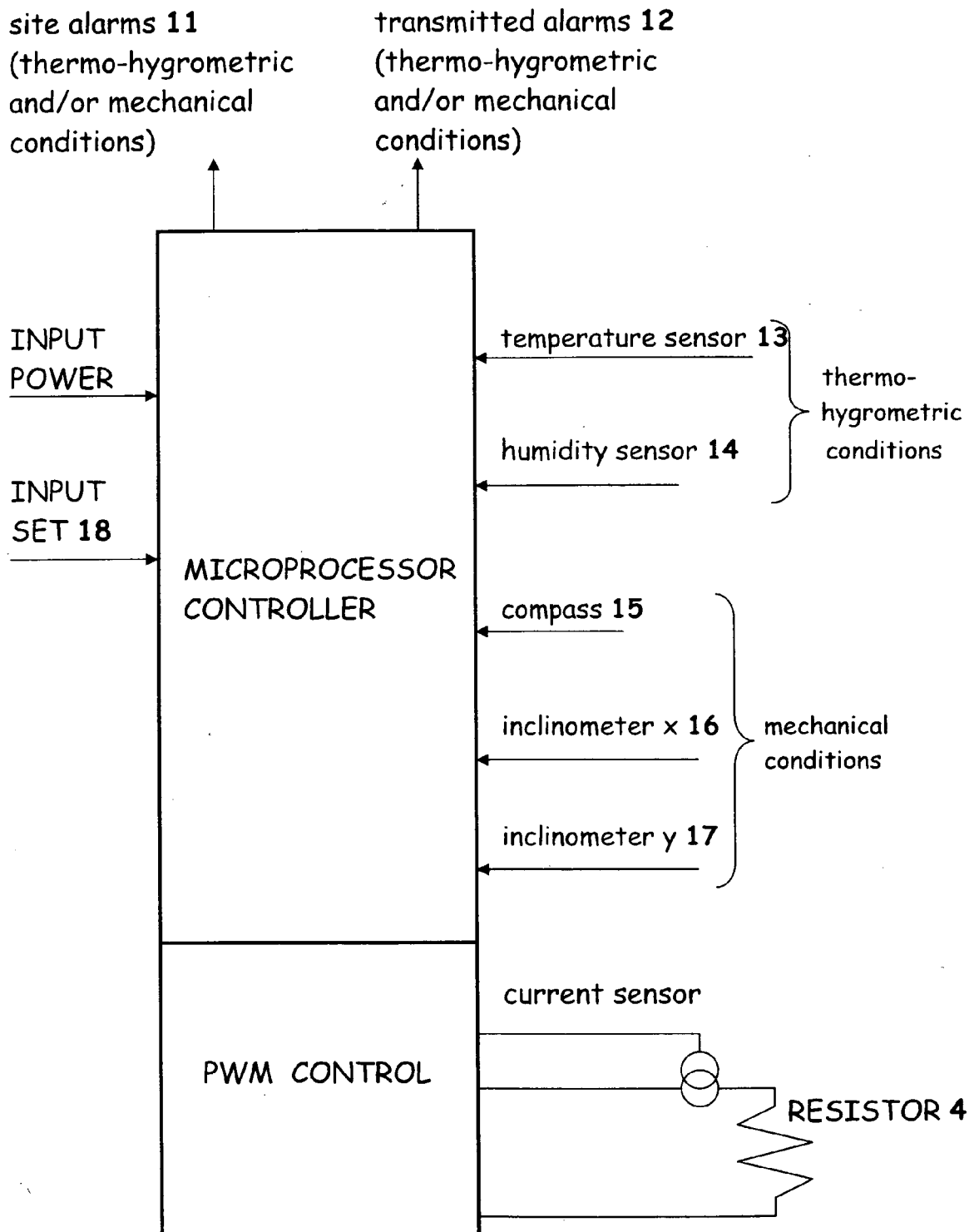
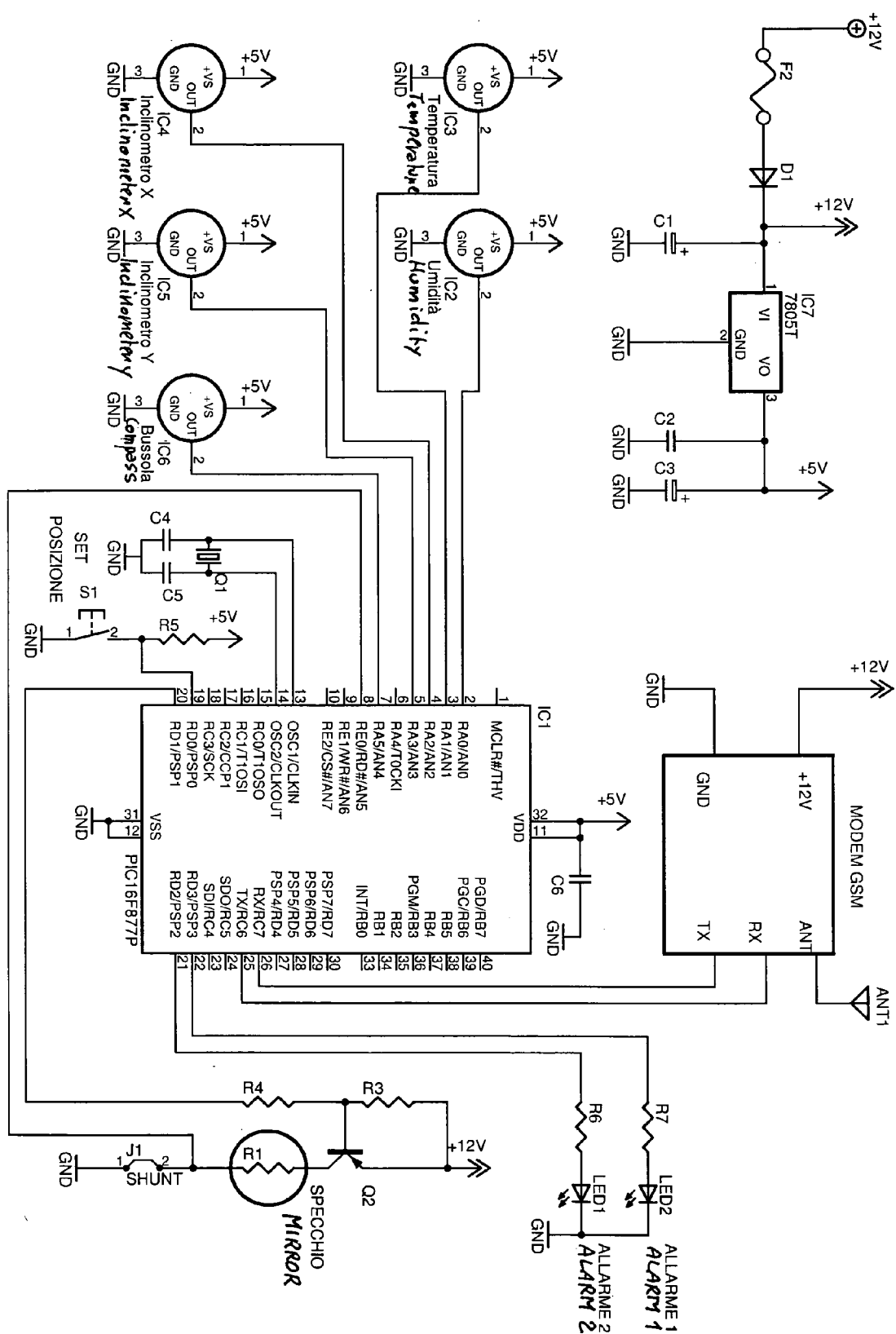


Figure 3



Figur 4

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- FR 2884837 A1 [0004] [0007]
- EP 1475767 A3 [0005] [0008]