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(56) Documents cited  
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UK CL (Edition J) **G1A AMP AMZ**  
INT CL<sup>4</sup> **G01N**

(54) **Detecting water droplets on a vehicle window and controlling windscreen wiper in response thereto**

(57) A sensor device (1) for detecting the presence of water droplets on a window (3) of a vehicle comprises a light source (7) installed along the lower edge of the window (3) and a photodetector (8) installed along the upper edge of the window (3) and operable to generate an electrical signal corresponding to the intensity of light which strikes it. Electrical windscreen wiper control apparatus may comprise the sensor device (1), means (13, 14, 15 and 16) including a comparator (16) for processing the electrical signal from the photodetector (8), and means (17 and 18) for controlling actuation of the windscreen wiper according to whether the signal reaching the comparator (16) from the detector (8) is above or below a reference signal.

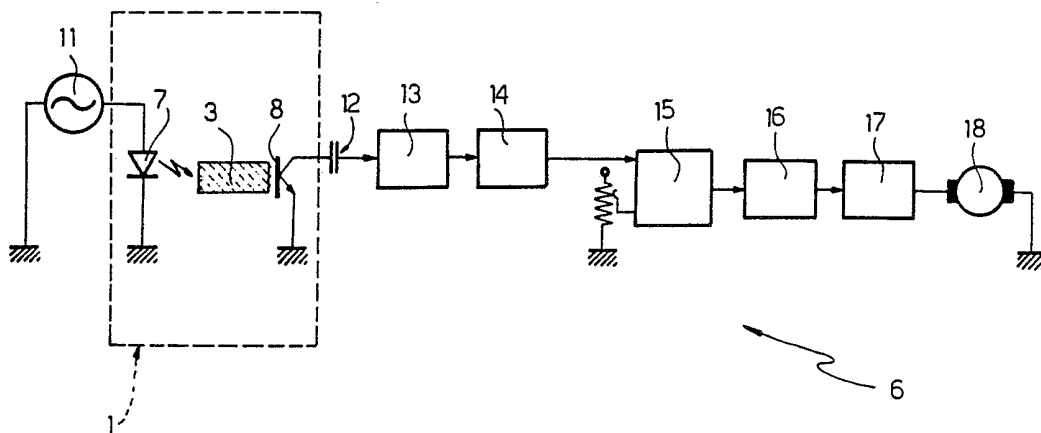


Fig. 3

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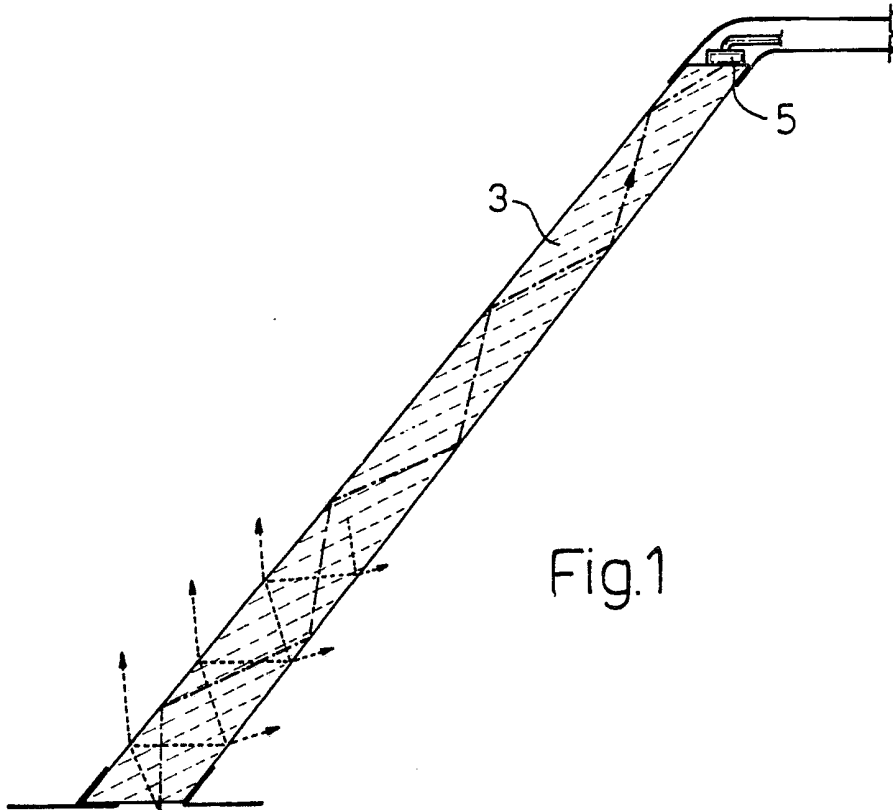


Fig. 1

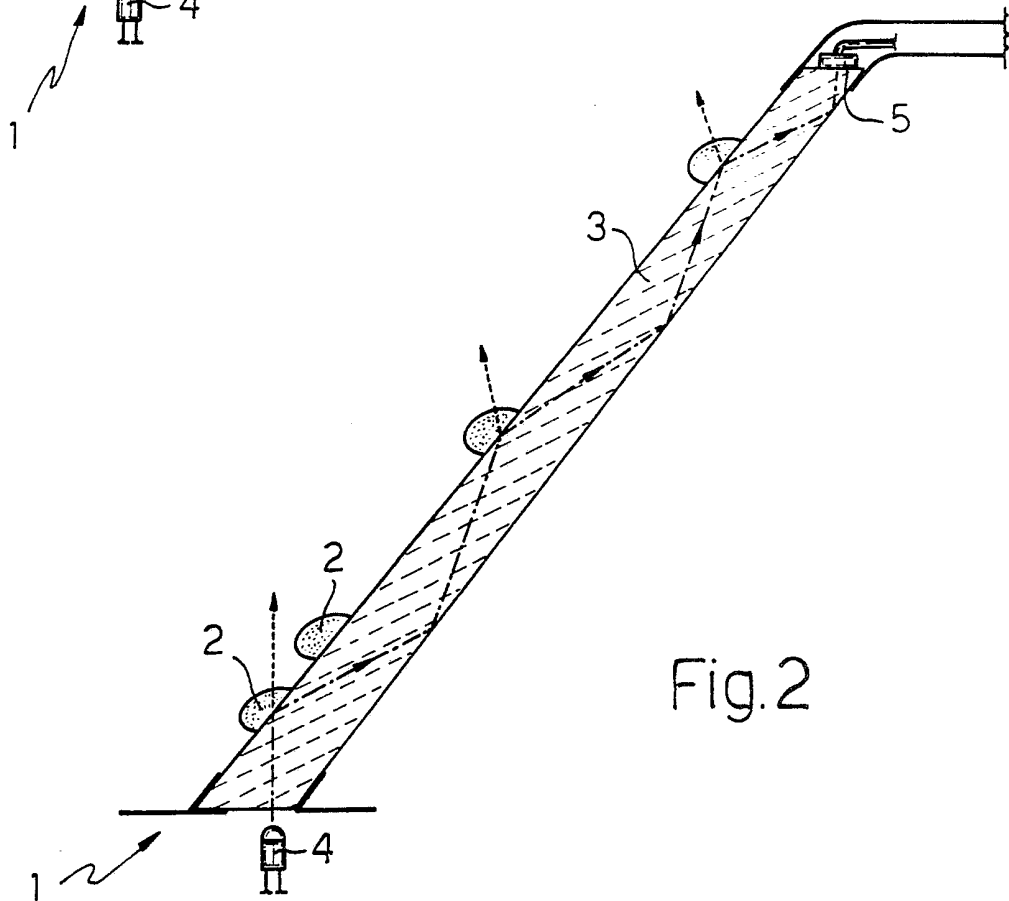


Fig. 2

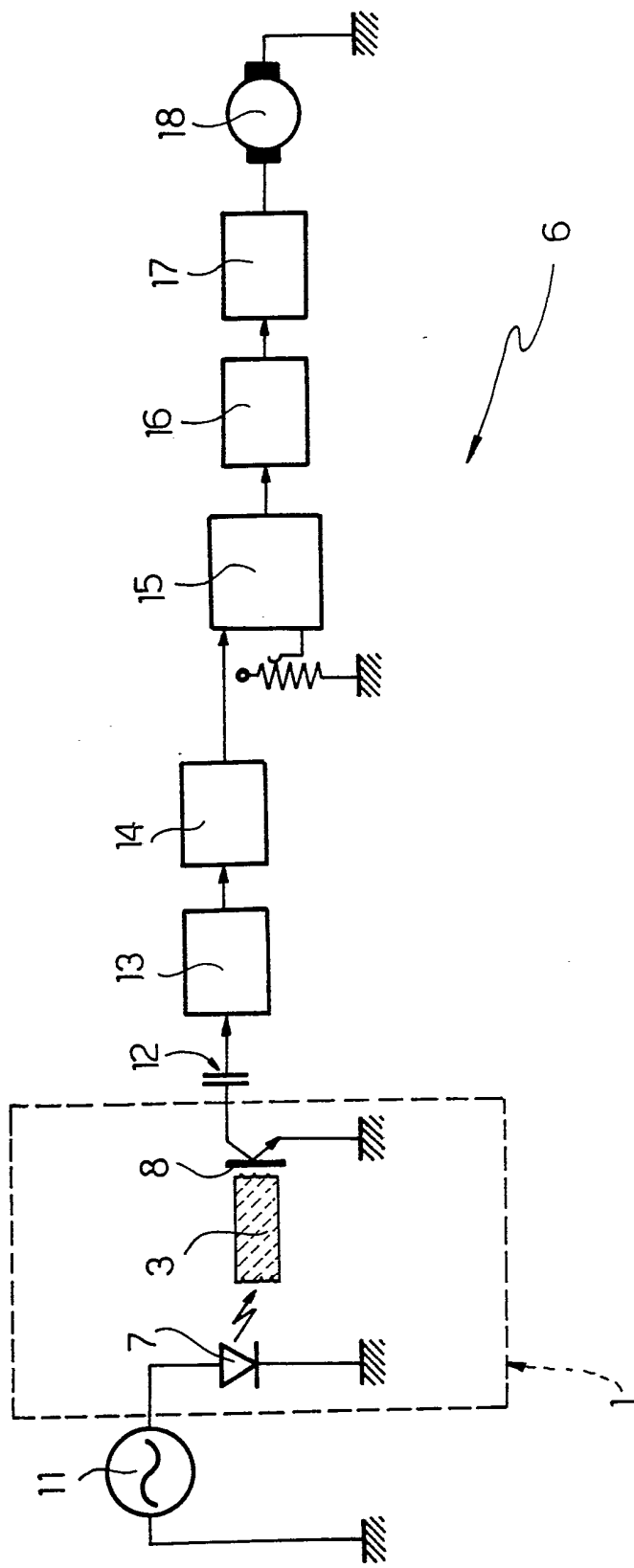


Fig. 3

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A SENSOR DEVICE FOR DETECTING THE PRESENCE OF WATER  
DROPLETS ON A VEHICLE WINDOW AND WINDSCREEN WIPER CONTROL  
APPARATUS PROVIDED WITH SAID DEVICE

- 5 The present invention relates to a sensor device for detecting the presence of water droplets on a window. The present invention further relates to windscreen wiper control apparatus provided with said device.
- 10 An object of the present invention is that of providing a sensor device for detecting the presence of water droplets on a vehicle window which can be simple to produce and assemble and of low production cost.
- 15 A further object of the present invention is that of providing windscreen wiper control apparatus provided with the said device, which can be simple to produce and of low production cost.
- 20 According to the present invention there is provided a sensor device for detecting the presence of water droplets on a vehicle window, characterised by the fact that it comprises:
- 25 a light source adapted to be installed close to the lower edge of the said window, which emits light rays which enter, through the said lower edge, into the said

window; and

a photodetector adapted to be installed close to the upper edge of the said window, the said photodetector emitting an electrical signal dependent on the intensity of the light rays which reach it after having traversed the said window.

According to the present invention there is further provided apparatus characterised by the fact that it comprises:

at least one sensor device for detecting the presence of water droplets on a window, of the type comprising a light source installed close to the lower edge of the said window and operable to emit light rays which enter through the said lower edge into the said window, which guides the said light rays and conveys them towards a photodetector installed close to the upper edge of the said window, and which is operable to emit an electrical signal corresponding to the intensity of light which strikes it; electrical processing means for processing the said electrical signal generated by the said photodetector; and

electrical control means for actuating the said windscreen wiper.

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For a better understanding of the present invention a

preferred embodiment is now described by way of non-limitative example and with reference to the attached drawings, in which:

Figures 1 and 2 illustrate the operation of a sensor device formed according to the principles of the present invention in two different working conditions; and

Figure 3 is an electrical block diagram of windscreen wiper control apparatus provided with the device of Figure 1.

As illustrated in Figures 1 and 2, the reference numeral 1 indicates a sensor device for detecting the presence of water droplets 2 on a window 3 of a vehicle. The device 1 can be applied to the windscreen and/or the rear window of the vehicle.

The device 1 comprises a light source 4 mounted facing the lower edge of the window 3 in such a way that the light rays emitted thereby enter into the window 3 through this lower edge, and a photodetector 5 installed along the upper edge of the window 3 and able to receive the light rays emitted by the source 4 and reflected along the window.

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With reference to Figure 1, according to the known laws

of optics, if the light rays are emitted with a low angle of incidence to the face of the window 3 they propagate along it, whilst if emitted with a high angle of incidence they are attenuated in that each ray is in part refracted towards the outside and in part reflected along the window 3. However such reflection takes place always with a high angle of incidence so that gradually as it propagates upwards each light ray is even more attenuated. For this reason the intensity of light conveyed towards the photodetector 5 is represented almost exclusively by the light rays emitted with a low angle of incidence.

With reference to Figure 3, in the case in which the outer face of the windscreen 3 has water droplets 2 present, these operate as spherical dioptric surfaces so that even the light rays emitted with a low angle of incidence are attenuated in that each of these, when incident on a zone in which a water droplet is present, is partly refracted outwardly and partly reflected along the windscreen 3. Consequently, if there are water droplets 2 present on the window 3 the intensity of light which the window 3 conveys towards the photodetector 5 is less than that conveyed when there are no water droplets 2 on the window 3.

As illustrated in Figure 3, the reference numeral 6 generally indicates electrical apparatus which, on the basis of the light intensity conveyed to the photodetector 5, is operable to control actuation of a windscreen wiper, not illustrated for simplicity, but operable to wipe the window 3.

The apparatus 6 includes the sensor device 1 which, in this embodiment, has a light source 4 constituted by a light emitting diode (LED) 7 and a photodetector 5 constituted by a phototransistor 8. The apparatus 6 further includes an electric current source 11 operable to supply the diode 7 and a processing and control circuit which has, in succession from the phototransistor 8, a capacitor 12, a signal amplifier block 13, a detector block 14, a comparator block 15, a power amplifier block 16, and a block 17 for controlling an electric motor 18 operable to drive the windscreen wiper. Therefore, the value of the light intensity conveyed to the phototransistor 8 has a corresponding proportional electrical signal which is amplified by the block 13. The block 14 detects the presence of this signal and transmits it to the block 15 which effects a comparison of the amplitude of the signal itself with a predetermined reference signal.



If the signal coming from the block 14 is less than the reference value (which signifies that there are droplets of water 2 on the window 3) the apparatus 6, via the blocks 16 and 17, controls the electrical supply of the motor 18 which in turn puts the windscreen wiper in motion, for example for a single wipe across the window 3.

Naturally it is possible to modify the apparatus 6 in such a way that it controls the actuation of the windscreen wiper for example for two or more wipes upon each detection of water droplets.

From what has been explained above the advantages achieved with the embodiment of the present invention are apparent.

In particular, the apparatus 6 detects the possible presence of water droplets on the window, without any action by the driver, and automatically provides for the removal of these. The driver therefore does not have to do anything and can therefore concentrate solely on driving the vehicle. This advantage is more apparent in particular conditions such as, for example, in the case of intermittent rain and in the case of a wet road in which water spray thrown up from other vehicles strikes

the windscreen, and in which the driver, in the absence of the apparatus 6, must operate the windscreen wiper often but with irregular frequency. Further, the constructional simplicity of the device 1 and the apparatus 6, which allows their production at low cost is emphasised.

Finally, it is clear that the device 1 and the apparatus 6 described and illustrated here can have modifications and variations introduced thereto without by this departing from the protective ambit of the present invention.

In particular, the apparatus 6 could include a plurality of devices 1 connected in parallel and disposed along a window 3 at a predetermined distance. This arrangement allows the actuation of the windscreen wiper to be controlled even when the water droplets are deposited, for example in the case of the condition of Figure 2 first described, only on a zone of the window 3 of limited extent but which could be important for correct visibility (thinking, for example, of the wide windows of industrial vehicles or of goods or passenger transports).

CLAIMS

1. A sensor device for detecting the presence of water droplets on a window of a vehicle, characterized by the fact that it comprises:
  - a light source adapted to be installed close to a first edge of the said window, which emits light rays which enter through the said first edge into the said window; and a photodetector which can be installed close to a second edge of the said window, opposite the said first edge, the said photodetector emitting an electrical signal dependent on the intensity of the light rays which reach it after having traversed the said window.
2. A sensor device according to Claim 1, characterized by the fact that the said light source comprises a light emitting diode.
3. A sensor device according to Claim 1 or Claim 2, characterized by the fact that the said photodetector comprises a phototransistor.
4. Windscreen wiper control apparatus characterized by the fact that it comprises:
  - at least one sensor device for detecting the presence of water droplets on a window and of the

type comprising a light source installed close to one edge of the said window and operable to emit light rays through the said one edge, into the said window which guides these rays and conveys them towards a  
5 photodetector installed close to an edge of the said window opposite the said one edge, which acts to emit an electrical signal corresponding to the intensity of light which strikes it;

electrical processing means for  
10 processing the said electrical signal generated by the said photodetector ; and

electrical control means for controlling the actuation of the said windscreen wiper.

15 5. Apparatus according to Claim 4, characterized by the fact that the said processing means include a comparator block operable to compare the value of the said electrical signal with a predetermined reference value.

20 6. Apparatus according to Claim 5, characterized by the fact that the said processing means comprise, downstream from the said photodetector , a signal amplifier block, a signal detection block , the said comparator block , and a power amplification block .

7. Apparatus according to Claims 5 and 6,  
characterised by the fact that the said control  
means comprise a block for controlling an electric  
5 motor operable to actuate the said windscreen wiper.

8. A sensor device for detecting the presence of water  
droplets on a window of a vehicle according to one of  
Claims 1 to 3, essentially as described and illustrated  
10 with reference figures 1, 2 and 3 of the drawings.

9. Windscreen wiper control apparatus according to one  
of Claims from 4 to 7, essentially as described and  
illustrated with reference to figure 3 of the drawings.

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