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(56) Documents cited

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(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 (2) on a vehicle window (3) comprises a light source (12) which emits light rays towards the window (3) on which is fitted a diffractive optical element (7) operable to convey the light rays towards a photodetector (13) which generates a signal corresponding to the intensity of light incident on it. Means (16, 17, 18 and 21) for processing the electrical signal from the photodetector (8) may include a comparator (16) and be connected to means (22 and 23) for controlling the actuation of a windscreen wiper according to whether the signal reaching the comparator (16) from the detector (8) is above or below a reference signal.

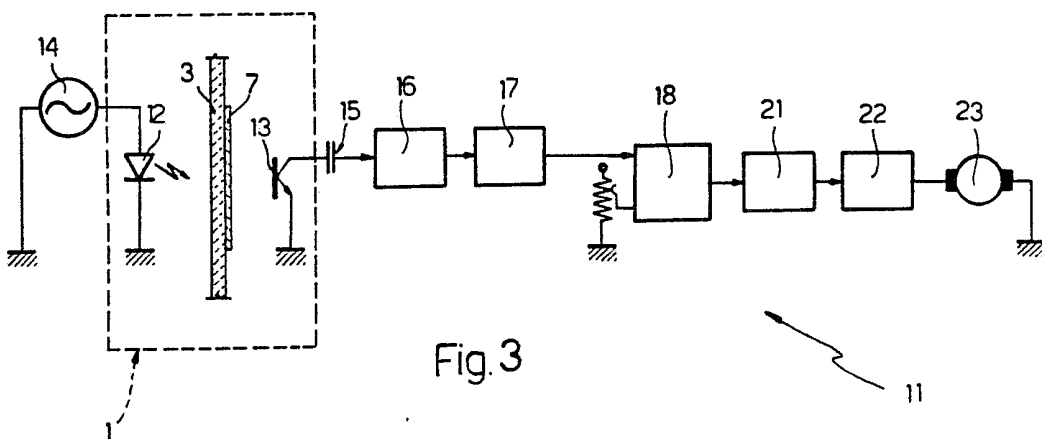


Fig. 3

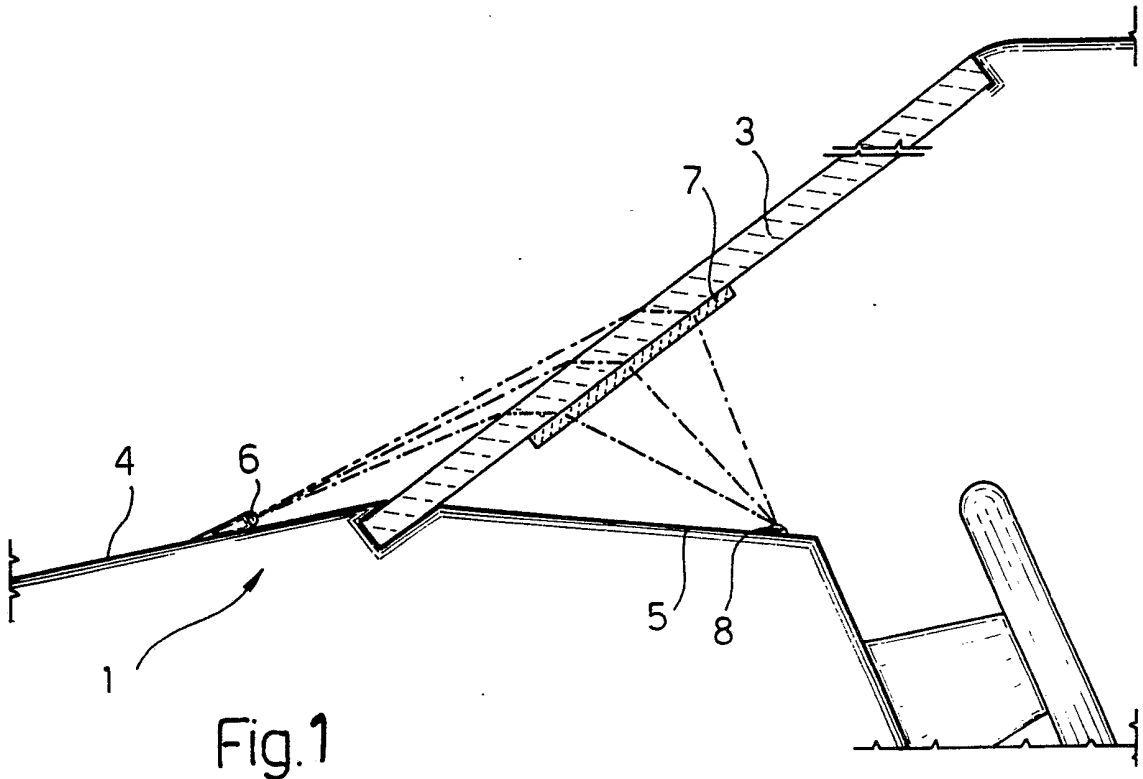


Fig. 1

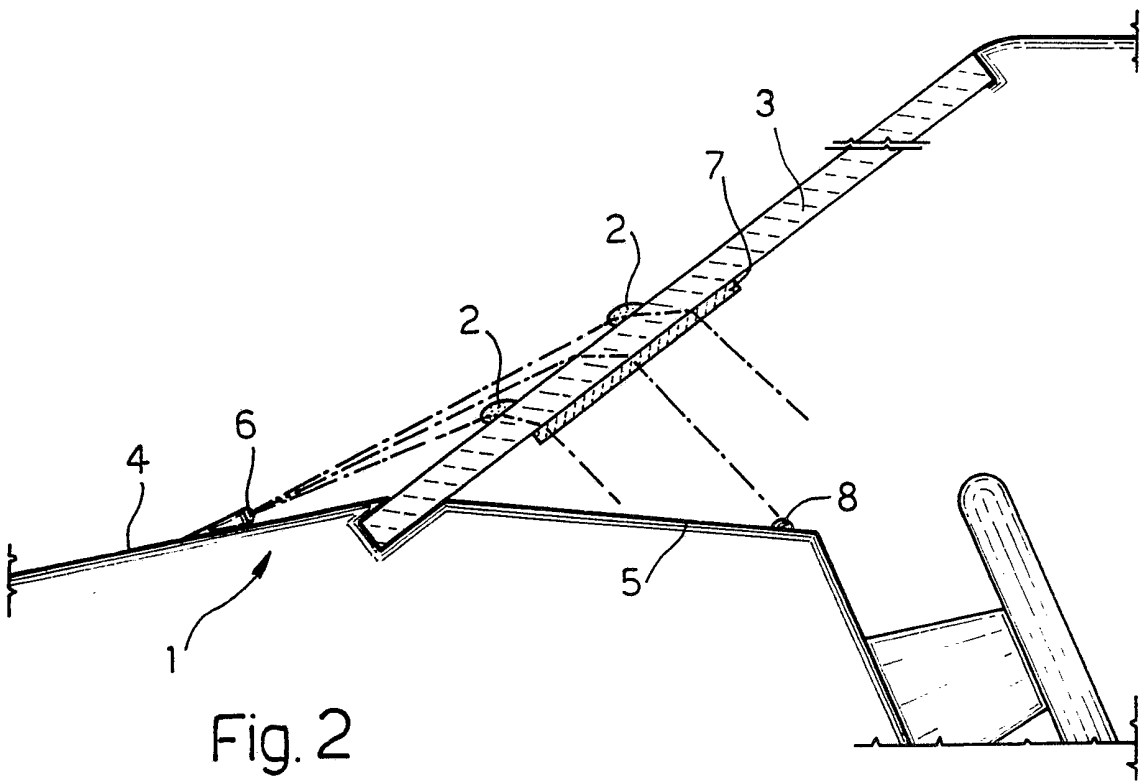


Fig. 2

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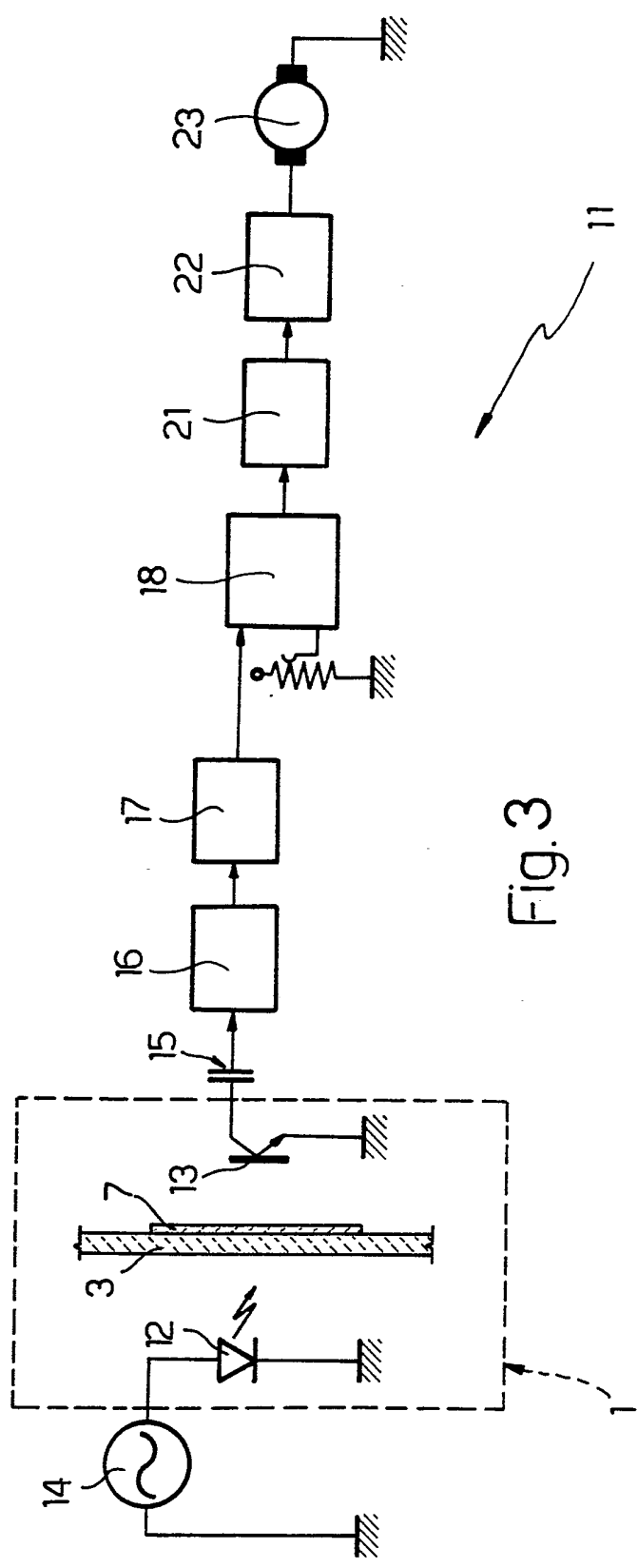


Fig. 3

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 manufacture and assemble, and of low production cost.
- 15 A further object of the present invention is that of providing windscreen wiper control apparatus incorporating 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 a light source operable to emit light rays towards the face of the window outside the vehicle,
- 25 and a diffractive optical element mounted on the inner face of the said window and operable to convey the light

rays refracted from the said window towards a photodetector operable to emit an electrical signal corresponding to the intensity of light incident thereon.

5 According to the present invention there is further provided windscreen wiper control apparatus, characterised by the fact that it comprises:

at least one sensor device for detecting the presence of water droplets on a vehicle window, of the type provided with a light source operable to emit light rays towards the said window and a diffractive optical element carried by the said window and operable to convey the light rays refracted from the said window towards a photodetector which generates an electrical signal corresponding to the intensity of light incident thereon;

15 electrical processing means for 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 purely by way of non-limitative example and with reference to the attached drawings, in which:

25 - 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
control apparatus for a window wiper provided with the
5 device of Figure 1.

As illustrated in Figures 1 and 2, a sensor device for
detecting the presence of water droplets 2 on a window
wiper 3 of a vehicle is generally indicated with the
10 reference numeral 1. The window 3 illustrated in Figures
1 and 2 is constituted by the windscreen of the vehicle,
but this does not constitute a limitation of the present
invention in that the device 1 can be applied also to
detect the presence of water droplets on the rear window
15 of the vehicle. This latter is illustrated partially and
in particular a portion 4 of the front part of the body
and a portion 5 of the dashboard corresponding to the
driver's position are also shown.

20 The device 1 comprises a light source 6 installed on the
portion 4 of the front part of the vehicle body, a
diffractive optical element 7 fixed to the face of the
window 3 within the vehicle, and a photodetector 8
installed on the portion 5 of the dashboard.

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Conveniently, the source 6 generates a collimated, almost

monochromatic beam of light and is formed by a light emitting diode (LED), whilst the photodetector 8 could be constituted by a common phototransistor.

5 The optical element 7 is constituted by a holographic lens the principal characteristic of which consists in diffracting light rays incident thereon with a predetermined angle of incidence towards a precise point which is called the focus of the lens.

10

In use, by fixing the position of the light source 6 and of the optical element 7 it is possible to determine the position of the focus of this latter to which the light rays coming from the light source 6 are conveyed. The
15 photodetector 8 is installed at this focus position which, naturally, is sought to be made on the portion 5 of the dashboard.

In the absence of water droplets on the face of the
20 window 3 (see Figure 1) the light rays emitted from the source 6 incident on the outer surface of the window 3 are subjected to refraction by the window 3 itself and subsequently diffraction by the optical element 7 which causes them to be focussed on the photodetector 8. In
25 these conditions the electrical signal generated by the photodetector 8 is at a maximum.

When a droplet of water is interposed in the optical path of the light rays emitted by the source 6 (see Figure 2) deviation of the rays intercepted by the droplet is caused in that it acts as a spherical dioptric surface. This causes a reduction in the intensity of the light incident on the photodetector 8 and, obviously, a reduction in the electrical signal generated by this latter.

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Electrical apparatus, generally indicated with the reference numeral 11, is shown in Figure 3; this, on the basis of the light intensity which is conveyed to the photodetector 8 operates to control the actuation of a windscreen wiper, not illustrated for simplicity, but obviously operable to wipe the outer face of the window 3.

The apparatus 11 comprises a sensor device 1 which commonly in this embodiment, has a light emitting diode (LED) 12 as a light source and a phototransistor 13 as photodetector. The apparatus 11 further includes an electric current source 14 operable to supply the diode 12, and a processing and control circuit which comprises, downstream from the phototransistor 13, a capacitor 15, a signal amplifier block 16, a detector block 17 a

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comparator block 18, a power amplifier block 21, and a block 22 for controlling an electric motor 23 operable to actuate the windscreen wiper.

5 As is known, a phototransistor is a junction transistor in which illumination of the base results in an injection of electrical charges from the emitter. Therefore the value of the light intensity conveyed to the phototransistor 13 corresponds to a proportional
10 electrical signal which is processed by the blocks 16, 17, 18 and 21. In particular, the block 16 amplifies this electrical signal, the block 17 detects its presence and transmits it to the block 18 which effects a comparison of the amplitude of the signal with a
15 predetermined reference signal.

If the signal coming from the block 17 is less than the reference value (which signifies that there are water droplets 2 on the window 3) the apparatus 11, via the
20 blocks 21 and 22, controls the supply of electricity to the motor 23 which in turn puts the windscreen wiper in motion.

As specified above, the apparatus 11 automatically
25 controls operation of the windscreen wiper (at least one blade) whenever it detects the presence of water droplets

on the surface of the window itself. Naturally it is possible to modify the apparatus 11 in such a way that it controls the actuation of the windscreen wiper for example for two or more passes upon each detection of water droplets.

From what has been described above the advantages achieved by the present invention are apparent.

In particular, the driver does not have to perform any manipulations and can therefore concentrate solely on driving the vehicle. This advantage is more evident in particular conditions such as, for example, in the case of intermittent rain and in the case of a wet road such that the window becomes sprayed with water thrown up by other vehicles, and in which the driver, in the absence of the apparatus 11, must operate the windscreen wiper often but with an irregular frequency. Further, the constructional simplicity and ease of assembly of the device 1 and the apparatus 11 is to be emphasised, which allows its production at low cost.

Finally, it is clear that the device 1 and the apparatus 11 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 1 could include a plurality
of devices 1 connected in parallel and disposed along the
5 windscreen 3 at a predetermined separation. This
arrangement would allow the windscreen 3 to be cleaned
even when, for example in the second of the particular
conditions described above, the water droplets on the
window 3 may be spaced from the driving position but no
10 less important for correct visibility (thinking, for
example, of the wide window of industrial vehicles or
goods or passenger transports).

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CLAIMS

1. A sensor device for detecting the presence of water droplets on the window of a vehicle, characterised
5 by the fact that it comprises a light source operable to emit light rays towards one face of the said window,
and an optical diffractive element mounted on the said window and operable, in combination with the refraction of the said window to direct the light rays
10 from the source towards a photodetector which in operation emits an electrical signal in dependence on the intensity of light incident thereon.

2. A sensor device according to Claim 1, characterised
15 by the fact that the said light source is installed on a portion of the front part of the body of the vehicle and in that the said photodetector is installed on a portion of the dashboard of the vehicle.

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3. A sensor device according to Claim 1 and/or Claim 2, characterised by the fact that the said optical element comprises a holographic lens.

25 4. A sensor device according to at least one of the preceding Claims, characterised by the fact that the said

light source comprises a light emitting diode (12).

5. A sensor device according to at least one of the preceding Claims, characterised by the fact that the said
5 photodetector comprises a phototransistor,

6. Windscreen wiper control apparatus, characterised by the fact that it comprises:

at least one sensor device for detecting the
10 presence of water droplets on a window of a vehicle and of the type provided with a light source operable to emit light rays towards the said window, and a diffractive optical element carried by the said window and operable to convey the light rays
15 refracted by the said window towards a photodetector (8) which generates an electrical signal corresponding to the intensity of light incident thereon;

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

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

7. Apparatus according to Claim 6, characterised by
25 the fact that the said processing means comprise a comparator block operable to compare the value of

the said electrical signal with a predetermined reference value.

8. Apparatus according to Claim 7, characterised by
5 the fact that the said processor means comprise, in
succession from the said photodetector , a signal
amplification block , a signal detection block ,
the said comparator block , and a power amplification
block .

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9. Apparatus according to at least one of Claims from
6 to 8, characterised by the fact that the said control
means include a block for controlling an electric
motor operable to actuate the said windscreen wiper.

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10. A sensor device for detecting the presence of water
droplets on a vehicle window, according to any of Claims
from 1 to 5, as described and illustrated with reference
to Figures 1, 2 and 3 of the drawings.

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11. Windscreen wiper control apparatus according to any
of Claims from 6 to 9, as described and illustrated with
reference to Figure 3 of the drawings.

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