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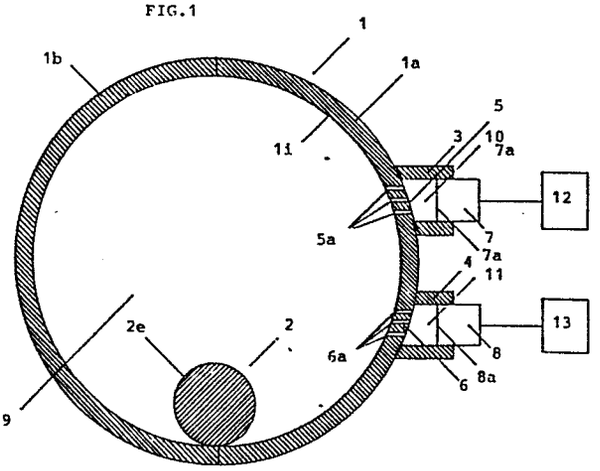
(54) **Device suitable for detecting changes in the state of rest or of rectilinear uniform motion of a body.**

(57) Device suitable for detecting changes of the state of rest or of rectilinear uniform motion of a body, composed of a hollow member (1) rigidly joined to said body and containing one or more mobile elements (2), of suitable means (7) for emitting ultra-sounds of a determinate frequency into the interior of the hollow member, and of suitable transducers (8) for receiving said ultra-sounds, so that by any changes of the state of the body the interior element or elements (2) move relative to the hollow member (1) and cause for this reason a change of frequency of the ultra-sounds picked up by said receiving transducers (8).

FIG.1



EP 0 141 294 A2

Device suitable for detecting changes in the state of rest or of rectilinear uniform motion of a body

The present industrial invention relates to a device suitable for detecting changes of the state of rest or of rectilinear uniform motion of a body, whether said states are absolute or they are relative, and moreover whether the changes relate to the whole body or they relate only to one or more parts of said body.
For semplifying in the text of the specification and in the claims instead of the words "body or one or more parts of a body" it will be used only the word "body".

Devices suitable for said purpose are employed e.g. in antitheft warning appliances for detecting movements or vibrations of movable or fixed bodies protected by said appliances, caused by thefts or theft attempts; in devices for detecting vibrations either of fixed structures for control or of motors or in general of machines with parts in movement for control and/or for eventual stopping or governing said ones; and moreover in the sismographs.

Said devices are constructed till now principally on the ground of the principle of the pendulum, or by lamellar or not elements, which, when they start to vibrate, close contacts, or by transducers in general piezoelectric, which transform mechanical pulses in signals of other kind, or with employment of bulbs with mercury with electrical terminals connected to special circuits in particular for detecting also very slow changes of state, which cause changes of orientation of said body.

The drawback of the pendulum systems employed in the control and measure instruments as the sismographs and the sismometers consists in the complexity of said systems, which does not make them suitable for easier appliances as e.g. in antitheft appliances for cars, while the pendulum devices employed in these cases are very semplified so as their detections are limited to determinate stresses and with few or any abilities to analyze or to select them with regard to the reasons which caused them, moreover said devices are not able to be installed in particular on mobile bodies.

The drawback of the devices with bulb of mercury consists in the fact that their employment is not suitable for many appliances in particular for detecting vibrations, and moreover their installation is not very easy; this last drawback is very serious because on the correct or incorrect installation depends the correct or incorrect working of the device.

The devices with impact contacts or with piezoelectric transducers are not sensitive to all kinds of perturbations due to the change of state of a body in particular if said changes occur with very low accelerations.

The invention as claimed is intended to remedy all the drawbacks of the above mentioned and known to the prior art devices, carrying out a device which has the following advantages:

- greatest facility of installation in all kinds of appliances,

- ability of detecting all kinds of state variations, from the smallest vibrations to the slow changes of orien tation of the body,
- high easyness of connection to electronic circuits or to other instruments suitable in general for analyzing and selecting the out put signals of the device and there fore for eliminating the signals not due to causes, which do not concern the specific appliance, as e.g. the acci_ dental causes not relating to theft attempts in the case of antitheft warning appliances.

On the whole therefore the great advantage of the inven_ tion consists in the great semplicity and universality of its employment.

The device suitable for detecting changes of the state of rest or of the rectilinear uniform motion of a body, in conformity with the present industrial invention com_ prises: - a hollow member suitable for being fixed to said body and made of ultra-sounds opaque material, - one or more elements inside the hollow member, made at least partially of ultra-sounds opaque material and completely mobile relative to said member, - suitable means for emit ting ultra-sounds of a fixed in advance frequency, - suita ble means for receiving ultra-sounds and converting them in signals of another kind of energy; being the hollow member equipped with two or more union elements rigidly fixed to it, made of the same or different materials, provided that these materials are ultra-sounds opaque, and with shape and size suitable for housing and holding on, in ultra-sound tight manner, the parts relative to the emission of said ultra-sounds by the emitting means

and to the reception by the receiving means, being the parts of the hollow member, corresponding inside to said union elements, made of ultra-sounds transparent material and equipped with one or more holes with shapes and sizes suitable both for the passage of the ultra-sounds respectively from the emitting means to the inside of the hollow member and from the inside of said member to the receiving means, and for not modifying the resistance the inner element or elements have to overcome for moving relative to the rest of the inner surface of the hollow member; being the space inside the hollow member and the union elements as far as the emitting and the receiving surfaces of said means filled with a fluid particularly suitable for the ultra-sounds propagation, preferably air; being the shape and the consistency of the inner surface of the hollow member and the shape and the consistency of the outside surface and the homogenousness of the mass of the inner element or elements, with regard to the greatest sensativeness fixed in advance of the device such that, in case of a change of the state of rest or of the rectilinear uniform motion of the body and furthermore of the hollow member fixed to it, it follows for Doppler effect a change of frequency of at least a part of the reflected ultra-sounds picked up by the receiving means, which therefore put out signals altered relative to the signals by them emitted when there are no state changes, alterations, which analyzed and selected in a suitable way by devices , known to the prior art and connected downstream from said receiving means, are able to act on members, known to the prior art, only of signaling and/or of controlling of

eventual automatic devices suitable for removing or modifying the causes which have brought about the detected changes.

One way of carrying out the invention is described in detail below with reference to drawings which illustrate only one specific embodiment, in which:

- figure 1 is a cross schematic view,
- figure 2 is a block diagram.

The embodiment of the invention described in the example is the detecting element of an antitheft alarm appliance for a motorcar.

The device A is composed by a ball 1 of plastic material, made of two parts 1a and 1b assembled, after inserting the iron ball 2, in such a way as to ensure a perfect continuousness of the inner surface 1i of the ball 1.

The semiball 1a is equipped during the manifacturing phase with two sleeves 3 and 4, being provided the parts 5 and 6 of the wall of the ball 1 with the cylindrical holes 5a and 6a.

In the sleeves 3 and 4 are inserted with pressure and in a tight manner the cylindrical parts respectively of emission 7a and of reception 8a of the ultra-sounds of the emitting transducer 7 and the receiving transducer 8.

The spaces 9, 10 and 11 inside respectively the ball 1 and the sleeves 3 and 4 are filled with air at atmospheric pressure.

The transducer 7 is connected upstream with an oscillatory circuit 12 suitable for emitting electrical signals

with 40 Hz frequency, having therefore the same frequency also the ultra-sounds emitted by the transducer and which go inside the ball 1 through the holes 5a.

The ultra-sounds reflected by the inner wall 1a of the ball 1 and by the external wall 2a of the ball 2 and picked up by the transducer 8 have the same 40 Hz frequency of the ultra-sounds emitted by the transducer 7 when the ball 1 is in state of rest and i.e. the motorcar is perfectly still, being said ball 1 rigidly fixed to the structure of the motorcar.

When instead the structure of the motorcar and therefore the ball 1 make the least movement, the ball 2 moves immediately relative to the ball 1, and that in relation both to the great smoothness of the wall 1i of the ball 1 and of the external wall 2a of the ball 2, and to the perfect homogeneity of the mass of the ball 2; said movement of the ball 2 relative to the ball 1 causes for Doppler effect a change of frequency of at least a part of the ultra-sounds picked up by the transducer 8.

Said transducer 8 is connected downstream with the electronic circuit, the block diagram of which is represented in figure 2 and which comprises an amplification circuit 13 of the out put signal of the transducer 8, a frequency demodulation circuit 14, a pulse emitter circuit 15, which directly or undirectly through the reset circuit 16 transmits the pulses, selected and worked by said circuits, to the counter circuit 17, which on the ground of the regulation made also on installation of the appliance on the motorcar, sends control signals through the out putcircuit 18 to the power circuit for acting the antitheft warning devices and eventual locks with it con-

nected.

Analysis, selection and integration of the signals, which have to release the warning, are obtained through the above cited circuits, which are not described in detail because they may be carried out in conformity with the required performances of the appliance by any person skilled in the art on the ground of the prior art.

The detecting device, in conformity with the present invention is available obviously for acting e.g. the warning not only because of vibrations caused by effraction attempts of the lock system of the accesses of the motorcar but also because of the mere lifting, however carried out with the greatest caution, of the car for thefting also merely the wheels or other parts of said car.

Claims:

1. Device suitable for detecting changes of the state of rest or of the rectilinear uniform motion of a body, characterised in that it comprises: - a hollow member (1) suitable for being fixed to said body and made of ultra-sounds opaque material, - one or more elements (2) inside the hollow member (1), made at least partially of ultra-sounds opaque material and completely mobile relative to said member (1), - suitable means (7) for emitting ultra-sounds of a fixed in advance frequency, - suitable means (8) for receiving ultra-sounds and converting them in signals of another kind of energy; being the hollow member (1) equipped with two or more union elements (3,4) rigidly fixed to it, made of the same or different materials, provided that these materials are ultra-sounds opaque, and with shape and size suitable for housing and holding on, in ultra-sounds tight manner, the part relative to the emission of said ultra-sounds by the emitting means (7) and to the reception by the receiving means (8), being the parts (5,6) of the hollow member (1), corresponding inside to said union elements (3,4) made of ultra-sounds transparent material and/or equipped with one or more holes (5a,6a) with shapes and sizes suitable both for the passage of the ultra-sounds respectively from the emitting means (7) to the inside of the hollow member (1)and from the inside of said member (1) to the receiving means (8), and for not modifying the resistance the inner element or elements (2) have to overcome for moving relative to the rest of the inner surface (1i) of the hollow member (1); being the

spaces (9,10,11) inside the hollow member (1) and the union elements (3,4) as far as the emitting and the receiving surfaces (7a,8a) of said means (7,8) filled with a fluid particularly suitable for the ultra-sounds propagation, preferably air; being shape and consistency of the inner surface (1i) of the hollow member (1) and shape and consistency of the outside surface (2a) and the homogenousness of the mass of the inner element or elements (2), with regard to the greatest sensativeness fixed in advance of the device, such that, in case of a change of the state of rest or of the rectilinear uniform motion of the body and furthermore of the hollow member (1) fixed to it, it follows for Doppler effect a change of frequency of at least a part of the reflected ultra-sounds picked up by the receiving means (8), which therefore put out signals altered relative to the signals by them emitted when there are no state changes, alterations, which analyzed and selected in a suitable way by devices known to the prior art and connected downstream from said receiving means (7), are able to act on members, known to the prior art, only of signaling and/or of controlling of eventual automatic devices suitable for removing or modifying the causes which have brought about the detected changes.

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FIG.1

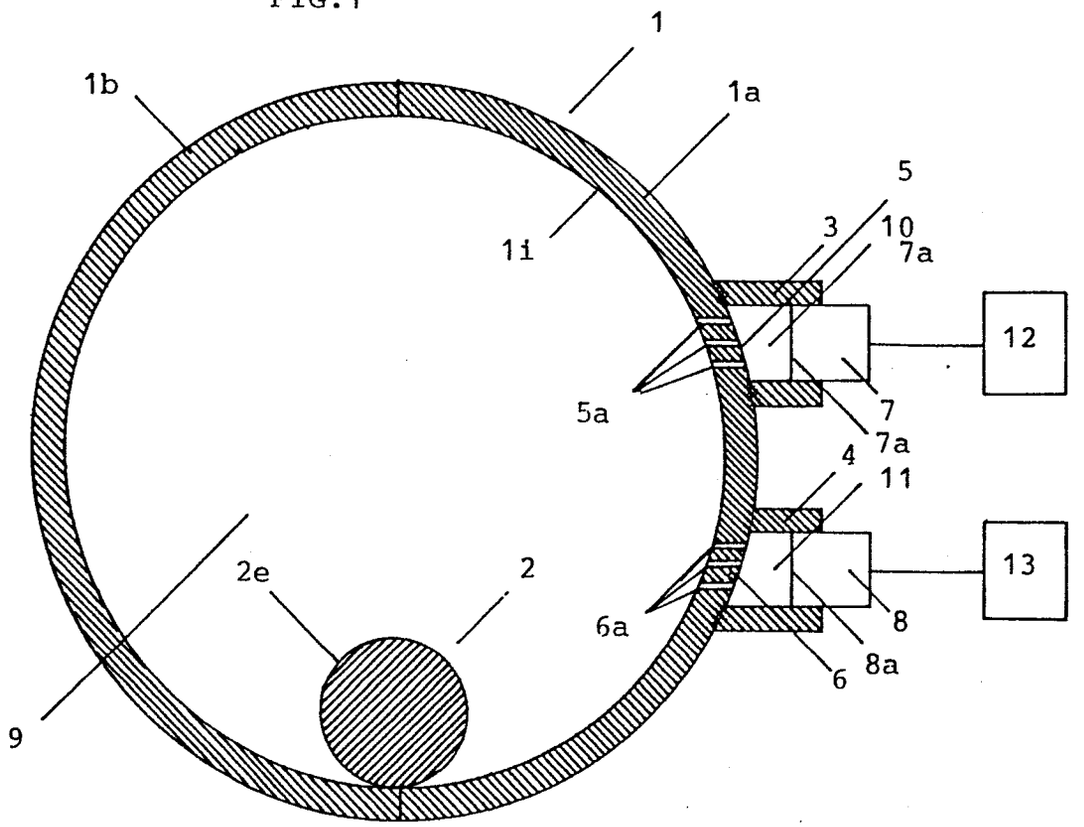

FIG.2