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The invention relates to a warning lamp for vehicles, comprising a light-permeable hood which is seated on a lamp socket, with a light bulb arranged within the hood, with a rotary reflector arranged within the hood, and with a drive for rotating the reflector, which is arranged within the hood and non-rotationally connected to the lamp socket.

A warning lamp of this type is known from the DE-PS 39 20 761 and is used, for example, for priority vehicles such as police and fire brigade vehicles, for emitting optically signals. This known warning lamp has a drive in the form of fast running electric direct current motor with mechanical commutation by a collector. This known warning lamp includes a toothed gearing to reduce the high motor torque to the desired torque of the reflector.

The known warning light has disadvantages. Due to the use of a collector as a mechanically commutating element, the direct current motor of a conventional warning lamp is subjected to considerable wear which limits the life of the drive motor and thus of the entire conventional warning lamp. The reduction gearing for reducing the high torque of the motor to a lower reflector rotation is expensive to buy and in the assembly of these parts, due to required additional parts, which makes the conventional warning lamp expensive. Furthermore, these additional gearing parts are also subjected to wear which may result in a reduction of life and operational breakdown of the conventional warning lamp. Furthermore, additional space, which increases the required product area of the conventional warning lamp, is required for arranging the gearing parts within the light-permeable hood or within the lamp socket. This increase in product size can also be given in that, for example, by selection of the gearing for example as in the conventional item, the drive motor must be arranged in its axle perpendicularly to the rotary axis of the reflector due to selection of a wormdrive.

Furthermore, mechanically commutating direct current motors of this type and required gearings produce oscillations and noises which can make the operation of the conventional warning lamp loud. Due to brush fires during mechanical commutation, these direct current electric motors generate electro-magnetic fields of interference,

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which, in particular when these warning lamps are used on motor vehicles, may interfere with other devices of the motor vehicle, for example with passive and active radio frequency transmitters.

Furthermore, mechanically commutating direct current electric motors of this type are always intended for specified operational voltages, so that with a given operational voltage the selection of the desired reflector torque is to be considered in its design. Subsequent changes of this reflector torque are possible only in an expensive manner by selection of other direct current electric motors or by changing the gearing ratio. Different types of the conventional warning lamps are required in particular for use of the conventional warning lamp with different onboard power circuits, for example 12 volt and 24 volt circuits, which makes it more expensive to stock these warning lamps.

It is an object of the invention to design a warning lamp for vehicle which offers longer life combined with simple and more cost-effective design relative to conventional items.

This object is achieved according to the invention in that the drive comprises a motor without collector or gearing and that the rotor of the motor is arranged outside the stator.

The use of a motor without collector allows in increase in lifespan of the inventive warning lamp relative to the previously known, as in contrast to the latter there is no wear on a mechanical commutator. Furthermore, electronically commutating motors without collector allow the torque to be set virtually independently from the operational voltage, so that the inventive warning lamp can be used for operation on different power supply voltage without changing the mechanical design of the warning lamp. Furthermore, the rotation of a motor without collector, and thus the reflector rotation, can be controlled solely by way of changes within the electronics which control the commutation and without changes in the mechanical design.

A gearing between the collector-free motor and a rotary reflector of the inventive warning lamp can be dispensed with, as a desired rotation with electronic commutation of the collector-free motor can

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be set virtually infinitely variable by selection of the electronic components, thus offering a direct drive of the rotary reflector. This inventive direct drive avoids all disadvantages linked to mechanical drives and as described earlier. The direct drive allows in particular the design size of the inventive warning lamp, its noise development and its life to be substantially improved relative to the conventional.

The invention provides that the rotor of the motor is arranged outside the stator in order to achieve an as even as possible and jerkfree rotary movement of the reflector at usually desired low rotations of the rotary reflector and thus of a drive motor without collector and gearing. This inventive arrangement increases the torque of the collectorfree motor as much as possible, as the moved mass of the rotor is as far away from the rotary axis as possible. Due to respectively large inertia, the collector-free motor then offers even rotation even at low torques.

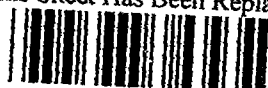
Furthermore, the electronic control of the collector-free direct current motor allows synchronization of a plurality of inventive warning lamps with collector-free drive motors. Moreover, the rotation of the reflector and braking of the reflector when switching off the inventive warning lamp can be monitored electronically and by simple means.

Advantageous embodiments and further developments of the inventive warning lamp are contained in the subclaims.

It is particularly advantageous if the stator is non-rotationally connected to the lamp socket, so that the rotating arrangement, comprising the rotary reflector and the rotor, is securely fixed, with the exception of the rotary movement, in the housing which is composed of the light-permeable hood and the lamp socket. However, in order to prevent a transfer of vibrations between stator and lamp socket, the stator can in this context advantageously be connected to the lamp socket in an oscillation buffered manner, in particular by means of rubber buffers.

On the other hand, in the context of a further reduction of structural cost and further reduction of design height of the inventive warning lamp, the stator can be arranged to be moulded at least partially in

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one piece with the lamp socket, in particular in plastic material. In contrast to previously known lamps, this is possible with the inventive warning lamp as the drive and the rotating reflector of the inventive warning lamp generate hardly any vibrations.

The stator can advantageously comprise the motor windings, and the motor windings are then arranged on a collar of a base plate. The required motor windings can advantageously be wound directly onto the collar. In this context, the base plate can carry a conducting plate with the electronic components for electronic commutation of the collector-free motor. This offers an advantageous structural assembly of the motor windings with the conducting plate which only requires short connecting wires between these two parts, thereby avoiding electrical losses.

The rotor can advantageously have permanent magnets, and due to the suggested direct drive, the reflector can also be non-rotationally connected to the rotor. In previously known lamps, the lamp bulb is spatially fixed. There are also warning lamps in which the light bulb rotates with the reflector. In these cases, it is particularly advantageous if the light bulb is non-rotationally connected to the rotor like the reflector.

In order to enable easy rotation of the reflector, it is particularly advantageous if the rotor has bearings rotationally arranged on a sleeve which is non-rotationally connected to the base plate. These bearings can be slide bearings or needle or ballbearings. In order to then establish an electric connection between the light bulb and the electrical connecting parts, it is particularly advantageous if the sleeve is electrically ducting and on the one hand connected to the light bulb and on the other hand to the electrical connecting means.

Also for the purpose of electrically connecting the light bulb, an electrical conductor, in particular a screw, can be arranged within the sleeve and insulated by means of a guide element and connected on the one hand to the light bulb and on the other hand to an additional electrical connection. In particular when arranging the electrical

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conductor as a screw, then the latter can, if appropriate, jointly with other parts axially fix the rotor and the stator against each other.

Such fixing is also possible in that the rotor is axially fixed on the sleeve by means of a disc. In particular when the light bulb rotates along; it is particularly advantageous if slides are provided for an electrical connection of sleeve and conductor to the light bulb.

Exemplary embodiments of the inventive warning lamp are illustrated in the drawings and will now be described in more detail based on these drawings.

Shown are, in

Fig. 1: an inventive warning lamp, with oscillationally uncoupled base plate, partially cross-sectional;

Fig. 2: a top view of the rotor and the base plate of a warning lamp as in Fig. 1; and

Fig. 3: an inventive warning lamp in a one-piece arrangement of the base plate together with the lamp socket and with a pipe connecting element for mounting the inventive warning lamp.

In Fig. 1, a light-permeable hood (1) is connected to a lamp socket 3 by means of a detachable bayonet connector. The entire inventive warning lamp of Fig. 1 can be attached with a rubber washer (4) to the surface of a vehicle, for example by means of screws.

Inside the hood is a rotary reflector (2) which is mounted on a rotor (12) of a collector-free direct current motor. The reflector (2) has a push-through opening to accommodate a light bulb (not illustrated in the Figures).

Also inside the light-permeable hood (1) is a base plate (5) which is in a vibration reducing manner attached to the lamp socket (3) by means of rubber buffers (7) and screws (9). The rubber buffers (7) are then arranged in eyes (8) of the base plate (5)

The base plate (5) carries at its bottom side a conducting plate (6) which carries electrical components (not illustrated in Fig. 1) for electronic commutation of the collector-free direct current motor. At

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the side facing away from the conducting plate (6), the base plate (5) has a collar (10) with the motor windings (11) of the collector-free direct current motor arranged thereon. The motor windings (11) can advantageously be mounded directly onto this collar (10).

The rotor (12) carries on its outer periphery permanent magnets (13), the magnetic fields of which correspond in dependence of applied current with the motor windings (11) and cause a rotation of the rotor (12) relative to the motor windings (11) which form the stator of the collector-free direct current motor.

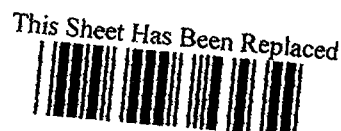
In order to allow easy rotation of the rotor (12) relative to the motor windings (11), the rotor (12) has bearings (14) which are rotationally arranged on an electrically conducting sleeve (15). Inside the sleeve (15) is a hexagonal screw (16), insulated by means of a guide element (17), which is also electrically conductive.

Furthermore, a disc (18), which is in an electrically conducting manner connected to the sleeve (15), is provided between the guiding element (17) and the rotor (12) for axially fixing the rotor (12) relative to the motor windings (11). Both the sleeve (15) and the hexagonal screw (16) are at their downwardly facing end as shown in the Figure (1) provided with flat plugs (20) which also pass through the electrical conductor plate (6) and which can be connected to the conducting tracks on this conducting plate (6).

Both on the disc (18) and on the hexagonal head of the hexagonal screw (16) are seated the slides (19) which are connected to the electrical connections of the light bulb in order to allow the light bulb to light up.

Parts of the device which are identical or of identical function as in Fig. 1 are given the same reference marks. Shown is here in particular the basic form of the base plate (5) with a total of three eyes (8) into which the rubber buffers (7) can be inserted. Also shown is that the rotor (12) has at its top fixing means for fixing the reflector and the part carrying the light bulb.

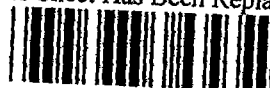
The inventive warning lamp as in Figures 1 and 2 operates as follows:



As soon as a voltage is applied to the flat plugs (20), the light bulb (not illustrated in the Figures) is switched on and emits light. By switching on the light bulb, the electronic circuit located on the conducting plate (6) is also supplied with a current and thereupon starts the process of electronic commutation of the collector-free direct current motor by applying a current to the motor windings (11) with a specified phase position. As soon as this is done, an electromagnetic field is established between the permanent magnets (13) and the motor windings (11), resulting in a rotational force acting between the rotor (12) and the motor windings (11). Due to the freely rotatable mounting of the rotor (12) on the sleeve (15) by means of bearings (14), the rotor (12) is rotated relative to the motor windings (11) by the effects of this force. As both the light bulb (not illustrated in the Figures) and the reflector (2) are non-rotationally connected to the rotor (12), the rotor (12) and the reflector (2) are jointly rotated, resulting in the known signalling effect of warning lamps of this type. This rotation of the reflector (2) is maintained as long as there is a voltage at the flat plugs (20). As soon as there is no longer a voltage at the flat plugs (20), the light bulb goes out, and the rotor (12) together with the reflector (2) terminates its rotary movement.

In Figure 3, parts of the device which are identical or have identical functions as in Figures 1 and 2 are provided with identical reference marks. In contrast to the inventive warning lamp of Figure 1, the base plate (5) is here jointly with the lamp socket (3) moulded in a plastic material. This structural solution is possible with the inventive warning lamp because the entire rotary arrangement, comprising the rotor (12), the permanent magnet (13), the bearings (14), the reflector (2) and the light bulb, generates virtually no vibrations which could be transferred to the remaining parts of the inventive warning lamp. If this is so, then the warning lamp according to Figure 3 offers the special advantage that the design is structurally simpler than the solution of Figure 1. In particular the eyes (8), the rubber buffers (7) and the screws (9), which can cause significant expense in particular during assembly, are then dispensed with. It is a further advantage of the inventive warning lamp of Figure 3 that the warning lamp

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comprising a hood (1) and a lamp socket (3) is of lesser structural height than the solution of Figure 1.

As the inventively applied collector-free direct current motor has a lifespan which corresponds approximately with that of the other components of the warning lamp, it is not necessarily required that parts of the warning lamp are replaced, as may be the case and is possible with the solution of Figure 1. Furthermore, the warning lamp in Fig. 3 is provided with a tubular connecting element (21) which can be used if the inventive warning lamp is not to be fitted on a smooth surface but to the end of a tube.

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Patent Claims

- 1: Warning lamp for vehicles, comprising a light-permeable hood (1) which is seated on a lamp socket (3), with a light bulb arranged within the hood (1), with a rotary reflector (2) arranged within the hood (1), with a drive for rotating the reflector, which is arranged within the hood (1) and non-rotationally connected to the lamp socket (3), **characterized in that** the drive comprises a motor without collectors and without gearing, and that the rotor (12) of the motor is arranged outside the stator (motor windings 11).
- 2: Warning lamp according to Claim 1, **characterized in that** the stator (motor windings 11) is non-rotationally connected to the lamp socket (3).
- 3: Warning lamp according to Claim 2, **characterized in that** the stator (motor windings 11) is connected to the lamp socket (3) in a vibration absorbing manner, in particular by means of rubber buffers (7).
- 4: Warning lamp according to Claim 2, **characterized in that** the base plate (5) is at least partially integrated with the lamp socket (3) and in particular moulded of plastic material.
- 5: Warning lamp according to Claim 1, **characterized in that** the stator comprises the motor windings (11), and the motor windings (11) are arranged on a collar (10) of a base plate (5).
- 6: Warning lamp according to Claim 5, **characterized in that** the base plate (5) carries a conducting plate (6) with the electronic components for electronic commutation of the motor.
- 7: Warning lamp according to Claim 7, **characterized in that** the rotor (12) comprises permanent magnets (13), and the reflector (2) is non-rotationally connected to the rotor (12).
- 8: Warning lamp according to Claim 7, **characterized in that** the light bulb is non-rotationally connected to the rotor (12).

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- 9: Warning lamp according to Claim 5, **characterized in that** the rotor (12) has bearings (14) rotationally arranged on a sleeve (15) which is non-rotationally connected to the base plate (5).
- 10: Warning lamp according to Claim 9, **characterized in that** the sleeve (15) is electrically ducting and connected on the one side to the light bulb and on the other side to an electrical connector (flat plug 20).
- 11: Warning lamp according to Claim 8 and Claim 10, **characterized in that** within the sleeve (15) and insulated by means of a guide element (17) is an electric conductor, in particular a screw (16), which is connected on the one side to the light bulb and on the other side to a further electrical connector (20).
- 12: Warning lamp according to Claim 10 or Claim 11, **characterized in that** the rotor (12) is axially fixed on the sleeve (15) by means of a disc (18), and that slides (19) are provided for an electrical connection of the sleeve (15) and the conductor to the light bulb.

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