
Electric motor scooter

Description

The invention concerns an electric motor scooter.

Motor scooters fitted with electric drives are known. Simply by way of example reference is made to EP 1 857 314 A2. Electric motor scooters or motorised two-wheelers usually have a body and two wheels, one of the wheels being driven by means of an electric drive which is fed by a battery.

Efficient use of the energy stored in an electric battery, along with travel comfort, which is also defined in terms of the dynamic performance of the vehicle, is a major challenge. The range of an electric motor scooter is determined primarily by how efficiently the available energy can be used. Furthermore, for a battery to be charged, substantially more time is needed than for filling up motor scooters driven by an internal combustion engine. Therefore, where possible, an electric motor scooter should have to be recharged as seldom as possible.

Furthermore, the safe use of an electric motor scooter is crucially dependent on its drivability.

Unintended sudden braking of an electric motor scooter should therefore be avoided.

Starting from this prior art, the object of the invention is to provide an electric motor scooter that uses the energy stored in the battery as efficiently as possible.

The object is accomplished by means of an electric motor scooter according to claim 1. In particular, the object is accomplished by means of an electric motor scooter comprising:

- at least an electric drive;
- at least an electric battery;
- at least an actuation unit, which is designed so that the actuation unit can be brought into different positions along the total distance of actuation;
- a control unit, which is designed
 - o to determine the position of the actuation unit;
 - o depending on the position thus determined, to select a driving mode from a number of driving modes and to set the selected driving mode, the driving modes comprising:
 - a) a recuperation mode;
 - b) a sailing mode;
 - c) an acceleration mode,wherein, when the recuperation mode is set, the control unit controls the electric drive so that energy generated in the electric drive is delivered, at least partially, to the battery.

A fundamental idea of the present invention is to provide a recuperation mode accessible by means of an actuation unit, in particular a thumb lever, through which kinetic energy can be converted into electric energy so that this energy can be stored in the battery. In this regard, it is essential that the relevant driving mode can be explicitly requested by the driver, so that no unintended braking of the vehicle takes place.

In an embodiment of the invention, in addition to the recuperation mode, a sailing mode and an acceleration mode can be set by means of the actuation unit. The sailing mode can be defined such that, in the sailing mode, no torque or only very low torque is applied by the electric drive. The acceleration mode can be defined such that, in contrast to the recuperation mode, the acceleration mode provides a positive torque, applied by the electric drive.

By providing a recuperation mode, it is therefore possible to recover the energy normally lost to thermal energy during braking as electrical energy.

In an embodiment of the invention, the control unit controls the acceleration mode in such a way that an essentially linear dependence exists between a position of the actuation unit and the torque applied by the electric drive. The position can be given using a distance value from a starting position to the current position. The position can also be given by an actuation unit, which can be moved essentially circularly around a centre, by means of an angle. In the said embodiment, a linear relationship exists between the position and the torque that is applied. This linear relationship can, for example, be given or approximated by the following formula:

$$M(P)=k_1 \cdot P+d,$$

where $M(P)$ is the torque of position p , k_1 is a first acceleration coefficient, P is the position, in degrees for example, and d is a constant. The linear relationship has the advantage that the speed can be adjusted very precisely. In addition, a comfortable driving feel arises when acceleration takes place in an appropriate manner.

The driving modes can comprise a boost mode. The control unit preferably controls the drive and/or the battery in the boost mode in such a way that, at least partially, there is an essentially linear dependence between a position of the actuation unit and the torque applied by the electric drive. This linear dependence can preferably be given by a second acceleration coefficient, this second acceleration coefficient being greater than the first acceleration coefficient already mentioned. In other words, faster acceleration (more torque) preferably takes place in the boost mode than in the "normal" acceleration mode.

The relationship between torque and position can be expressed by means of the following formula:

$$M(P)=k_2 \cdot P + d_2,$$

where k_2 is the second acceleration coefficient and d_2 is a second constant.

The first acceleration coefficient can be (much) smaller than the second acceleration coefficient ($k_1 < k_2$ or $k_1 \ll k_2$). For example, the first acceleration coefficient can be at least 10, 20, 30, 40 or 50 per cent smaller. According to the invention, the second acceleration coefficient can be twice as big as the first acceleration coefficient.

The control unit can be designed to emit signals indicating whether the electric drive and/or the battery is in a state in which a boost can be carried out. It is possible to offer a boost in the boost mode which is damaging for the electric motor scooter over the long term. For example, the boost can have a damaging effect on the battery and/or the drive over a long period of time. It is possible for the battery to overheat due to fast discharging. To prevent the electric motor scooter from being damaged, the control unit can emit signals which enable this critical situation to be avoided. These are preferably signals which indicate whether a boost can be carried out or not.

Whether a boost can be carried out or not is preferably determined by means of parameters which are collected by the control unit. Parameters which come from the electric drive and/or the battery are preferably taken into consideration. In an embodiment of the invention the following parameters are taken into consideration in the determination:

- period of time since the last boost; and/or
- duration of the last boost; and/or
- temperature values of the battery and/or the drive.

The period of time since the last boost and its duration can be determined by the control unit provided the control unit has control over the relevant procedure. Temperature values are preferably provided by the battery and/or the drive by

means of an appropriate sensor. According to the invention, it is also possible to estimate temperature values using models.

An appropriately designed control unit can help to determine a situation reliably in which a boost can be carried out without exposing the motor scooter to damage.

The control unit can be designed to emit signals which indicate over what period of time a/the boost is available. This period of time is preferably displayed on a display. According to the invention the control unit can also be designed to quantify readiness to carry out a boost. An important quantification can consist of the length of time the boost will be available. It is possible to indicate the period of time over which the boost is available in figures. It is advantageous for the use of the motor scooter according to the invention if the values are displayed by means of appropriate symbols. When the motor scooter is travelling on the road, symbols can be identified and classified more easily. In an embodiment of the invention the period of time is displayed using bars or similar symbols. For example, several bars one on top of the other can form a column, which indicates how long a relevant boost is available. The length of the boost mode can also be displayed by means of the fill level of individual bars or of all the bars. It is also possible, in theory, to display percentages for example in the form of pie charts. When both bars and pie charts are displayed, for implementation it is possible for there to be a pre-set maximum length for requesting the boost. This maximum length can, for example, be less than or equal to 3 minutes or less than or equal to 2 minutes or less than or equal to 90 seconds.

In an embodiment of the invention, after the boost has been used, the period of time to a new or further use of the boost can be partially reduced or completely eliminated. In this situation, the period of time preferably builds up again gradually and is displayed in an appropriate manner.

The electric scooter, in particular the actuation unit, can be designed such that:

- at least 10 per cent, in particular at least 15 per cent, of the total distance of actuation is assigned to the recuperation mode; and/or
- at least 5 per cent, in particular at least 10 per cent, of the total distance of actuation is assigned to the sailing mode; and/or
- at least 40 per cent, in particular at least 50 per cent, of the total distance of actuation is assigned to the acceleration mode; and/or
- at least 3 per cent, in particular at least 5 per cent, of the total distance of actuation is assigned to the boost mode.

This means, for example, that relatively long distances are available for the recuperation mode, which can be used to activate recuperation in a regulated way. As recuperation normally leads to the deceleration of the vehicle, gradual activation, preferably over the distance assigned to the recuperation mode, can increase the safety of the vehicle. Furthermore, roll stopping distances, for instance at traffic lights, can be used particularly efficiently to recover energy for the battery.

In an embodiment of the invention, the electric scooter comprises a smartphone holder, the smartphone holder comprising:

- a foam container in which to place the smartphone; and
- a rotatably mounted, at least partially transparent, cover, which presses the smartphone against the foam container in a locked position.

The purpose of the smartphone holder is to efficiently hold a smartphone on the electric motor scooter, preferably on the steering unit thereof. The smartphone holder can also comprise an integrated display, which can be used by the control unit. For example, the symbols regarding the availability and the period of time of the boost mode or the boost can be displayed on the display. The smartphone holder can be regarded as a separate invention. In an embodiment of the invention, however, it provides the housing for at least part of the described electronics for the control unit.

In an embodiment of the invention, the cover comprises an upper flat section and a lower flat section, the upper flat section protecting the integrated display and the lower flat section holding the smartphone. Both the lower and the upper flat sections can be designed to be at, least partially, transparent, so that the integrated display and/or the display of the smartphone can be read.

The smartphone holder is preferably designed in such a way that the integrated display and the smartphone lie in a position in which their surfaces are at an obtuse angle to each other. The sections of the cover can also be arranged at an obtuse angle to each other. It is preferable for the cover to have a relatively large surface, so that the smartphone is pressed against the phone with a certain handle.

In an embodiment of the invention, in an upper area of the upper section at least one bracket is provided for the rotational mounting of the cover on the smartphone holder. In the lower area of the lower section a snap-in locking device can also be provided to fix the cover. With this design, the smartphone can be inserted and removed easily.

Other advantageous embodiments of the invention are described in the dependent claims.

The invention is described below by means of embodiments of the invention, which are explained in more detail with the aid of illustrations.

- Fig. 1 shows an overall view of an electric motor scooter according to the invention with a steering unit for steering the motor scooter;
- Fig. 2 shows a detailed view of the upper section of the steering unit with a display for displaying information and a thumb lever for specifying a driving mode;
- Fig. 3 shows a view of the driving modes with corresponding torques;

- Fig. 4-6 show different screen displays, which show the availability status of a boost mode;
- Fig. 7 shows individual components of the motor scooter from Fig. 1;
- Fig. 8 shows a plan view of a smartphone holder integrated into the steering unit according to Fig. 1 and Fig. 2;
- Fig. 9 shows a cross section through the smartphone holder from Fig. 8.

In the following description the same reference numerals are used for parts that are identical or have the same effect.

Fig. 1 shows an overall view of a scooter or motor scooter 10 according to the invention. The motor scooter 10 has a body to which a front wheel 12 and a rear wheel 12' are rotatably attached. The body also comprises a steering unit 30 for steering the motor scooter 10. The front wheel 12 is located at the lower end of the steering unit 30. In the back part of the body there is a battery box 21, to which a saddle 20 is connected.

The upper area of the steering unit 30 is in the shape of a T (see Fig. 2). Handle grips are arranged on the left-hand and right-hand sides of the steering column into which the brake lever (left-hand side) and a thumb lever 31 (right-hand side) protrude. At the end of the steering column in the upper area of the steering unit 30 there is a smartphone holder 200, into which a display 100 with a screen 110 (Fig. 8) is integrated.

A fundamental component of the motor scooter 10 is a control unit 300 (Fig. 7), which communicates with the thumb lever 31 and with the display 100. The thumb lever 31 is equipped with an appropriate sensor, with the result that it can deliver signals to the control unit 300 about its position in relation to a starting

position. For its part, the control unit 300 can emit signals which can be displayed on the screen 110 by means of the display 100.

The control unit 300 also communicates via a bus system with a battery 60, which is integrated into the battery box 71, and with a motor 40. The motor 40 and the battery 60 make up the drive of the motor scooter 10, at least when it is connected to the power source.

The control unit 300 controls the behaviour of the motor 40 and of the battery 60.

In an embodiment of the invention, the control unit 300 implements four different driving modes. These driving modes are as follows:

- a) a recuperation mode;
- b) a sailing mode;
- c) an acceleration mode; and
- d) a boost mode.

The individual driving modes are implemented in such a way that they provide torques, as shown in Fig. 3.

The axes of the graph in Fig. 3 designate a position P of the thumb lever 31 (x axis) and a torque (y axis), which is applied by the motor 40.

According to an embodiment of the invention, when not in use the thumb lever 31 is in the zero position. Then, distances follow for:

- a) the recuperation mode = s_{Rec} ;
- b) the sailing mode = s_{GI} ;
- c) the acceleration mode = s_B ;
- d) the boost mode = s_{HB} .

The thumb lever 31 is therefore in the starting position/rest position. First, it covers the distance sREC for recuperation, then the distance for the sailing mode sGL, then the distance for the acceleration mode sB and, finally, the distance for the boost mode sHB. The distances are broken down in the execution example as follows:

- sREC = 20 per cent;
- sGI = 10 per cent;
- sB = 65 per cent;
- sHB = 10 per cent

of a distance of actuation sGES.

When the motor scooter 10 travels, there is no resulting torque in the sailing mode, while, in the recuperation mode, a negative torque acts which increases preferably linearly with increasing distance from the sailing mode. In the acceleration mode, therefore, there is a positive torque, which also increases with increasing distance from the sailing mode. There is preferably a linear dependence between the distance and the torque. There is also a positive torque in the boost mode, which increases linearly with increasing distance from the acceleration mode. The acceleration mode and the boost mode are preferably implemented such that acceleration in the boost mode is much greater than in the acceleration mode.

According to the invention, the control unit 300 can be designed to emit signals indicating whether a boost mode is available. The availability of the boost mode may not be given if the battery 60 is low. For the purpose of determining whether a boost mode can be implemented without damaging the motor scooter 10, temperature conditions in or in the area of the battery 60 and/or in or in the area of the motor 40 can be taken into consideration. According to the invention, one or more of the named criteria can be used to determine availability.

In the described execution example, the control unit 300 is designed such that it makes the availability of a boost mode dependent on when a boost mode was last requested and how long the vehicle was driven in boost mode.

The control unit 300 also emits signals to indicate to the user how long he or she can drive with the boost. These signals are emitted via the display 100. Fig. 4 to 6 show the screen 110 of the display 100 in different states. In each of the states shown, the screen 110 shows four charge bars 111, 111', 111'', 111'''. According to the state of the motor scooter 10, or, more accurately, the availability of the boost mode, the charge bars 111, 111', 111'', 111''' are filled or simply outlined. If all charge bars 111, 111', 111'', 111''' are filled, the boost mode is available for a maximum time interval (= maximum time), for example 1 minute. The control unit 300 controls the display 100 so that the layout of the screen 110 is different when availability is lower.

In Fig. 4 only the lowest charge bar 111 is filled. The remaining charge bars 111', 111'', 111''' are empty. Ultimately, therefore, the control unit 300 indicates that the boost mode is available for just a quarter of the maximum time, for example 15 seconds.

In Fig. 5 the lowest charge bar 111 and the next charge bar above 111' are filled. The remaining charge bars 111'', 111''' are empty. This means that the control unit 300 is signalling a state in which the boost mode is available for a time interval which is half the maximum time. The display according to Fig. 5 can therefore indicate that the boost mode is available for approximately 30 seconds. In Fig. 6 three charge bars 111, 111', 111'' of the four charge bars 111, 111', 111'', 111''' are filled. The result is, therefore, that the boost mode can be requested for three quarters of the maximum time.

In this embodiment of the invention, the control unit 300 is designed such that the availability of the boost mode can be slowly reduced when driving takes place in boost mode. For example, as soon as the aforementioned maximum time is reached, the available torque is reduced. When driving takes place in normal

acceleration mode, or in recuperation mode, or in sailing mode, availability increases again, with the result that, after a certain time, it is possible to return to boost mode.

Fig. 8 and 9 show details of the smartphone holder 200 from Fig. 2. The smartphone holder 200 comprises a display 100 with a screen 110 as well as a foam block 201, on which a smartphone 1 can be placed and fixed.

According to the cross section from Fig. 9 the smartphone holder 200 effectively has two sections, which are arranged at an obtuse angle to each other. The display 100 is integrated into the upper section and the foam block 201 is integrated into the lower section. The smartphone holder 200 comprises a cover 210, which is rotatably mounted on the housing of the smartphone holder 200. The cover also comprises an upper cover section 211 and a lower cover section 212, which are effectively arranged at an obtuse angle to each other. The cover 210 makes it possible to open and close (= lock) the smartphone holder 200. In an embodiment of the invention, the cover 210 is made of a transparent durable material, so that the screen 110 of the display 100 can be read in the closed state or in the locked position. Accordingly, the cover 110 also enables displays on the smartphone 1 to be recognised in the closed state. The foam block 201 and the housing, as well as the cover 210, of the smartphone holder are designed in such a way that, in the locked state, the smartphone 1 is clamped between the lower cover section 212 and the foam block 201. In this state, the smartphone 1 cannot therefore shift and is securely held. A snap-in locking device 214 provides a snap-lock connection for the cover 210 so that, in the closed state, the cover 210 is releasably held on the casing.

Numerous other embodiments of the invention open up for the person skilled in the art, who is active in this area. In the foregoing description, a control unit 300 was described which controls the battery 60 and the motor 40. According to the invention, the control unit 300 can also be a regulating device which regulates some of the functions. According to the application, there is no difference between controlling and regulating.

According to the invention, the motor scooter 10 can also be equipped in such a way that it does not comprise a smartphone holder 200 as described in connection with Fig. 8 and 9. In theory, conventional displays 100 can be used that are suitable for displaying signals emitted by the control unit 300. It is also possible to use the smartphone holder 200 according to the invention without the described control unit 300.

As regards the smartphone holder 200, it should also be noted that the arrangement of the swivel joint in the upper area of the housing of the smartphone holder 200 is not essential. For example, it is possible for the upper cover section 211 to be fixed to the housing and for just the lower cover section 212 to comprise the aforementioned rotary connection. In this execution example it is also possible to fix the smartphone 1 securely between the foam block 201 and the lower cover section 212.

The distances specified for the individual driving modes are also to be understood to be purely examples. According to the invention, these distances can be varied at will. Preferred variations, however, lie within a variation of no more than 50 per cent, in particular no more than 30 per cent of the individual distances.

List of reference numerals

1	Smartphone
10	Scooter
12	Front wheel
12'	Rear wheel
20	Saddle
21	Battery box
30	Steering unit
31	Thumb lever
40	Motor or drive
60	Battery
100	Display
110	Screen
111, 111' 111", 111'''	charge bars
200	Smartphone holder
201	Foam block
210	Cover
211	Upper cover section
212	Lower cover section
214	Snap-in locking device
300	Control unit
M	Torque
P	Position of the thumb lever
sGes	Total distance of actuation
sRec	Distance for the recuperation mode
sGI	Distance for the sailing mode
sB	Distance for the acceleration mode
sHB	Distance for the boost mode

Claims

1. Electric motor scooter (10), comprising:
 - at least one electric drive (40);
 - at least one electric battery (60);
 - at least one actuation unit, in particular a thumb lever (31), wherein the actuation unit is designed so that the actuation unit can be brought into different positions along the total distance of actuation (sGes);
 - a control unit (300), which is designed,
 - o to determine the position (P) of the actuation unit;
 - o depending on the position thus determined, to select a driving mode from a number of driving modes and to set the selected driving mode, wherein the driving modes comprise:
 - d) recuperation mode;
 - e) sailing mode;
 - f) acceleration mode,

wherein, when the recuperation mode is set, the control unit (300) controls the electric drive so that energy generated in the electric drive (40) is delivered, at least partially, to the battery (60).
2. Electric motor scooter (10) according to claim 1, characterised in that the control unit (300) controls the electric drive (40) and/or the battery (60) in the acceleration mode so that, according to a first acceleration coefficient (kl), an essentially linear dependence exists between a position (P) of the actuation unit and the torque (M) applied by the electric drive (40), for example according to the following formula: $M(P)=k_1 \cdot P + d$.

3. Electric motor scooter (10) according to one of the preceding claims, characterised in that
the driving modes comprise a boost mode, wherein the control unit (300) controls the electric drive (40) and/or the battery (60) in the boost mode so that, at least partially, according to a second acceleration coefficient (k_2), an essentially linear dependence exists between a position (P) of the actuation unit and the torque (M) applied by the electric drive, for example according to the following formula:
$$M(P) = k_2 \cdot P + d,$$

wherein the first acceleration coefficient (k_1), is, in particular, much smaller than the second acceleration coefficient (k_2), for example by at least 10 or 20 or 30 or 50 per cent.
4. Electric motor scooter (10) according to one of the preceding claims, in particular according to claim 3, characterised in that
the control unit (300) emits signals which indicate whether the electric drive (40) and/or the battery (60) are in a state in which a boost can be undertaken.
5. Electric motor scooter (10) according to one of the preceding claims, in particular according to claim 4, characterised in that
the control unit (300) is designed so that, when establishing whether the electric drive (40) and/or the battery (60) are in a state in which a/the boost can be undertaken, the following are taken into consideration:
 - period of time since the last boost; and/or
 - duration of the last boost; and/or
 - temperature values of the battery (60) and/or the drive (40).
6. Electric motor scooter (10) according to one of the preceding claims, in particular according to one of the preceding claims 3 to 5, characterised in that
the control unit (300) is designed to emit signals which indicate over what period of time a/the boost is available,
wherein a display (100) indicates the period of time.

7. Electric motor scooter (10) according to one of the preceding claims, in particular according to one of the preceding claims 3 to 6, characterised in that the control unit controls the display (100) so that bars (111, 111', 111'', 111''') or similar symbols indicate the period of time, wherein, preferably following the use of a/the boost, an increase in the period of time is displayed.
8. Electric motor scooter (10) according to one of the preceding claims, characterised in that
 - at least 10 per cent, in particular at least 15 per cent, of the total distance of actuation (sGes) is assigned to the recuperation mode; and/or
 - at least 5 per cent, in particular at least 10 per cent, of the total distance of actuation (sGes) is assigned to the sailing mode; and/or
 - at least 40 per cent, in particular at least 50 per cent, of the total distance of actuation (sGes) is assigned to the acceleration mode; and/or
 - at least 3 per cent, in particular at least 5 per cent, of the total distance of actuation (sGes) is assigned to a/the boost mode.
9. Electric motor scooter (10) according to one of the preceding claims, characterised by a smartphone holder (200), comprising:
 - a foam container (201) in which to place the smartphone (1); and
 - a rotatably mounted, at least partially transparent, cover (210), which presses the smartphone (1) against the foam container (201) in a locked position.
10. Electric motor scooter (10) according to one of the preceding claims, in particular according to claim 9, characterised in that the cover (210) comprises an upper flat section (211) to cover an integrated display (110) and a lower flat section (212) to hold the smartphone (1), wherein the sections are arranged at a, preferably obtuse, angle to each other.

11. Electric motor scooter (10) according to one of the preceding claims, in particular according to claim 9 or 10,
characterised in that
in an upper area of the upper section (211) brackets for the rotational mounting,
and
in a lower area of the lower section (212) a snap-in locking device (214) to fix the cover (210) are provided.