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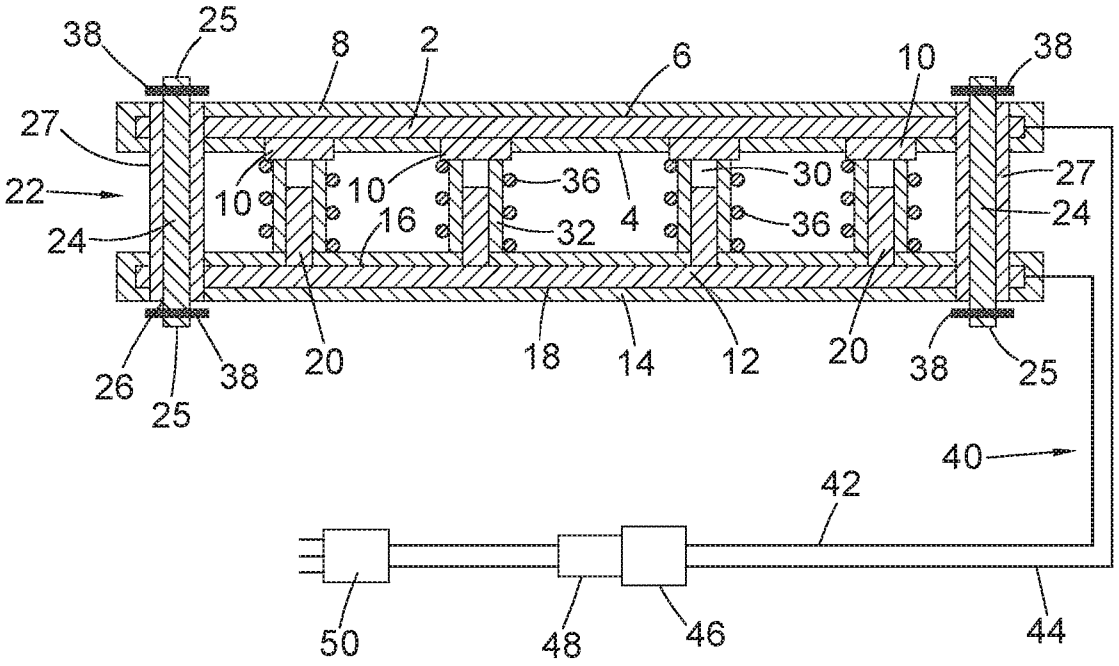
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Fig. 1

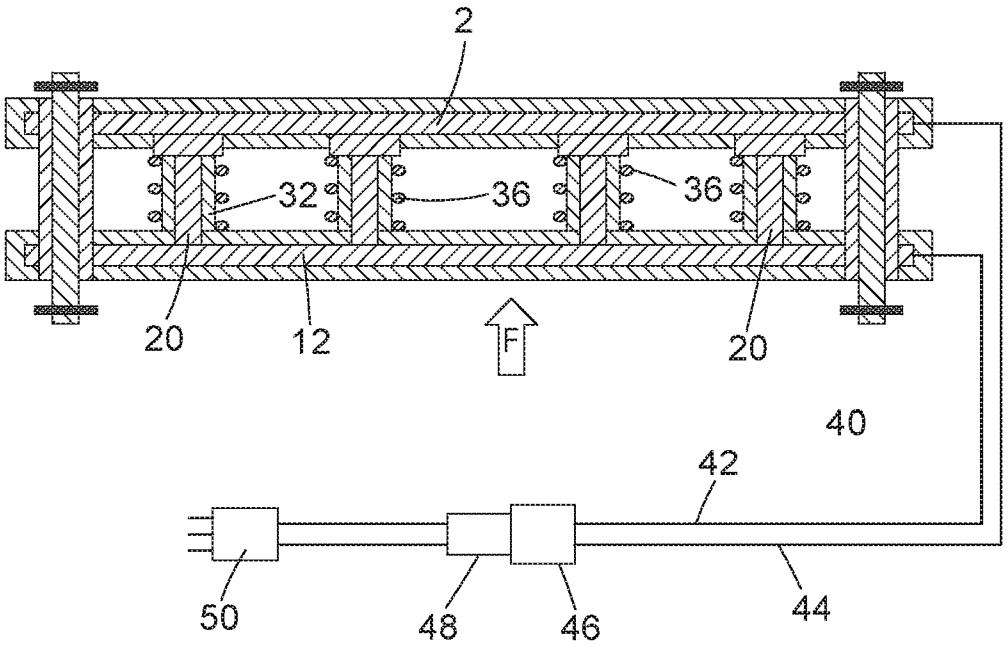
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Fig. 2

A COLLISION SWITCH FOR A MOBILITY SCOOTER

The present invention relates to an emergency stop device for an electric vehicle, and in particular a collision switch for a mobility switch.

A mobility scooter is an electrically powered scooter designed for people with restricted mobility. Typical users of a mobility scooter are elderly or disabled people. Mobility scooters are divided into class 2 and class 3 vehicles. Class 2 scooters are limited up to 4mph and in general are designed for pavement use. Class 3 scooters have a maximum speed of up to 8mph for road use, and include a switch to reduce the maximum speed to 4mph so they can be used on a pavement. Class 3 scooters tend to be larger and heavier.

All classes of mobility scooters have certain basic controls in common. An on/off switch, which may be key operated, is used to operate the scooter, and acceleration is controlled by a simple lever. The lever is pushed in a first direction to move the scooter forward, and in a second direction to reverse.

Class 2 scooters are not provided with conventional user operated brakes, and in order to stop the user must release the accelerator lever. As soon as the user stops pressing the accelerator lever the throttle is disengaged and the brakes automatically activate to bring the scooter to a stop. This is referred to as passive braking and the braking system is configured to activate even if power to the scooter is cut. However, the action of passive braking can be difficult to get used to as it is counterintuitive, and is the opposite of the way in which a bike is stopped for example. These difficulties in braking can lead to accidents. For example, the user may simply be too slow to react when a collision is imminent. It has also been found that user's panic before a collision and instead of releasing the accelerator they grip it in a conventional 'braking' action, which not only prevents the scooter from stopping but makes it accelerate and lurch forward making the collision worse. In certain cases where pedestrians have been hit by a mobility scooter, the user's impulse to grip the brake results not only in a collision with the pedestrian, but

also in the pedestrian being driven several meters forward until the scooter comes to a halt. As such, the injuries incurred as a result of the collision can be far worse.

It is therefore desirable to provide an improved braking system for a mobility scooter which addresses the above described problems and/or which offers improvements generally.

According to the present invention there is provided a collision switch for a mobility scooter as described in the accompanying claims.

In an embodiment of the invention there is provided a collision switch for a mobility scooter. The collision switch comprises a bumper member including a contact surface, the bumper member being configured to be mounted to a mobility scooter such that contact surface is outwardly facing and arranged to be impacted during a collision. The collision also includes first and second electrical contacts and an electrical circuit connected to the first and second electrical contacts such that separation of the first and second electrical contacts creates a break which opens the electrical circuit. The electrical circuit includes a connector for connecting the electrical circuit to a mobility scooter immobiliser. The bumper member is configured such that when mounted to a mobility scooter it is movable relative to the mobility scooter from an expanded configuration to a compressed configuration when the outer surface is engaged during a collision, and wherein the first and second electrical contacts are arranged such that when the bumper is in the expanded position the first and second electrical contacts are separated to open the electrical circuit, which in use permits movement of the mobility scooter, and when the bumper is in the compressed position the first and second electrical contacts are in contact to close the electrical circuit, which in use immobilises the mobility scooter. The bumper member is moved to the compressed configuration during a collision and movement of the bumper member to the compressed configuration causes the scooter to be immobilised, which mitigates the injury and/or damage caused during the collision.

The collision switch may comprise a support member configured to be mounted to a mobility scooter, and the bumper member may connected to the support member such that it is movable in a rearwards direction towards the support member and a forwards direction away from the support member, the bumper member moving rearwardly to the compressed configuration and forwardly to the expanded configuration. The bumper member and support member form part of a switch assembly configured to be mounted to scooter as a single unit, which enables the switch to be easily retro fitted to existing scooters.

The first electrical contact may be located on the support member and the second electrical contact may be located on the bumper member.

The support member is preferably configured such that when mounted to the mobility scooter in use it is fixed in position relative to the mobility scooter. The support member is thereby used to mount the switch to the scooter, and to support the bumper member.

The support member and the bumper member may each have an inner surface and an outer surface that faces forwardly away from the mobility scooter in use, the inner surface of the bumper member and the outer surface of the support member face each other, and the first electrical contact is located on the outer surface of the support member and the second electrical contact is located on the inner surface of the bumper member. The bumper member moves rearwardly towards the support member with the forward and rearward direction being defined relative to the forward direction of travel of the scooter. It will however be appreciated that the collision switch could alternatively or in addition be mounted to the rear of the scooter.

The collision switch may comprise at least one biasing member arranged to bias the bumper member away from the support member to the expanded configuration. The biasing members hold the bumper in the expanded configuration and return it to the expanded configuration following compression.

The bumper member may be mounted to the support member by at least one guide member, and the bumper member may be slidable along the at least one guide member to move between the expanded and compressed configurations in the forward and rearward direction. Preferably a plurality of guide members are provided that extend in the forward/rearward direction.

Preferably the bumper member and support member comprise metal bars or plates

The bumper member preferably comprises an electrically conductive core at least partially covered by an insulating layer, and the second electrical contact comprises at least one electrically conductive projection connected to the core of the bumper member and extending rearwardly from the bumper member towards the support member, and wherein the first electrical contact is aligned with the at least one projection and the first and second electrical contacts are arranged such that the at least one projection is spaced from the first electrical contact in the expanded configuration and such that the at least one projection contacts the first electrical contact in the compressed configuration.

The biasing member may be at least one spring arranged about the at least one projection, and the at least one projection is surrounded by at least one electrically insulating sleeve located between the at least one projection and the at least one spring.

The second electrical contact may comprise a plurality of projections extending rearwardly from the bumper member and the first electrical contact comprises a plurality of first electrical contacts arranged on the outer surface of the support member and aligned with the plurality of second electrical contacts.

The support member may comprise an electrically conductive core and an electrically insulating layer at least partially covering the core, and the plurality of first electrical contacts are in electrical contact with the core of the support member.

In another aspect of the invention there is provided an electric vehicle such as a mobility scooter having a vehicle body and comprising a collision switch as described above mounted to the vehicle body such that the bumper member is contacted in the event of a collision, wherein the vehicle comprises a drive motor and an immobiliser arranged to immobilise the vehicle by preventing operation of the drive motor and/or by activating the brakes, and the electrical circuit is connected to the immobiliser to cause the immobiliser to prevent operation of the drive motor when the bumper member is in the compressed configuration and the electrical circuit is closed.

The electric vehicle may comprise a battery and a charging socket for charging the battery, and the immobiliser is connected to the charging socket such that the immobiliser is activated to immobilise the vehicle when a closed electrical circuit is connected to the charging socket, and the electrical circuit of the collision switch is connected to the charging socket.

The vehicle preferably has a front end which faces forwardly relative to the direction of travel and the collision switch is mounted to the front end of the vehicle and arranged such that the bumper element is the foremost part of the vehicle.

The electrical circuit is preferably connected to an intermediate socket mounted to the vehicle body, and the intermediate socket is connected to the charging socket via a secondary cable having a first plug compatible with the charging socket and a second plug compatible with the intermediate socket.

The present invention will now be described by way of example only with reference to the following illustrative figures in which:

Figure 1 shows a collision switch according to the present invention in the expanded configuration; and

Figure 2 shows a collision switch according to the present invention in the compressed configuration.

Referring to Figure 1, an emergency stop device for a mobility scooter is shown in cross section. The emergency stop device comprises a first bar 2 formed from an electrically conductive material. The first bar 2 is preferably an elongate flat metal bar having a front face 4 and rear face 6. The first bar 2 defines a metal core, which is surrounded by an electrically insulating layer 8. The electrically insulating layer 8 may be a heat shrink plastic layer, a moulded plastic coating or any other suitable insulting material layer. A series of electrically conductive contacts 10 are arranged along the front face 4 of the first bar 2. The electrical contacts 10 are disc shape elements formed from an electrically conductive material such as copper. The electrical contacts 10 are secured to, and are in electrical contact with the front face 4 of the first bar 2. The electrical contacts 10 project through the insulating coating 8 enabling external electrical contact to be made with the first bar 1.

A second bar 12 is formed from an electrically conductive material. The second bar 12 is preferably similar in form to the first bar 2 and comprises an elongate flat metal bar having a front face 14 and rear face 16. The second bar 12 defines a metal core, which is surrounded by an electrically insulating layer 18. The electrically insulating layer 8 may be a heat shrink plastic layer, a moulded plastic coating or any other suitable insulting material layer. The second bar 12 includes a series of electrically conductive rods 20 arranged along the rear face 16. The electrically conductive rods 20 are secured to, and are in electrical contact with the rear face 16 of the second bar 12. The electrically conductive rods 20 project through the insulating coating 18.

The second bar 12 is arranged parallel to the first bar 2 and is spaced forwardly from first bar 2 defining a spacing gap 22. The terms ‘front’, ‘rear’, ‘forwardly’ and ‘rearwardly’ are relative terms and relate to the arrangement of the components in use, wherein the device is mounted to a mobility scooter having a front and rear, and a forward and

rearward direction of travel. A pair of guide rods 24 extend through corresponding apertures 26 in the first bar 2 and the second bar 12, and are arranged at opposing ends of the first bar 2 and second bar 12. The apertures 26 are aligned lengthwise along the bar such that the guide rods are arranged perpendicular to the length of the first bar 2 and second bar 12. The guide rods 24 each comprise a cylindrical metal bar 25 at its core, surrounded by an electrically insulating sleeve 27, which electrically isolates the metal core 25 from the first bar 2 and second bar 12. The second bar 12 is slidingly received on the guide rods 24 such that it is able to slide along the guide rods 24 towards and away from the first bar 1 in a rearward and forward direction transverse to the length of the first bar 2.

The series of electrically conductive rods 20 correspond in number to the series of electrical contacts 10 and are longitudinally aligned with the electrical contacts 10, with each electrically conductive rod 20 being aligned with a corresponding electrical contact. The electrically conductive rods 20 project rearwardly across the gap 22 towards the electrical contacts 10. Each electrically conductive rod 20 has a side wall 28 and a distal end face 30. An electrically insulating sleeve 32 surrounds the side wall 28 of each electrically conductive rod 20. Each sleeve 32 is hollow and open ended, such that a clear passage is defined between each distal end face 30 and the adjacent electrical contact 10. Each sleeve 32 is surrounded by a compression spring 36. The compression springs 36 contact the front face 4 of the first bar 2 at a first end and the rear face 16 of the second bar 12 at a second end. The compression springs 36 are arranged and configured to bias the first bar 2 and second bar 12 away from each other in the forwards/rearwards direction.

Split pins 38 are provided through the guide rods 24 at opposing ends. The split pins 38 define retaining members that prevent the ends of the guide rods 24 from passing through the apertures 26. Each split pin 38 is located proximate the distal end of the corresponding guide rod 24. The spacing of the split pins 38 along the length of the guide rods 24 sets the maximum spacing of the first bar 2 and the second bar 12. It will be appreciated that any other suitable retaining members may be used, for example circlips,

threaded caps or any other retaining member having a diameter greater than the aperture 26.

The first bar 2 is mounted to the front bumper of a mobility scooter, such that the rear face 6 of the first bar 2 is adjacent the bumper and the front face 14 of the second bar 12 is foremost and forwardly facing. An electrical circuit 40 is connected to the first bar 2 and second bar 12. A first electrical wire 42 is connected to the first bar 2 such that it is in electrical contact with the metal core. The electrical wire 42 is in electrical contact with the electrical contacts 10 via the metal core of the first bar 2. A second electrical wire 44 is connected to the second bar 12 such that it is in electrical contact with the metal core defined by the second bar 12. The electrical wire 44 is in electrical contact with the electrically conductive rods 24 via the metal core of the second bar 12. The first wire 42 and second wire 44 are connected to a jack socket 46, which is connected to by a jack plug 48. The jack plug 48 is connected to a 3-pin plug 50 that is configured to connect to the charging socket of a mobility scooter. The jack socket 46 is mounted on the steering column or 'tiller' of the scooter, and the first and second wires. The charging system of a mobility scooter includes an immobiliser configured to disconnect the battery during charging to immobilise the motor and prevent the scooter from being driven. The immobiliser is activated when a closed electrical circuit is connected to the charging socket.

The springs 36 urge the first bar 2 and second bar 12 apart to the maximum separation, where they are held by the retaining members 38. In this separated configuration, the distal end faces 30 of the electrically conductive rods 20 are spaced from the electrical contacts 10 by a gap 52. The springs 36 are electrically isolated from the second bar 12 by the insulating skin 18 surrounding the bar 12 and the insulating sleeves The first bar 2 and second bar 12 are therefore electrically isolated from each other and the electrical circuit 40 is broken by the gap 52. When the 3-pin plug is connected to the charging socket of the mobility scooter, and the first and second bars 2,12 are in the spaced configuration, the battery of the mobility scooter remains connected with the scoter in an active state. This is because the immobiliser requires a closed circuit to be connected to the charging

socket in order to activate. The user is therefore able to freely drive the scooter when the first and second bars 2,12 are on the spaced configuration.

During a front-on collision, the first part of the scooter to come into contact with the object being collided with is the second bar 12 of the emergency stop device. As shown in Figure 2, during the collision an impact force F is applied to the second bar 12, which functions as a bumper plate. The force F causes the second bar 12 to move towards the first bar 2 in a rearward direction. As the second bar 12 moves rearwardly the springs 36 are compressed. The insulating sleeves 32 and 27 are formed from a resilient, compressible material, and compress as the second bar 12 moves rearwardly. The second bar 12 continues to move rearwardly until it reaches a fully compressed configuration in which the end faces 30 of the electrically conducting rods 20 are in contact with and abut the electrical contacts 10, which prevents further movement of the second bar 12. Contact between the electrically conducting rods 20 and the electrical contacts 10 completes the electrical circuit 40, which activates the immobiliser o the mobility scooter, causing the battery to disconnect and stopping the motor. Even if the user continues to pull the accelerator lever, the scooter is no longer able to move. The scooter is therefore automatically immobilised immediately upon collision, thereby preventing the further injury or damage that may occur if the scooter were to continue moving or accelerated.

Following the collision, once the force F has been removed, the springs 36 acts to return the second bar 12 to the expanded, separated configuration. The electrical circuit is broken once more and the scooter is able to be restarted and operated.

CLAIMS

1. An electric vehicle such as a mobility scooter comprising:

a vehicle body;

a drive motor;

a battery charging socket for receiving a charger;

a battery;

an immobiliser operatively connected to the charging socket such that the immobiliser is activated to immobilise the vehicle when a closed electrical circuit is connected to the charging socket;

a collision switch comprising:

a bumper member including a contact surface mounted to the vehicle body such that contact surface is outwardly facing and arranged to be impacted during a collision, and movable relative to the vehicle from an expanded configuration to a compressed configuration when the contact surface is engaged during a collision;

first and second electrical contacts;

an electrical circuit connected to the first and second electrical contacts such that separation of the first and second electrical contacts creates a break which opens the electrical circuit, the first and second electrical contacts being arranged such that when the bumper is in the expanded position the first and second electrical contacts are separated to open the electrical circuit, which in use permits movement of the mobility scooter, and when the bumper is in the compressed position the first and second electrical contacts are in contact to close the electrical circuit; and

wherein the electrical circuit of the collision switch is connected to the charging socket to cause the immobiliser to prevent operation of the drive motor when the bumper member is in the compressed configuration and the electrical circuit is closed.

2. An electric vehicle such as a mobility scooter according to claim 1 comprising a support member configured to be mounted to a mobility scooter, wherein the bumper member is connected to the support member such that it is movable in a rearwards direction towards the support member and a forwards direction away from the support

member, the bumper member moving rearwardly to the compressed configuration and forwardly to the expanded configuration.

3. An electric vehicle such as a mobility scooter according to claim 2 wherein the first electrical contact is located on the support member and the second electrical contact is located on the bumper member.

4. An electric vehicle such as a mobility scooter according to claim 3 wherein the support member is configured such that when mounted to the mobility scooter in use it is fixed in position relative to the mobility scooter.

5. An electric vehicle such as a mobility scooter according to claim 4, wherein the support member and the bumper member each have an inner surface and an outer surface that faces forwardly away from the mobility scooter in use, the inner surface of the bumper member and the outer surface of the support member face each other, and the first electrical contact is located on the outer surface of the support member and the second electrical contact is located on the inner surface of the bumper member.

6. An electric vehicle such as a mobility scooter according to claim 5 comprising at least one biasing member arranged to bias the bumper member away from the support member to the expanded configuration.

7. An electric vehicle such as a mobility scooter according to claim 6 wherein the bumper member is mounted to the support member by at least one guide member, and the bumper member is slidable along the guide member to move between the expanded and compressed configurations.

8. An electric vehicle such as a mobility scooter according to claim 6 or 7 wherein the bumper member comprises an electrically conductive core at least partially covered by an insulating layer, and the second electrical contact comprises at least one electrically conductive projection connected to the core and extending rearwardly from the bumper

member towards the support member, and wherein the first electrical contact is aligned with the at least one projection and the first and second electrical contacts are arranged such that the at least one projection is spaced from the first electrical contact in the expanded configuration and such that the at least one projection contacts the first electrical contact in the compressed configuration.

9. An electric vehicle such as a mobility scooter according to claim 8 wherein the biasing member is at least one spring arranged about the at least one projection, and the at least one projection is surrounded by at least one electrically insulating sleeve located between the at least one projection and the at least one spring.

10. An electric vehicle such as a mobility scooter according to claim 9 wherein the second electrical contact comprises a plurality of projections extending rearwardly from the bumper member and the first electrical contact comprises a plurality of first electrical contact elements arranged on the outer surface of the support member and aligned with the plurality of projections of the second electrical contact.

11. An electric vehicle such as a mobility scooter according to claim 10 wherein the support member comprises an electrically conductive core and an electrically insulating layer at least partially covering the core, and the plurality of first electrical contact elements are in electrical contact with the core of the support member.

12. An electric vehicle such as a mobility scooter according to any preceding claim wherein the mobility scooter has a front end which faces forwardly relative to the direction of travel and the collision switch is mounted to the front end of the vehicle and arranged such that the bumper element is the foremost part of the vehicle.

13. An electric vehicle such as a mobility scooter according to claim 12 wherein the electrical circuit is connected to an intermediate socket mounted to the vehicle body, and the intermediate socket is connected to the charging socket via a secondary cable having

a first plug compatible with the charging socket and a second plug compatible with the intermediate socket.