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(54) **SYSTEM FOR PROVIDING A SCALE FOR A STATE OF CHARGE INDICATOR AND HYBRID VEHICLE WITH SUCH A SYSTEM**

SYSTEM ZUM BEREITSTELLEN EINER SKALA FÜR EINE BATTERIE-LADEZUSTANDSANZEIGE UND HYBRIDFAHRZEUG MIT EINEM SOLCHEN SYSTEM

SYSTÈME POUR METTRE EN DISPOSITION UN CADRAN POUR UN INDICATEUR D'ÉTAT DE CHARGE D'UNE BATTÉRIE ET VÉHICULE HYBRIDE AVEC UN TEL SYSTÈME

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EP 3 036 125 B1

Description

TECHNICAL FIELD

[0001] This invention relates to a display for displaying an amount between a minimum and a maximum, such as an indicator for indicating a state of charge, in particular for indicating the state of charge of a battery of a hybrid electric vehicle.

BACKGROUND TO THE INVENTION

[0002] Hybrid electric vehicles are well known, and generally comprise an internal combustion engine, an electric motor, a battery and a control system for determining whether the vehicle is driven by the engine, the motor or a combination of engine and motor. The battery may be charged by a vehicle generator, or by the motor acting as a generator, for example during regenerative vehicle braking. In some circumstances the engine may drive the motor (as generator) to charge the battery.

[0003] Many factors influence how and when the vehicle battery should be charged when the vehicle is in use. For example account must be taken of the optimum state of charge of the battery, and the likely availability of opportunistic re-charging, for example by regenerative braking (at no fuel cost). The nominal state of charge may vary according to whether a vehicle driver has selected a program which is optimized for maximum fuel economy, maximum range or maximum performance. Charging of the battery may be controlled by a torque control system having a plurality of charging maps for each vehicle operating mode. In a hybrid electric vehicle, operating modes may include normal, electric (giving extended range under electric power), and sport (giving increased acceleration).

[0004] Charging maps may be determined empirically for a particular vehicle type or specification, and are not the subject of this invention as such.

[0005] Batteries used in hybrid vehicles have a relatively high voltage and certain characteristics, in particular they should in general not be fully discharged (0%) nor should they be repeatedly fully charged (100%), since this can be detrimental to battery life. The theoretical range of charge is less than 0-100%, and the useable range of charge may be smaller still, typically 25-75%.

[0006] In one embodiment the nominal state of charge of the battery may be at around 50%. This allows headroom for opportunistic recharging up the maximum usable state of charge of approximately 70%, and also allows the battery to operate at its most efficient state of charge.

[0007] The nominal state of charge may vary according to the operating mode of the vehicle, and the corresponding charging map.

[0008] The state of charge is generally indicated to the vehicle driver by means of a dashboard or instrument panel display, which may show a maximum and minimum corresponding to the range of charge which is permitted by the torque control system.

[0009] Typically the vehicle driver is not presented with an indicator of the full theoretical range of charge because to do so would give a misleading impression that the battery could not reach a desired 'maximum' charge. As noted above maximum theoretical charge is not desirable.

[0010] Accordingly the vehicle driver is generally presented with a display or indicator representing in effect a reduced range, in which the displayed minimum may correspond to 25% charge, and the displayed maximum to 75% charge.

[0011] Nevertheless, considering that a control allowance is included for opportunistic recharging, and to permit different levels of nominal charge, a conventional charge indicator may typically reach the maximum charge indication only seldom.

[0012] The present invention provides a method of displaying the state of charge and a display which addresses this circumstance, and gives an appropriate indication of the state of charge to the vehicle driver.

[0013] FR2976889 describes a known vehicle (VH) having a man/machine interface (IH) dedicated to displaying first and second schematic representations of first and second autonomies offered respectively by a rechargeable battery (BA) and by a fuel tank (RC) which is able to operate it either in what is known as a full-electric selected mode or in what is known as an all-combustion selected mode or alternatively in what is known as an electric and combustion selected mode. This interface (IH) is designed to vary the relative positions of the first and second schematic representations according to which mode of operation for hybrid motor vehicle (VH) has been selected.

[0014] DE102008047923 describes a known vehicle (10) having a preset target electrical range. A driven distance is preset and stored in the vehicle from a current location until next charging of a battery (7). A driving operation of the vehicle is optimized such that a loading condition of the battery lies on a minimum value under the consideration of boundary conditions that are preset by the target electrical range and the driven distance up to the next loading when the vehicle stores the driven distance.

[0015] The document DE 10 2008 016527 A1 does not discloses a system for providing a scale of electrical charge of a vehicle battery with a second maximum state of charge is higher than a first maximum state of charge, and wherein, when the vehicle is in the second driving mode, the displayed first indicator and the displayed second indicator and the range there between are displayed, and an extension to the range is provided between the displayed second indicator and the displayed third indicator

SUMMARY OF THE INVENTION

[0016] Aspects of the invention are defined in the ap-

pended claims.

[0017] According to an aspect of the invention there is provided a system for providing a scale of electrical charge of a vehicle battery, according to the subject-matter of claim 1.

[0018] In an embodiment the system comprises:

a display arranged to display the scale of state of charge of the battery and the state of charge detected,
wherein the controller is arranged to control the display to display the scale in dependence on the state of charge detected.

[0019] This is advantageous because the maximum and/or minimum parameters of the scale may be selected without affecting the indicator linked to the state of charge of the battery. For example, the indicator may be movable with respect to the scale for indicating an instant value of state of charge on the scale, wherein the range of the scale is adapted to be changed without movement of said indicator.

[0020] According to some, but not necessarily all, examples, there is provided a display for displaying an amount between a minimum and a maximum, said display comprising a scale indicating a progressive increase from minimum to maximum, and said indicator movable with respect to the scale for indicating the instant value on said scale, wherein the range of said scale is adapted to be changed without movement of said indicator.

[0021] The scale may be made longer or shorter, and may be lengthened or shortened asymmetrically. In such a display, the scale may for example be adapted to show an extension in certain circumstances, the instant position of the indicator being substantially unchanged regardless of whether the extension is provided or is not provided.

[0022] The extension may, for example, be hidden, and revealed only when circumstances permit. The scale and extension may be real or virtual. In the case of an electronic display, the extension may be caused to appear and disappear, as required, according to whether power is applied to particular display elements. The scale may be illuminated or projected, and thus may the extension be hidden or revealed. A mechanically actuated shutter may be provided whereby the extension is revealed when required.

[0023] The indicator, which may for example be a real or virtual pointer, may not change in position upon a change in the range of the scale.

[0024] In the case of an extension to the scale, which may be at the minimum or maximum, the extension may be differently represented so as to be distinguishable. An extension may for example be denoted by different scale markings, and/or different frequency of scale markings, and/or different colouring.

[0025] In an embodiment of the invention, the display is an indicator of battery charge in a hybrid electric vehicle, and comprises a progressive charge display having the first indicator of a charge level, the second indicator of a charge level higher than that of the first indicator, and a range therebetween, wherein an extension to said range is provided, said extension being represented differently to said range. A scale, which may progressively increase, is provided between the first and second indicators, which may respectively represent a normal minimum charge and a normal maximum charge. The extension may represent an extended charge, which is available in certain circumstances of use. The normal maximum charge may be the nominal state of charge of the battery.

[0026] Aspects of the invention relate to the system and to a vehicle incorporating the system.

[0027] Features of the system will be apparent from the claims appended hereto.

BRIEF DESCRIPTION OF DRAWINGS

[0028] Other features of aspects of the invention will be apparent from the following description of embodiments illustrated by way of example only in the accompanying drawings in which:

Fig. 1 represents an embodiment of a display according to aspects of the invention.
Figs. 2 and 3 represent an alternative embodiment according to aspects of the invention.

DESCRIPTION OF EMBODIMENTS

[0029] With reference to the drawings a state of charge indicator or display 10 of a hybrid electric vehicle comprises a conventional circular dashboard dial having an arcuate scale 11 and a pointer 12 which can swing across the scale, as indicated by arrow 13, from a minimum to a maximum. The scale and the pointer may each be real or virtual.

[0030] The arcuate scale 11 comprises a first portion with widely spaced graduations, and a second portion with closely spaced graduations.

[0031] In the example illustrated the minimum 14 is represented by the left hand end of the scale, and the maximum 15 by the right hand end of the first scale portion. The second scale portion represents an extension to the charge range, and terminates at an extended maximum 16 at the extreme right hand end of the scale.

[0032] The minimum 14 and maximum 15 may be for example marked 'MIN' and 'MAX', and correspond to the nominal range of charge selected by a charge control program. The range may represent, for example, 30-50% of the theoretical maximum charge of for example a hybrid vehicle battery, and be optimised for overall fuel economy of the vehicle.

[0033] Adjustment of the minimum 14 and/or maximum 15 and/or provision of the extension is performed by a controller (not shown). The controller determines the

charge control program, or battery usage parameter, dependent on at least one of: a mode of operation of the vehicle; a state of charge of the battery; and a state of health of the battery.

[0034] The extension represents an allowance, typically for opportunistic recharging, which permits the state of charge to reach for example 70% of the theoretical maximum charge, for example for optimising for city driving under electric power only. For example, city driving mode may be selected.

[0035] The vehicle driver will thus be aware that a maximum nominal charge is reachable in normal use, and will not be concerned that the vehicle battery is faulty or that a charging fault has developed. The extension to the charge range represents an extended charge which is available in certain conditions of use associated with an action by the vehicle driver.

[0036] The means by which the extension is distinguished from the normal range requires that a difference be noticeable. The difference may include a colour difference, and the colour of the extension may for example be blue, which is a colour that has become associated in the popular mind with electric vehicles or electrical vehicle travel.

[0037] The indicator may be electronically generated, or may be a conventional instrument, or may be a combination.

[0038] In one embodiment the extension may be visible only if the state of charge exceeds normal maximum 15, and in a variant the amount of extension which is visible may correspond to the state of charge that has been reached.

[0039] In an embodiment the extension is visible only when certain vehicle programmes are activated. For example a vehicle driver may prepare for an extended period of driving in an electric mode by activating an 'E' program. In such circumstances the extension may be made visible, and the engine may be commanded to charge the battery so as to increase the available range under electric drive only, to the extent permitted by the torque control system. In the example given above, the nominal state of charge of the battery will be increased from 50% to 70%, and the vehicle driver will be aware of the increased charge by virtue of the pointer 12 entering the extended range.

[0040] Likewise the vehicle driver may require a period of rapid acceleration in a sport mode, and activate an 'S' program in which both the engine and electric motor fully contribute to accelerating the vehicle. In consequence a greater reservoir of charge may be required, and accordingly when the driver is not commanding significant torque, the engine will be used to both drive the vehicle and to charge the battery to the extension limit of 70%. Such charging is opportunistic in the sense that should the vehicle driver command significant torque from the vehicle engine, charging of the battery in this mode will be suspended.

[0041] It will be understood that the foregoing example quotes exemplar charging limits and ranges, which may of course be varied according to vehicle and conditions of use. In particular different levels for optimum charge and charge extension may be determined according to mode of vehicle use.

[0042] An example of a change between scales is illustrated in Figs. 2 and 3. The linear scale 21 of Fig. 2 has minimum and maximum markings 22, 23 and progressive markings therebetween indicating 25%, 50% and 75% of nominal charge capacity range (which may represent a range 30-50% of the theoretical charge of the battery). An indicator 24 for the scale, indicates the current value of charge. In place of a pointer a progressive colour change, a series of lights or any other progressive indicator could be used.

[0043] In Fig. 3, the MAX identifier is substituted by a high frequency banding 25, which corresponds to the charge extension of Fig. 1.

[0044] In switching from the scale of Fig. 2 to that of Fig. 3, the position of the indicator 24 is not changed, but the scale is extended to show the possibility of an increased state of charge (for example up to 70% of the theoretical charge of the battery), for example in preparation for city or sport driving according to a preference of the vehicle driver.

[0045] Upon cessation of conditions for the extended scale of Fig. 3, the display reverts to the scale of Fig. 2, and maximum charge may be indicated notwithstanding that the actual state of charge corresponds to a value within zone 25.

Claims

1. A system for providing a scale of electrical charge of a vehicle battery, the system comprising:

a scale of state of charge (11, 21) of the vehicle battery; and

a controller arranged to display a current value of charge indicator (12, 24) on the scale (11, 21), the current value of charge indicator (12, 24) indicating the state of charge detected by a detector, wherein the controller is arranged to control the current value of charge indicator (12, 24) to appear on the scale (11, 21) between a displayed first indicator (14, 22) indicating a first minimum state of charge and a displayed second indicator (15, 23) indicating a first maximum state of charge when the vehicle is in a first driving mode, wherein the displayed first indicator (14, 22) and the displayed second indicator (15, 23) define a range therebetween;

the system is **characterised in that**:

the controller is arranged to control the current value of charge indicator (12, 24) indicating the state of charge detected to ap-

pear on the scale (11, 21) between the displayed first indicator (14, 22) and a displayed third indicator (16) when the vehicle is in a second driving mode;
the third indicator (16) indicates a second maximum state of charge;
the second maximum state of charge is higher than the first maximum state of charge; and **in that**,
when the vehicle is in the second driving mode, the displayed first indicator (14, 22) and the displayed second indicator (15, 23) and the range therebetween are displayed, and an extension to the range is provided between the displayed second indicator (15, 23) and the displayed third indicator (16).

2. A system according to claim 1 for providing a scale of electrical charge of a vehicle battery, the system comprising:

a display (10) arranged to display the scale of state of charge (11, 21) of the battery and the state of charge detected,
wherein the controller is arranged to control the display (10) to display the scale (11, 21) in dependence on the state of charge detected.

3. A system according to claim 2 for indicating progressively the state of charge of the battery, said display (10) having the first indicator (14, 22), the second indicator (15, 23) higher than the first indicator (14, 22) and a progressively increasing range of indication therebetween, wherein the extension is represented differently to said range.

4. A system according to claim 3, wherein said extension is enabled in a pre-determined charge condition.

5. A system according to claim 4, wherein said extension is visible only in said pre-determined charge condition.

6. A system according to any of claims 3 to 5, wherein said extension is coloured differently to said range.

7. A system according to any of claims 3 to 6, wherein said range comprises a first linear scale, and said extension comprises a second linear scale.

8. A system according to claim 7, wherein said first linear scale comprises a sequence of marks at a first frequency, and wherein said second linear scale comprises a sequence of marks (25) at a second frequency.

9. A system according to any of claims 7 or 8, wherein said first and second linear scales comprise a single arc, and wherein the display (10) comprises the current value of charge indicator (12, 24), the current value of charge indicator (12, 24) being centred on said arc.

10. A system according to any of claims 3 to 9, and comprising an instrument having a face, markings on said face to indicate said range and said extension, and the current value of charge indicator (12, 24) movable along said range and said extension to progressively indicate the state of charge.

11. A hybrid electric vehicle having a system according to any of claims 3 to 10, said vehicle including driver selectable modes of hybrid use, and being adapted to provide on said display (10) a range of indication determined by the selected mode.

12. A vehicle according to claim 11 and having driver selectable driving modes adapted to optimise one of fuel economy, distance in electric mode, and vehicle acceleration.

Patentansprüche

1. System zum Bereitstellen einer Skala für die elektrische Ladung einer Fahrzeugbatterie, wobei das System Folgendes umfasst:

eine Skala des Ladezustands (11, 21) der Fahrzeugbatterie; und
eine Steuervorrichtung, die angeordnet ist, um einen aktuellen Wert einer Ladeanzeige (12, 24) auf der Skala (11, 21) darzustellen, wobei der aktuelle Wert der Ladeanzeige (12, 24) den durch einen Detektor erfassten Ladezustand anzeigt, wobei die Steuervorrichtung angeordnet ist, um den aktuellen Wert der Ladeanzeige (12, 24) zu steuern, so dass er auf der Skala (11, 21) zwischen einer dargestellten ersten Anzeige (14, 22), die einen ersten minimalen Ladezustand anzeigt, und einer dargestellten zweiten Anzeige (15, 23) erscheint, die einen ersten maximalen Ladezustand anzeigt, wenn sich das Fahrzeug in einem ersten Fahrmodus befindet, wobei die dargestellte erste Anzeige (14, 22) und die dargestellte zweite Anzeige (15, 23) einen Bereich dazwischen definieren;
wobei das System **dadurch gekennzeichnet ist, dass**:

die Steuervorrichtung angeordnet ist, um den aktuellen Wert der Ladeanzeige (12, 24) zu steuern, der den erfassten Ladezustand anzeigt, so dass er auf der Skala (11, 21) zwischen der dargestellten ersten An-

zeige (14, 22) und einer dargestellten dritten Anzeige (16) erscheint, wenn sich das Fahrzeug in einem zweiten Fahrmodus befindet;
die dritte Anzeige (16) einen zweiten maximalen Ladezustand anzeigt;
der zweite maximale Ladezustand höher als der erste maximale Ladezustand ist; und dass,
wenn sich das Fahrzeug in dem zweiten Fahrmodus befindet, die dargestellte erste Anzeige (14, 22) und die dargestellte zweite Anzeige (15, 23) und der Bereich dazwischen dargestellt werden, und eine Erweiterung des Bereichs zwischen der dargestellten zweiten Anzeige (15, 23) und der dargestellten dritten Anzeige (16) bereitgestellt ist.

2. System nach Anspruch 1 zum Bereitstellen einer Skala für die elektrische Ladung einer Fahrzeugbatterie, wobei das System Folgendes umfasst:

ein Display (10), das angeordnet ist, um die Skala des Ladezustands (11, 21) der Batterie und den erfassten Ladezustand darzustellen,
wobei die Steuervorrichtung angeordnet ist, um das Display (10) zu steuern, um die Skala (11, 21) in Abhängigkeit von dem erfassten Ladezustand darzustellen.

3. System nach Anspruch 2 zum schrittweisen Anzeigen des Ladezustands der Batterie, wobei das Display (10) die erste Anzeige (14, 22), die zweite Anzeige (15, 23), die höher als die erste Anzeige (14, 22) ist, und einen schrittweise zunehmenden Anzeigebereich dazwischen aufweist, wobei die Erweiterung anders als der Bereich abgebildet wird.

4. System nach Anspruch 3, wobei die Erweiterung in einem vorbestimmten Ladezustand aktiviert wird.

5. System nach Anspruch 4, wobei die Erweiterung nur in dem vorbestimmten Ladezustand sichtbar ist.

6. System nach einem der Ansprüche 3 bis 5, wobei die Erweiterung anders als der Bereich gefärbt ist.

7. System nach einem der Ansprüche 3 bis 6, wobei der Bereich eine erste lineare Skala umfasst und die Erweiterung eine zweite lineare Skala umfasst.

8. System nach Anspruch 7, wobei die erste lineare Skala eine Folge von Markierungen mit einer ersten Frequenz umfasst und wobei die zweite lineare Skala eine Folge von Markierungen (25) mit einer zweiten Frequenz umfasst.

9. System nach einem der Ansprüche 7 oder 8, wobei die erste und die zweite lineare Skala einen einzelnen Bogen umfassen, und wobei das Display (10) den aktuellen Wert der Ladeanzeige (12, 24) umfasst, wobei der aktuelle Wert der Ladeanzeige (12, 24) auf dem Bogen zentriert ist.

10. System nach einem der Ansprüche 3 bis 9, das ein Instrument umfasst, das eine Fläche aufweist, wobei Markierungen auf der Fläche den Bereich und die Erweiterung anzeigen und der aktuelle Wert der Ladeanzeige (12, 24) entlang des Bereichs und der Erweiterung beweglich ist, um den Ladezustand schrittweise anzuzeigen.

11. Hybridelektrofahrzeug, das ein System nach einem der Ansprüche 3 bis 10 aufweist, wobei das Fahrzeug durch einen Fahrer auswählbare Hybridbetriebsmodi einschließt und angepasst ist, um auf dem Display (10) einen durch den ausgewählten Modus bestimmten Anzeigebereich bereitzustellen.

12. Fahrzeug nach Anspruch 11, das durch den Fahrer auswählbare Fahrmodi aufweist, die angepasst sind, um einen Kraftstoffverbrauch, eine Entfernung in dem Elektromodus oder eine Fahrzeugbeschleunigung zu optimieren.

Revendications

1. Système de fourniture d'une échelle de charge électrique d'une batterie de véhicule, le système comprenant :

une échelle d'état de charge (11, 21) de la batterie du véhicule ; et
un dispositif de commande agencé pour afficher une valeur actuelle de l'indicateur de charge (12, 24) sur l'échelle (11, 21), la valeur actuelle de l'indicateur de charge (12, 24) indiquant l'état de charge détecté par un détecteur, dans lequel le dispositif de commande est agencé pour commander la valeur actuelle de l'indicateur de charge (12, 24) afin qu'elle apparaisse sur l'échelle (11, 21) entre un premier indicateur affiché (14, 22) indiquant un premier état de charge minimum et un deuxième indicateur affiché (15, 23) indiquant un premier état de charge maximum lorsque le véhicule est dans un premier mode de conduite, dans lequel le premier indicateur affiché (14, 22) et le deuxième indicateur affiché (15, 23) définissent une plage entre eux ;
le système est **caractérisé en ce que** :

le dispositif de commande est agencé pour commander la valeur actuelle de l'indicateur de charge (12, 24) indiquant l'état de

charge détecté afin qu'elle apparaisse sur l'échelle (11, 21) entre le premier indicateur affiché (14, 22) et un troisième indicateur affiché (16) lorsque le véhicule est dans un second mode de conduite ;
le troisième indicateur (16) indique un second état de charge maximum
le second état de charge maximum est supérieur au premier état de charge maximum ; et **en ce que**,
lorsque le véhicule est dans le second mode de conduite, le premier indicateur affiché (14, 22) et le deuxième indicateur affiché (15, 23) et la distance entre eux sont affichés, et une extension de la plage est fournie entre le deuxième indicateur affiché (15, 23) et le troisième indicateur (16) affiché.

2. Système selon la revendication 1 destiné à fournir une échelle de charge électrique d'une batterie de véhicule, le système comprenant :

un dispositif d'affichage (10) agencé pour afficher l'échelle d'état de charge (11, 21) de la batterie et l'état de charge détecté,
dans lequel le dispositif de commande est agencé pour commander le dispositif d'affichage (10) afin d'afficher l'échelle (11, 21) en fonction de l'état de charge détecté.

3. Système selon la revendication 2 destiné à indiquer progressivement l'état de charge de la batterie, ledit dispositif d'affichage (10) ayant le premier indicateur (14, 22), le deuxième indicateur (15, 23) plus élevé que le premier indicateur (14, 22) et une plage d'indication progressivement croissante entre eux, l'extension étant représentée différemment de ladite plage.

4. Système selon la revendication 3, dans lequel ladite extension est activée dans une condition de charge prédéterminée.

5. Système selon la revendication 4, dans lequel ladite extension n'est visible que dans ladite condition de charge prédéterminée.

6. Système selon l'une quelconque des revendications 3 à 5, dans lequel ladite extension est colorée différemment de ladite plage.

7. Système selon l'une quelconque des revendications 3 à 6, dans lequel ladite plage comprend une première échelle linéaire, et ladite extension comprend une seconde échelle linéaire.

8. Système selon la revendication 7, dans lequel ladite première échelle linéaire comprend une séquence de marques à une première fréquence, et dans lequel ladite seconde échelle linéaire comprend une séquence de marques (25) à une seconde fréquence.

9. Système selon l'une quelconque des revendications 7 ou 8, dans lequel lesdites première et seconde échelles linéaires comprennent un arc unique, et dans lequel le dispositif d'affichage (10) comprend la valeur actuelle de l'indicateur de charge (12, 24), la valeur actuelle de l'indicateur de charge (12, 24) étant centré sur ledit arc.

10. Système selon l'une quelconque des revendications 3 à 9, et comprenant un instrument ayant une face, des marques sur ladite face pour indiquer ladite plage et ladite extension, et la valeur actuelle de l'indicateur de charge (12, 24) mobile le long de ladite plage et de ladite extension pour indiquer progressivement l'état de charge.

11. Véhicule électrique hybride ayant un système selon l'une quelconque des revendications 3 à 10, ledit véhicule comprenant des modes d'utilisation hybride sélectionnables par le conducteur, et étant adapté pour fournir sur ledit dispositif d'affichage (10) une plage d'indications déterminée par le mode sélectionné.

12. Véhicule selon la revendication 11 et ayant des modes de conduite sélectionnables par le conducteur adaptés pour optimiser l'un parmi l'économie de carburant, la distance en mode électrique et l'accélération du véhicule.

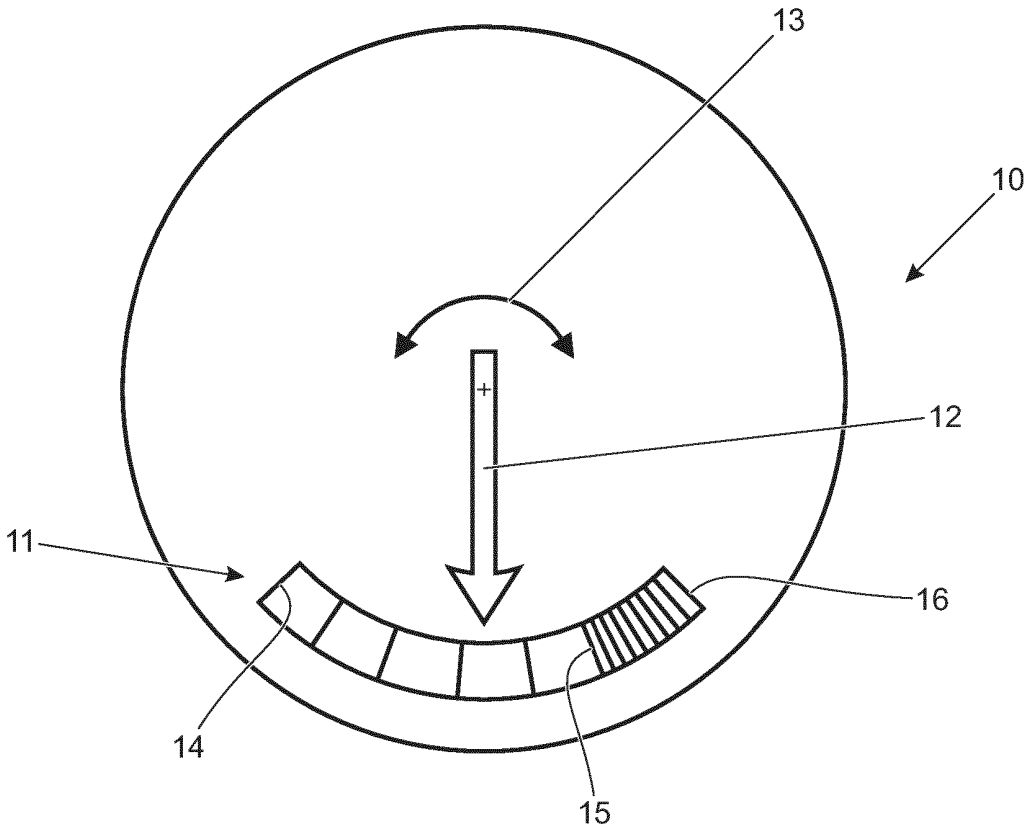

Fig 1

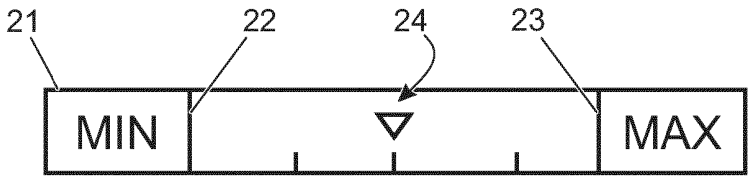

Fig 2

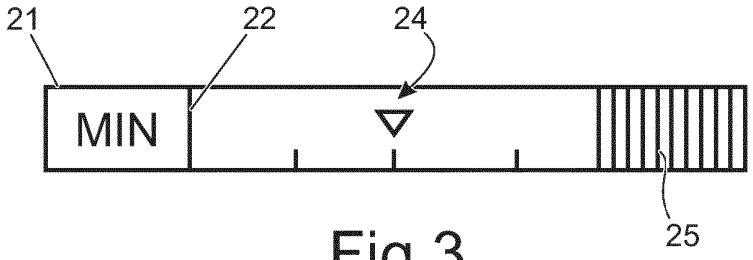

Fig 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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