SYSTEM FOR EQUALIZING THE LEVEL OF CHARGE IN BATTERIES

Technical field

The presently most used way to charge and discharge batteries is to connect charging or load to the pole bolts of the total battery. The battery consists normally of a number of cells which are connected in series. At charging or discharging the same current will go through all the battery cells.

Prior Art

At charging or discharging of batteries there are normally a control system, by varying degree of complexity, which controls the process. Charging or discharging are done by supplying or loading a current in the battery. The size of this current is controlled by a number of parameters e.g. current battery voltage, temperature at battery, battery performance, current charging level etc. One problem which occur by the use batteries connected in series is that the battery cells have different pole voltages, temperatures, performance, charging levels etc. One method, which is used to minimise this problem, is to equalise discharge the battery. I.e. that the whole battery is emptied of energy to get the cells on as equal charging level as possible, at the next charging cycle. As the demands of availability and lifetime increase, charging systems have been developed which can equalise charging. These systems have an electrical connection to each battery cell or battery block. This means that the main charging current is supplied as usual via the pole bolts. Beside that extra currents, to the battery cells or battery blocks which needs extra charging to reach full charging level, can be supplied via the separate connections. One disadvantage with this type of system is that cable arrangement becomes very complex, and that equalising only can be done at charging.

Summary of the invention

An object of the present invention is to considerably avoid mentioned problems and by an equalising system direct charging currents between different battery cells or battery blocks in the battery during all operating conditions, without having an inconvenient cable installation.

These objects are reached by a voltage converter, mounted on each battery cell or battery block. These voltage converter units are connected to a common current path, which is connected to the pole bolts, of the total battery, where the energy is transferred from the cells which have a higher charging level, temperature, pole voltage etc. As this current path is connected the pole bolts of the total battery an equalisation of the charging levels is made.

The system can also have an alternative technical solution where energy is transferred from the common current path via the voltage converter units to the respective battery cell or battery block. The energy is now transferred in the opposite direction, compared to the above solution, but this gives the same effect if the energy now is supplied to the battery cells or battery blocks which have a lower charging level, temperature, pole voltage etc. compared to the other battery cells or battery blocks.

Brief description of the drawings

The invention will now be described below with the schematic connection diagrams where fig. 1 shows a battery where the charge level equalising system is connected to each battery cell in the battery. Fig. 2 shows a battery where the charge level equalising system is connected to each battery block in the battery.

Detailed description

Fig.1 shows in principal a connection diagram of a system for charge level equalising in batteries, where the system is connected on battery cell level. The battery having a positive pole 1 and a negative pole 2 comprises a number of cells 3 connected in series. The system for charge level equalising comprises a number of voltage converters 4 which are remotely controlled by a in relation to the battery centrally oriented control unit. The voltage converters 4 are on one side connected to positive pole 8 and negative pole 7, respectively, of the battery cells. The positive pole 10 or negative pole 11 of the battery blocks. The voltage converters 4 are on the other side connected to a positive pole 5 and a negative pole 6 of a common current path. The positive pole 5 of the common current path is connected to the positive pole 1 of the battery. The negative pole 6 of the common current path is connected to the negative pole 2 of the battery.

The voltage converters 4 can be designed to obtain energy from one or more battery cells 3 and transfer the energy to the common current path 5,6. Alternatively the voltage converters 4 can be designed to obtain energy from the common current path 5,6 and transfer energy to one or several battery cells 3.

Fig.2 shows in principal a connection diagram of a system for charge level equalising where the system has been connected on battery block level 9. The function of the system is equal to that described with reference to fig 1 with the exception that the battery cells 3 have been replaced by the battery blocks 9.

The system for charge level equalising in batteries can be controlled by different algorithms, which means during the charging phase of the total battery, in spite of the series connections, a part of the charging current can be directed to the different battery cells 3 or the battery blocks. In this way these can be charged individually to the intended level. In the same way at

discharging of the battery, in spite of connections in series, the current can be directed to the intended level for respective battery cell 3 or battery block 9.

The voltage converters 4 are also provided with devices for sensing individual temperatures and pole voltages of the battery cells 3 or battery blocks 9. The voltage converters are controlled from a, for the battery assembly central control unit which via wire or wireless communicates with the voltage converters 4. The voltage converters mentioned above can also be connected in other ways to each battery cell 3 or battery block 9. Fig 3 shows an example of a so called reduced connection i.e. the charging level of each battery cell can be controlled in spite of the fewer numbers of voltage converters than the number of battery cells.

Fig. 4 shows an arrangement there the voltage converters have been connected to a common ground. This procedure is specially applicable in low voltage battery systems.

CLAIMS

1. A system for charge level equalising in batteries comprising battery cells (3) or battery blocks (9) connected in series *characterised* by

controllable voltage converters which on one side are connected to single or groups of battery cells (3) or battery blocks (9) and on the other side are connected to a common current path (5, 6), a positive conductor (5) thereof being connected to the positive pole (1) of the battery and the negative conductor (6) thereof being connected to the negative pole (2) of the battery.

2. A system for charge level equalising in batteries according to claim 1, *characterised* in

that the controllable voltage converters are designed to transfer energy to or from the battery cells (3) or battery blocks (9) to control the level of charging to the desired level in each battery cell or battery block.

3. A system for charge level equalising in batteries according to claim 1, *characterised* in

that the voltage converters (4) are connected to measure individual pole voltages of the battery cells (3) or battery blocks (9) and to transmit data thereof to a control system that is central to the battery arrangement.

4. A system for charge level equalising in batteries according to claim 1, *characterised* in

that the voltage converters (4) are arranged to measure individual temperatures of the battery cells (3) or battery blocks (9) and to transmit data thereof to a control system that is central to the battery arrangement.

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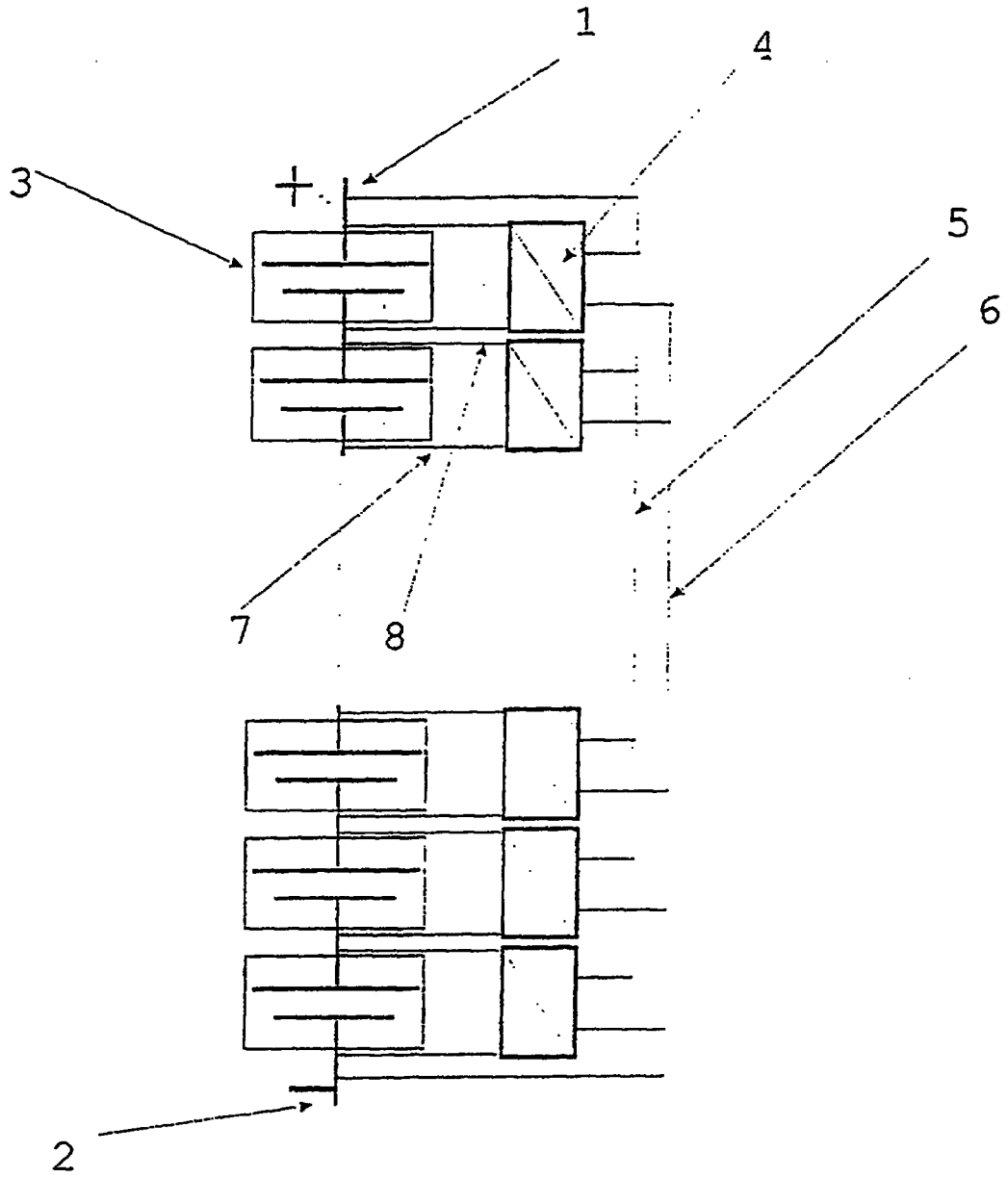

Fig. 1

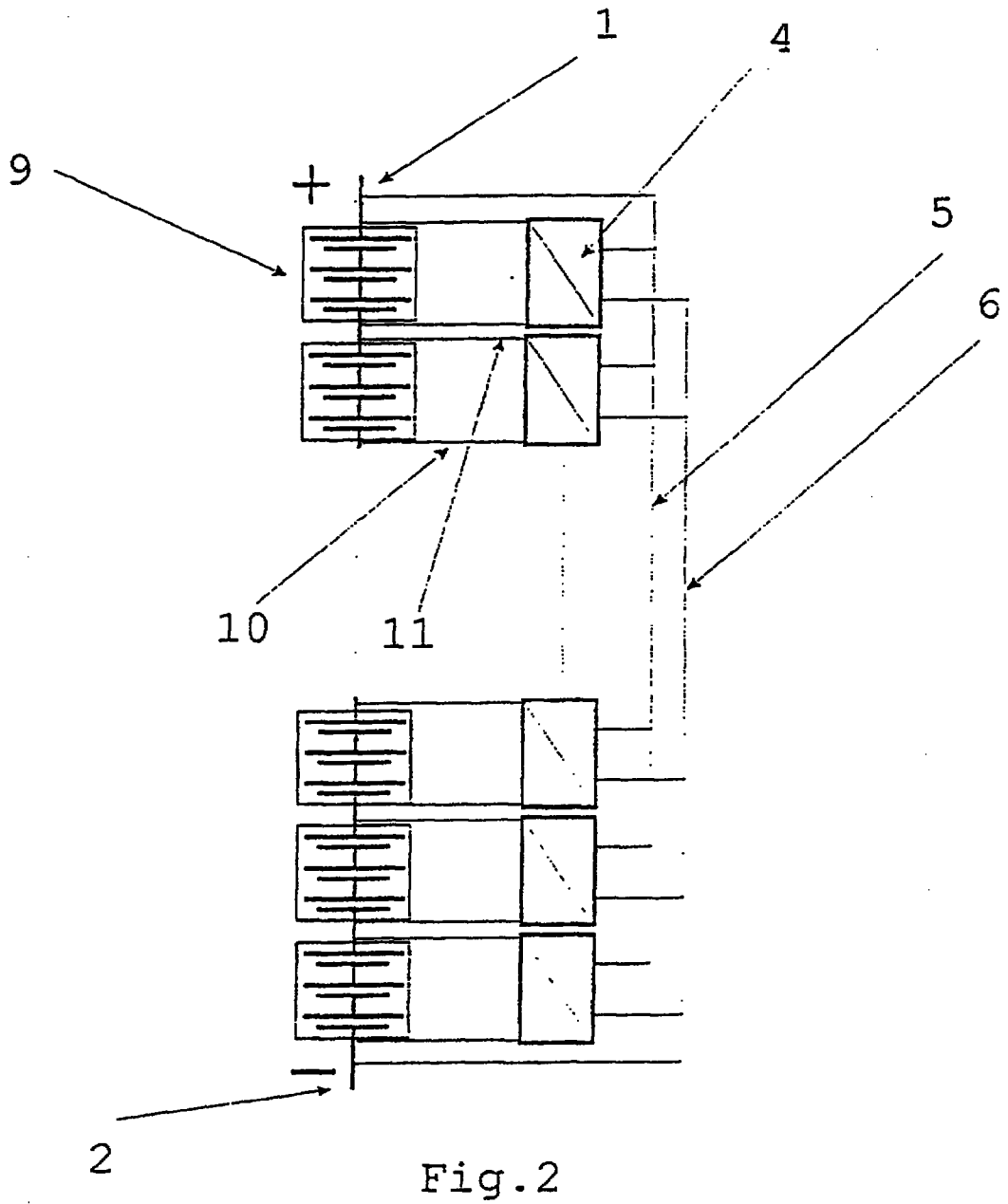

Fig.2

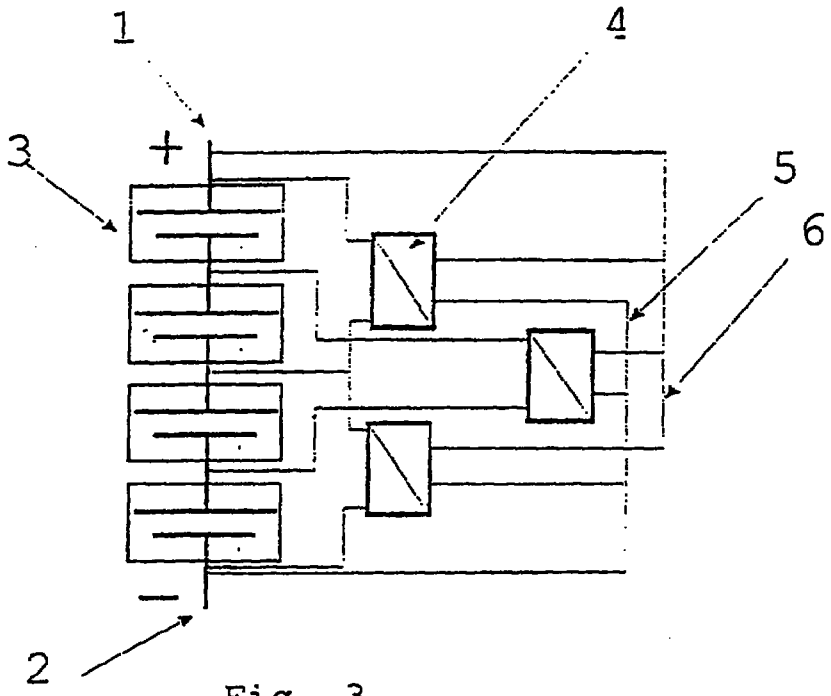

Fig. 3

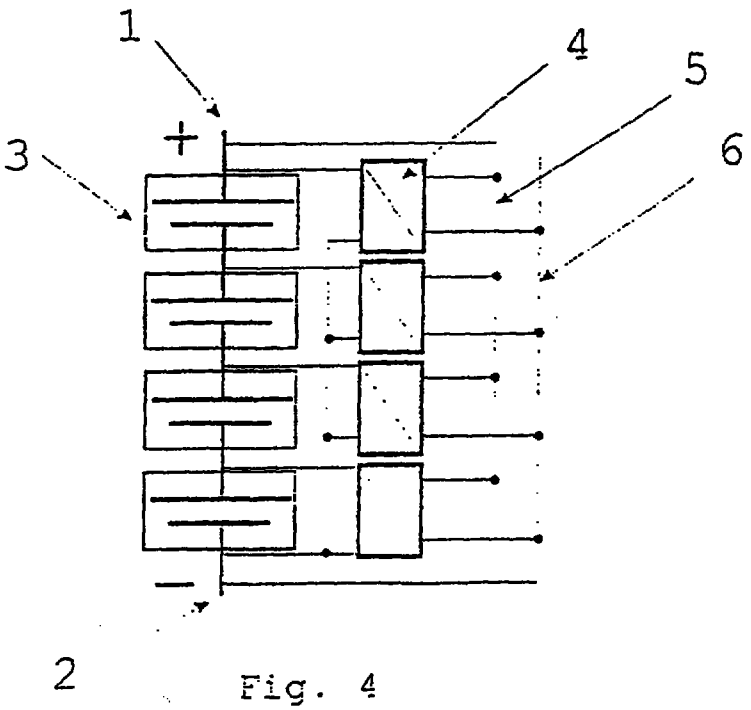

Fig. 4

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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H02J 7/00 — A1

(11) International Publication Number: **WO 97/16879**

(43) International Publication Date: 9 May 1997 (09.05.97)

(21) International Application Number: PCT/SE96/01390

(22) International Filing Date: 30 October 1996 (30.10.96)

(30) Priority Data:
9503861-8 31 October 1995 (31.10.95) SE

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(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Swedish).

(54) Title: SYSTEM FOR EQUALIZING THE LEVEL OF CHARGE IN BATTERIES

(57) Abstract

A system for equalizing the charge level of batteries comprising battery cells (3) or battery blocks (9) connected in series. Controlled voltage converters (4) are on one side connected to a single or groups of battery cells (3) or battery blocks (9) and on another side connected to a common current path (5, 6), a positive conductor (5) thereof being connected to a positive pole (1) of the battery and the negative pole (6) thereof being connected to a negative pole (2) of the battery.

