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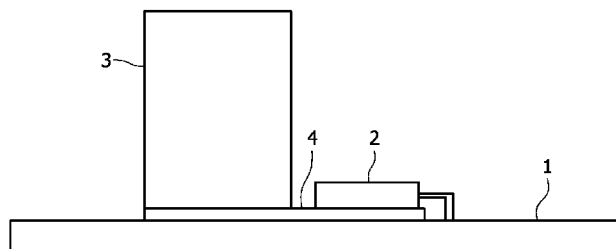


FIG. 1

(57) Abstract: The invention relates to an electric charger for an accumulator or a battery or the like, which is adapted for rapid charging during an on-period and comprises for this purpose control means for starting and ending the on-period. The charger is provided with a circuit for converting a supply voltage to a charging current for the battery, and further with a heat-absorbing member in heat-conducting coupling with at least an electrical component of the circuit to be protected against overheating. The control means are adapted such that the on-period cannot be restarted during an off-period following the on-period. The electric charger can hereby comprise a heat-absorbing member with a relatively low heat loss, this saving space and cost.



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Electric charger for an accumulator or battery

The invention relates to an electric charger for an accumulator or a battery or the like, which is adapted for rapid charging during an on-period, for which purpose the charger
5 comprises control means for starting and ending the on-period, wherein the charger further comprises a circuit for converting a supply voltage to a charging current for the battery and a heat-absorbing member for absorbing heat generated during operation in heat-conducting coupling with at least an electrical component of the circuit to be protected against overheating.

10

Such an electric charger is known from American patent publication US-B-6 956 354. Known from this publication is a battery charger which is intended for relatively fast charging of battery cells, i.e. charging the battery cells in a time period of less than 30 minutes. The known battery charger has a housing in which a compartment is adapted to
15 receive the battery cells for charging. Further provided is an electrical circuit received inside the housing for the purpose of charging the battery cells, and also provided is a heat-absorbing member which is placed directly adjacently of the battery compartment, thus realizing an intensive heat-exchanging contact with the battery cells. The heat which develops in the battery cells during charging can thus be effectively absorbed in
20 the heat-absorbing member and carried to the surroundings via this member, which is also in contact with the housing, in order to relinquish the heat to the surroundings through radiation or convection.

25

The known electric charger is limited in the speed at which the charging can be performed. This is because with a further increase in the charging speed the charger becomes too hot, which can only be solved by additional provisions such as fans, (extra large) cooling fins and the like. This however has the drawback that the charger becomes relatively large and expensive. Size in particular is a significant factor in mobile applications.

30

The invention has for its object to enable very rapid charging of an accumulator or battery, i.e. to make possible an effective charging period of several minutes without the charger having to take an appreciably larger and more expensive form than the known electric charger and without this resulting in appreciably higher costs for the charger.

The heat obtained externally by the electric charger must here remain within the acceptable preconditions for this heat.

5 The electric charger according to the invention is characterized for this purpose by one or more of the appended patent claims.

10 In a first embodiment of the invention the electric charger is characterized in that the control means for starting and ending the on-period are adapted such that the on-period cannot be restarted during an off-period following the on-period. The electric charger according to the invention is based on the insight that the development of heat occurs only during the limited on-period and that the electric charger is generally out of operation for an extended period after charging because the control means prevent a restart of the on-period.

15 The heat-absorbing member is therefore preferably accommodated in the electric charger such that it can absorb the heat created during charging and can then relinquish it to the surroundings in delayed manner, for which purpose a comparatively good thermal coupling of the heat-absorbing member to the heat-producing part of the circuit is preferably desirable, in addition to a relatively poor thermal coupling of the heat-
20 absorbing member to the other parts of the circuit and the housing of the electric charger. The heat stored in the heat-absorbing member cannot therefore damage the integrity of the circuit, while externally the electric charger can also be kept at acceptable temperature levels and does not become unacceptably hot.

25 Known heat-absorbing members which serve as cooling body for electric circuits are generally adapted precisely such that they relinquish as much heat as possible, for instance by providing the heat-absorbing member with cooling fins. According to the invention the electrical component of the circuit to be protected against overheating, from which the greater part of the heat generated during operation generally derives, is
30 in a first heat-conducting contact with the heat-absorbing member. The heat-absorbing member is in a second heat-conducting contact with the surroundings, preferably a housing of the charger. The first coefficient of thermal conductivity of the first heat-conducting contact is preferably greater than a second coefficient of thermal conductivity of the second heat-conducting contact, such that the heat-absorbing

member has a monotonously increasing heat content during the on-period and that the heat-absorbing member has substantially a monotonously decreasing heat content during the off-period, wherein the heat absorption takes place relatively quickly while, conversely, the generation of heat during the off-period takes place relatively slowly.

5

During use the electric charger provides an on-period and an off-period (immediately) following the on-period, wherein the on-period corresponds to the charging time. The charging time can here be fixed or adjustable. The control means for starting and ending the on-period for instance comprise a digital or analog timer. The control means
10 according to the invention ensure that the electric charger cannot be switched on (thus starting a new on-period) for an off-period which is, if desired, predetermined and which depends on, among other factors, the degree and speed at which heat is relinquished from the heat-absorbing member. Sufficient time is provided during the off-period for relinquishing to the surroundings heat absorbed by the heat-absorbing
15 member during charging.

According to a preferred variant of the invention the setting means, preferably a timer, begins measuring the relevant period from the beginning of the on-period, from a phase in the charging process, from the end of the on-period (corresponding to the start of the
20 off-period) or from a phase after ending of the on-period. The beginning of the count from a determined phase can for instance occur when a determined situation occurs during the charging process (during the on-period), for instance the maximum voltage is reached. Determined situations, which could represent the beginning of a counting for the period, can also occur after charging (after ending of the on-period). Examples of
25 such situations are for instance the fall of the battery voltage below a determined level, a component of the charger exceeding or falling below temperature or (in the case charging is interrupted) the point in time at which charging would have ended. The length of the off-period (the cooling time) can, if desired, be set by the manufacturer, by the user or be made dependent upon another variable, such as for instance the
30 temperature before and during charging, the current during charging, the temperature after charging, the temperature during cooling, or the charging time.

In a preferred embodiment the electric charger is characterized in that the control means comprise a timer with circuit breaker. In a further improved preferred embodiment the

control means comprise a microcontroller which controls the charger unit and prevents or interrupts charging by not giving or by interrupting the control signal.

5 Although the length of the off-period can be chosen within wide limits, the control means are adapted such that the off-period is at least 2 times longer, more preferably at least 5 times longer and most preferably at least 10 times longer than the on-period. Typical lengths for the off-period preferably lie between 2 and 60 minutes, more preferably between 5 and 30 minutes and most preferably between 8 and 15 minutes.

10 In a further variant the control means are controlled by a temperature measurement, wherein the temperature can be measured of the heat-absorbing member and/or of other components, such as for instance the battery, the component to be protected, the housing or the air temperature in the housing. The control means can then be controlled such that they bring about the ending of the off-period at the moment the measured
15 temperature falls below a determined threshold value. This threshold value will generally depend on the overheating temperature and the supplied power of the electrical component to be protected, and on the heat capacity of the heat-absorbing member.

20 According to the invention, during operation the total heat loss of the heat-absorbing member will be relatively low and the absorption of the heat supplied thereto relatively high. Owing to the characteristics of the invented electric charger the overall heat loss of the heat-absorbing member will moreover be lower at the overheating temperature of the component than the heat supplied to the member. Even if the heat-absorbing
25 member were to become too hot to adequately protect the electrical component, this member will not relinquish sufficient heat and thus become even warmer.

In a further preferred embodiment the electric charger according to the invention is characterized in that the ratio of the heat capacity of the heat-absorbing member,
30 expressed in $J/^{\circ}C$, and the heat loss of the heat-absorbing member, expressed in $W/^{\circ}C$, is twice as high as the charging time, expressed in seconds, more preferably five times higher, still more preferably ten times higher and most preferably twenty times higher. This provides an additional safeguard against overheating.

In the context of the present application the heat capacity of the heat-absorbing member is understood to mean the required amount of energy necessary to cause the temperature of the member rise by 1°C (expressed in J/°C). The heat capacity of the heat-absorbing member can be determined in simple manner by measurement or by multiplying the
5 specific heat of the material from which the heat-absorbing member is manufactured by the mass of the heat-absorbing member. According to the invention the heat capacity of the heat-absorbing member need not per se be constant. This is the case for instance when use is made of a heat-absorbing member which comprises a substance which can absorb heat by means of a phase change. In such a case the heat capacity is defined as
10 the energy required to heat the member from a starting temperature (for instance 20°C) to a final temperature (for instance 120°C), and dividing this energy by the difference in temperature between the starting and final temperature (in this example therefore 100°C). The heat capacity then corresponds to an average heat capacity over the temperature range.

15

The overall amount of heat the heat-absorbing member loses during a determined period depends on, among other factors, the material from which the heat-absorbing member is manufactured, on the total surface area along which the heat can leave the member, on the temperature difference with the immediate vicinity, and on possible convection
20 current in the immediate vicinity. The heat loss (in W/°C) is given by the manufacturer of heat-absorbing members or can be measured by keeping the heat-absorbing member at a determined temperature (for instance 50°C), measuring the power required for this purpose and then dividing this power by the temperature difference with the vicinity (at an ambient temperature of 20°C this is 30°C). It is noted that such a measurement is
25 performed according to the invention in a charger which is provided with a possible housing, is placed in a draught-free space of 20°C and wherein optionally present fans operate at their nominal speed.

According to the present preferred embodiment, the heat capacity (J/°C, measured as the
30 number of Joules necessary to heat the member from for instance 20°C to 120°C) is greater than the heat loss (W/°C, measured by keeping the member to temperature), multiplied by twice the length of the on-period, expressed in seconds.

Although the electric charger according to the claim is in principle suitable for use at all charging times, the advantages thereof are particularly manifest when the charging time is less than 900 seconds, preferably less than 450 seconds and more preferably less than 80 seconds.

5

The charger, and the heat-absorbing member in particular, are in principle not limited to a determined size. The volume of the heat-absorbing member can for instance thus have a size of a number of dm^3 , or be even larger. Particularly for mobile applications, where size is an important factor, the electric charger, and in particular the heat-absorbing member, has a compact form. A typical volume of the heat-absorbing member then lies in the cm^3 range. The smaller the volume of the heat-absorbing member, the more manifest are the advantages of the invention. A charger with a heat-absorbing member with a volume smaller than 50 cm^3 is therefore recommended, more preferably smaller than 10 cm^3 and most preferably smaller than 3 cm^3 .

10

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The electric charger is preferably characterized here in that the overall surface area of the heat-absorbing member is smaller than twice the surface area of a cube with the same volume as the heat-absorbing member, more preferably smaller than 1.5 times the surface area of a cube with the same volume as the heat-absorbing member, and most preferably smaller than 1.25 times the surface area of a cube with the same volume as the heat-absorbing member.

20

25

Electric chargers generally comprise a number of objects, such as for instance screws and bolts, which can be deemed as heat-absorbing members. In the context of the invention a heat-absorbing member is generally understood to mean a member which has a heat capacity of at least $2.5 \text{ J}^\circ\text{C}$. It is also possible for the heat-absorbing member to comprise a number of members or bodies, which together have the intended operation and which are all in heat-conducting coupling with the electrical component to be protected against overheating.

30

Many usable technical solutions are suitable for the heat-absorbing member.

In a preferred embodiment the heat-absorbing member is substantially spherical, cube-shaped, beam-shaped or cylindrical. The heat-absorbing member is preferably

substantially beam-shaped, and the longest and the shortest sides of the beam differ by a maximum of a factor 5, more preferably a factor 3 and most preferably a factor 2.

Although not strictly necessary, it is advantageous that the electric charger according to the invention comprises a housing in which at least the electrical component to be protected against overheating and the heat-absorbing member are accommodated. The heat-absorbing member is herein preferably placed centrally in the housing in order to minimize heat exchange between the heat-absorbing member and the housing of the electric charger.

It has been found advantageous to adapt the electric charger such that the first coefficient of thermal conductivity is at least ten times greater than the second coefficient of thermal conductivity. In another preferred embodiment the electric charger comprises thermal insulation between the heat-absorbing member and the housing. In yet another preferred embodiment the heat-absorbing member is in contact with the housing via ambient air present in the housing. This ambient air forms an adequate thermal insulator with which the delayed relinquishing of heat by the heat-absorbing member to the surroundings can be realized. For the same reason it is also advantageous to characterize the electric charger according to the invention in that the heat-absorbing member is provided on its outside with a heat-insulating layer. Another, likewise advantageous embodiment comprises a (highly) reflective layer which reduces radiation of the heat.

A further preferred embodiment of the electric charger according to the invention has the feature that the heat-absorbing member is manufactured from a metal chosen from the group of copper, aluminium and steel. The heat-absorbing member then functions as a so-called heat sink. In another preferred embodiment the electric charger has the feature that the heat-absorbing member comprises a container having received therein a substance which can make a phase change. Said container can for instance contain paraffin. The heat-absorbing member can be coupled to a thermally active element, such as a Peltier element or a heat pump. A better utilization of the heat storage is hereby possible. The operation of the heat-absorbing member can be based on an endothermic chemical reaction, which in some cases can also be reversible.

Yet another preferred embodiment of the electric charger according to the invention has the feature that the heat-absorbing member forms part of at least a part of the circuit.

This is particularly advantageous when this part of the circuit has a great heat capacity, for instance in the case that a coil or a part of a transformer, such as a transformer core and/or the transformer wiring, is applied for the heat-absorbing member. As is usual, all non-stated technical embodiments of course fall within the scope of protection of the appended claims.

In another aspect of the invention the electric charger has the feature that the battery or accumulator is accommodated in the housing and forms at least a part of the heat-absorbing member. This is particularly advantageous in the case the battery or accumulator is of the type which has an improved efficiency or an improved operation at increased temperature. It can otherwise be noted that the embodiment of the electric charger in which the battery or accumulator is accommodated fixedly in the charger is particularly useful for applications in combination with a mobile telephone, wherein an alternative energy source is quickly required when the telephone battery is empty. It is useful here for the heat-absorbing member to be adapted for heat absorption from the battery or accumulator during charging, but also during discharging thereof.

In order to also keep the heat obtained externally by the electric charger within acceptable preconditions, it is also advantageous to give the housing of the electric charger a closed form, for instance not providing it with cooling openings and the like. The heat exchange between the heat-absorbing member and the vicinity of the electric charger is hereby limited.

The invention will be further elucidated hereinbelow on the basis of several schematic exemplary embodiments which do not limit the patent claims, and with reference to the drawing. In the drawing fig. 1 - fig. 6 show in each case schematic cross-sectional views of principle embodiments of the interior of an electric charger according to the invention. Figure 7 shows a schematic diagram of a charger according to the invention provided with control means for starting and ending the on-period. In figure 1 - figure 6 corresponding components are designated in each case with the same reference numeral. The housing is not further shown in the figures, while the circuit received in the housing is not shown fully either since, as correctly noted in US-B-6,956,354, such

a circuit forms part of the general prior art known to the skilled person (see column 3, lines 42-47). This also means that optionally applicable temperature sensors for regulating the electric charger and for safeguarding against overheating are not shown here. The electric charger according to the invention generally has a circuit received in a housing and placed on a printed circuit board 1. Said circuit serves to convert a supply voltage, usually a mains voltage, to a charging voltage and current, for which purpose, among other parts, a semiconductor or semiconductors 2 are applied which in this specific example, which is not limitative for the appended claims, form that part of the circuit which produces the greater part of the heat generated during the charging operation.

This semiconductor or these semiconductors 2 must be in a first heat-conducting contact with a heat-absorbing member 3 via an adequate thermal coupling, while this heat-absorbing member 3 is in a second heat-conducting contact with the other part of the circuit, which is arranged on printed circuit board 1 and/or is in contact with the housing (not shown) such that the first coefficient of thermal conductivity of the first heat-conducting contact is greater than a second coefficient of thermal conductivity of the second heat-conducting contact. The ratio of the two coefficients of thermal conductivity must preferably amount here to at least 10:1. In all the figures the heat-absorbing member 3 is placed into thermal contact with other parts of the circuit and/or the housing via ambient air, so that a highly delayed generation of heat by heat-absorbing member 3 is obtained.

Figure 1 shows the embodiment variant in which heat-absorbing member 3 is a metal heat sink, for instance a copper or brass block which in the shown case is in good thermal contact with the semiconductor or semiconductors 2 via a copper track 4 arranged on printed circuit board 1.

The charger is further provided with control means for starting and ending the on-period, with the proviso that the control means are adapted such that the on-period cannot be restarted during an off-period following the on-period. Referring to figure 7, a charger unit 20 is shown which is connected according to the invention to a supply voltage 21 (for instance the mains voltage) and a battery 23 for charging. Charger unit 20 is connected to a timer 22. Timer 22 comprises a detection means (not shown

separately) with which the charging can be detected during the on-period (or a phase therein or thereafter). Suitable detection means comprise for instance of a measurement of the (supply) voltage 21 or the (charging) current, or of the command to charge or the command to end charging. The detection means can optionally also be a temperature measurement. Timer 22 can switch off charger unit 20. For this purpose timer 22 can for instance keep the charging current low, give the charger unit a control signal to switch off or give a control signal not to switch on. Charger unit 20 can optionally comprise a switch which can prevent a charging current flowing by interrupting supply voltage 21 or interrupting the charging current to battery 22. In other exemplary embodiments timer 22 can ensure that an attempted charging is interrupted (current is detected and interrupted) or that an attempted charging never takes place (for instance, a mains voltage is detected, a user gives a command to charge, or a battery is attached). It will be apparent that the skilled person has multiple options available which fall within the scope of the invention. Figure 7 shows an exemplary embodiment wherein the control means are designated as hardware components. In another embodiment of the invention the electric charger comprises control means in the form of software, in particular a microcontroller which, in addition to controlling charger unit 20, also programmes timer 22.

According to a preferred embodiment of the invention, the heat-absorbing member 3 has a heat capacity which is approximately five times higher than the product of the heat loss in $W/^{\circ}C$ and five times the set charging time. Without this being deemed limitative, use can for instance be made of a desired charging time of 60 seconds. A material and mass with a heat capacity of $7 J/^{\circ}C$ is chosen for the heat-absorbing member. The geometry and the material of the heat-absorbing member produce a heat loss of $0.02 W/^{\circ}C$. This value can be given by the manufacturer of the heat-absorbing member or can be determined from tests. The overall amount of heat generated in the charging time of 60 seconds then amounts to $1.2 J/^{\circ}C$. This is lower than the heat capacity, and therefore according to the invention. The heat stored in the heat-absorbing member during charging, or at least part thereof, can be generated to the surroundings in delayed manner according to the invention because the electric charger is provided with the control means which ensure that the charger unit cannot be switched on during a certain off-period, which in the present embodiment amounts to 600 seconds.

Figure 2 shows that this metal heat sink 3 is moreover intensively coupled to printed circuit board 1 using a screw 5.

Figure 3 shows the embodiment variant in which the semiconductor or semiconductors 2 are mounted directly onto heat-absorbing member 3.

Figure 4 shows the embodiment in which the semiconductor or semiconductors 2 are coupled to heat-absorbing member 3 using a heat-conducting element 6 and via screw 5.

Figure 5 shows the embodiment in which the semiconductor or semiconductors 2 are mounted onto core 7 of a transformer 8.

Finally, figure 6 shows the embodiment in which the semiconductor or semiconductors 2 are mounted onto a container 9 in which a solid/liquid is received, for instance a paraffin wax 10.

Not shown in the figures, but expressly forming part of the invention, is the embodiment variant in which the battery or accumulator is accommodated in the housing and forms part of the electric charger. A particular embodiment variant hereof has the feature that the battery or accumulator can herein form a part of the heat-absorbing member.

As will be apparent from the foregoing description, the electric charger according to the invention has many variants in addition to the specific embodiments elucidated in the foregoing. Suitable applications of the electric charger comprise, among others, of charging batteries for electronics, for portable telephones, but for instance also for (partially) electric vehicles.

The scope of protection ensuing from the following patent claims is thus not limited to the shown exemplary embodiments, but is defined solely by said patent claims. The elucidation given above serves only for the purpose of explaining the scope of these patent claims, without limiting the claims thereto. It is for instance not stated in the patent claims, and thus included in the scope of protection of these patent claims, that the heat-absorbing member can be provided with cooling fins.

Claims

1. Electric charger for an accumulator or a battery or the like, adapted for rapid charging during an on-period and comprising for this purpose control means for starting
5 and ending the on-period, wherein the charger further comprises a circuit for converting a supply voltage to a charging current for the battery and a heat-absorbing member in heat-conducting coupling with at least an electrical component of the circuit to be protected against overheating, characterized in that the control means comprise a microcontroller which controls the charger unit and prevents or interrupts charging by
10 not giving or by interrupting the control signal, wherein the microcontroller is adapted such that the on-period cannot be restarted during an off-period following the on-period.
2. Electric charger as claimed in claim 1, characterized in that the control means are adapted such that the off-period is at least 5 times longer than the on-period.
15
3. Electric charger as claimed in claim 1 or 2, characterized in that the ratio of the heat capacity of the heat-absorbing member, expressed in $J/^{\circ}C$, and the heat loss of the heat-absorbing member, expressed in $W/^{\circ}C$, is at least twice as high as the charging time, expressed in seconds.
20
4. Electric charger as claimed in claim 3, characterized in that the ratio is at least five times higher than the charging time, expressed in seconds.
5. Electric charger as claimed in any of the foregoing claims, characterized in that
25 the charging time is less than 900 seconds, preferably less than 450 seconds and more preferably less than 80 seconds.
6. Electric charger as claimed in any of the foregoing claims, wherein the heat-absorbing member has a compact form and the overall surface area of the heat-
30 absorbing member is smaller than twice the surface area of a cube with the same volume as the heat-absorbing member, more preferably smaller than 1.5 times the surface area of a cube with the same volume as the heat-absorbing member, and most preferably smaller than 1.25 times the surface area of a cube with the same volume as the heat-absorbing member.

7. Electric charger as claimed in any of the foregoing claims, wherein the heat-absorbing member is substantially spherical, cube-shaped, beam-shaped or cylindrical.
- 5 8. Electric charger as claimed in claim 7, wherein the heat-absorbing member is substantially beam-shaped, and the longest and the shortest sides of the beam differ by a maximum of a factor 2 in length.
9. Electric charger as claimed in any of the foregoing claims, wherein the electric
10 charger comprises a housing in which at least the electrical component to be protected against overheating and the heat-absorbing member are accommodated.
10. Electric charger as claimed in claim 9, wherein the heat-absorbing member is placed centrally in the housing in order to minimize heat exchange between the heat-
15 absorbing member and the housing of the electric charger.
11. Electric charger as claimed in claim 9 or 10, wherein the electric charger comprises thermal insulation between the heat-absorbing member and the housing.
- 20 12. Electric charger as claimed in claim 9 or 10, characterized in that the heat-absorbing member (3) is in contact with the housing via ambient air present in the housing.
13. Electric charger as claimed in any of the foregoing claims, characterized in that
25 the heat-absorbing member is manufactured from a metal, preferably from a copper alloy such as brass or bronze.
14. Electric charger as claimed in any of the foregoing claims, characterized in that the heat-absorbing member comprises a container (9) having received therein a
30 substance which can make a phase change.
15. Electric charger as claimed in any of the foregoing claims, characterized in that the heat-absorbing member is a coil or a part of a transformer, preferably a transformer core (7) and/or the transformer wiring.

16. Electric charger as claimed in any of the foregoing claims, characterized in that the battery or accumulator is accommodated in the housing and forms at least a part of the heat-absorbing member.

5

17. Electric charger as claimed in any of the foregoing claims, wherein the heat-absorbing member is provided on its outside with a heat-insulating layer and/or a reflective layer.

10 18. Electric charger as claimed in any of the foregoing claims, wherein the housing of the electric charger is closed for the purpose of limiting heat exchange between the cooling element and the vicinity of the electric charger.

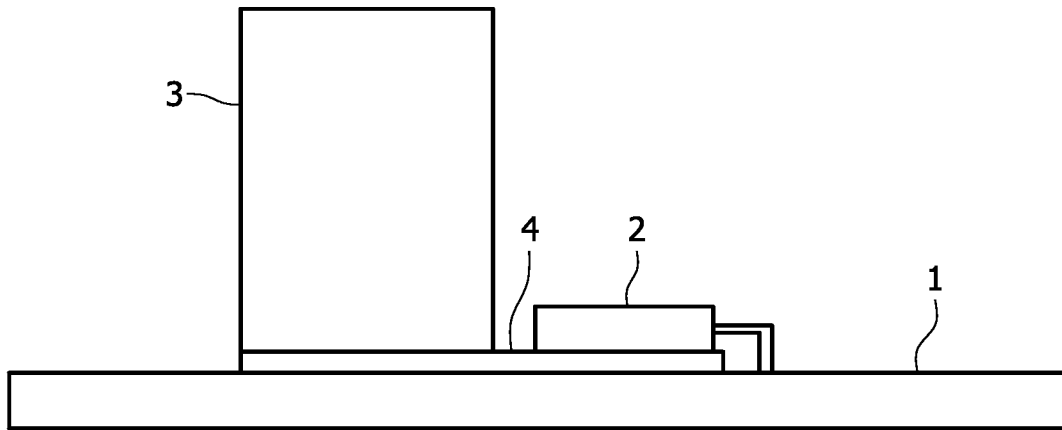


FIG. 1

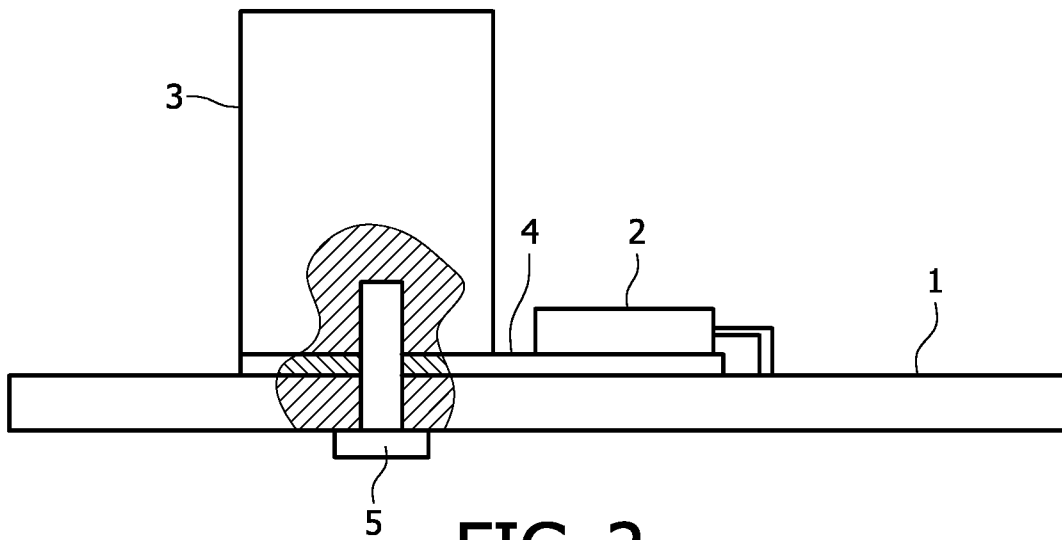


FIG. 2

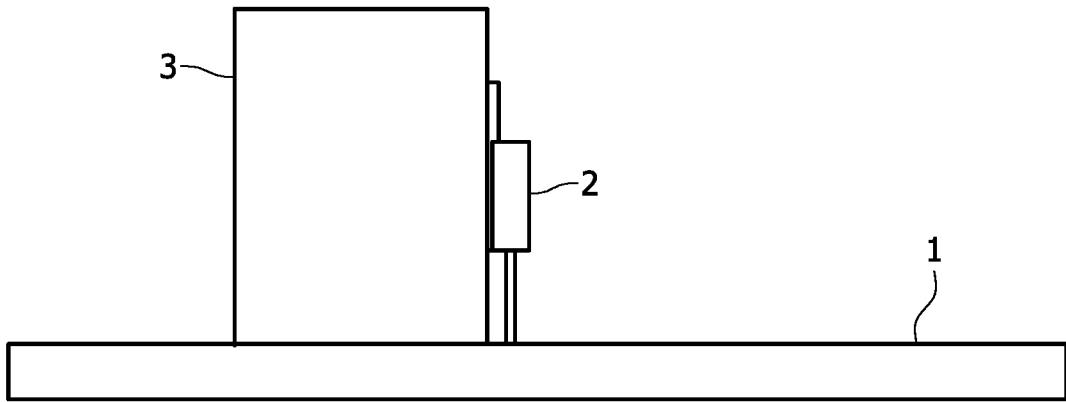


FIG. 3

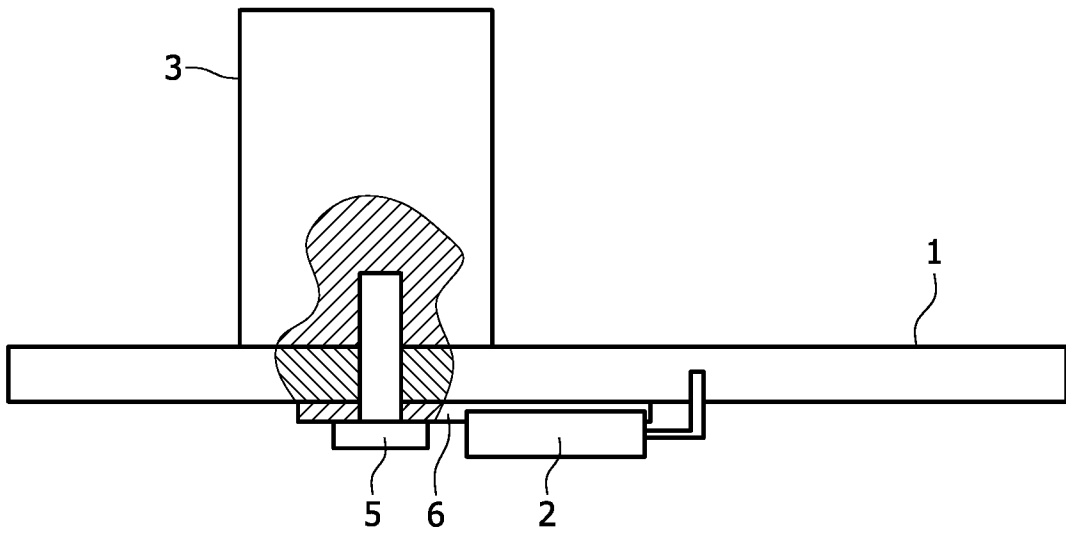


FIG. 4

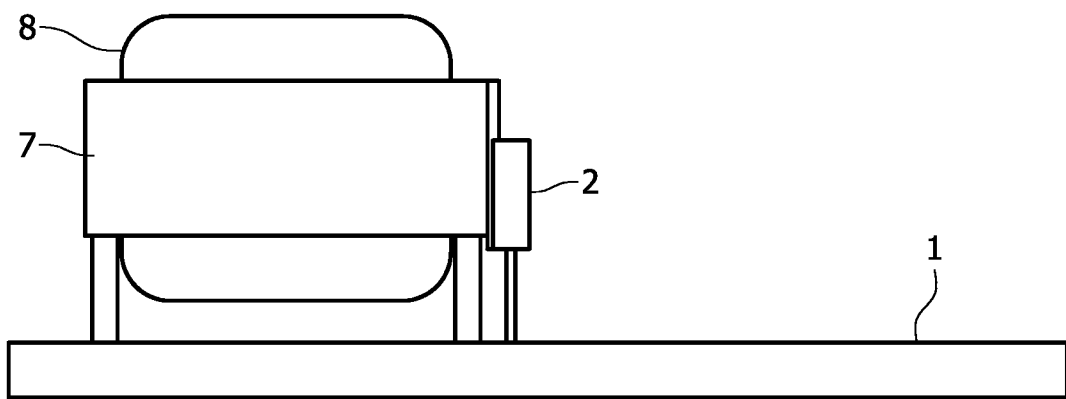


FIG. 5

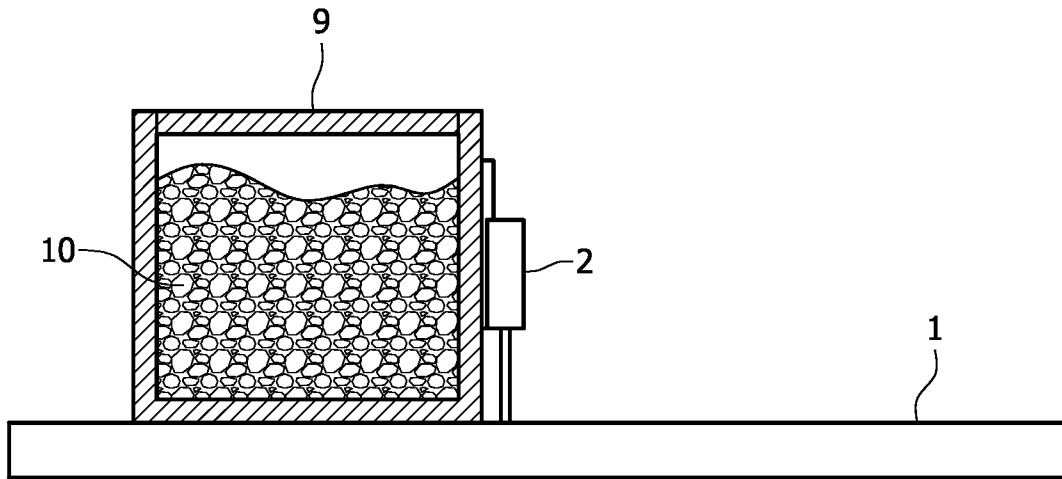


FIG. 6

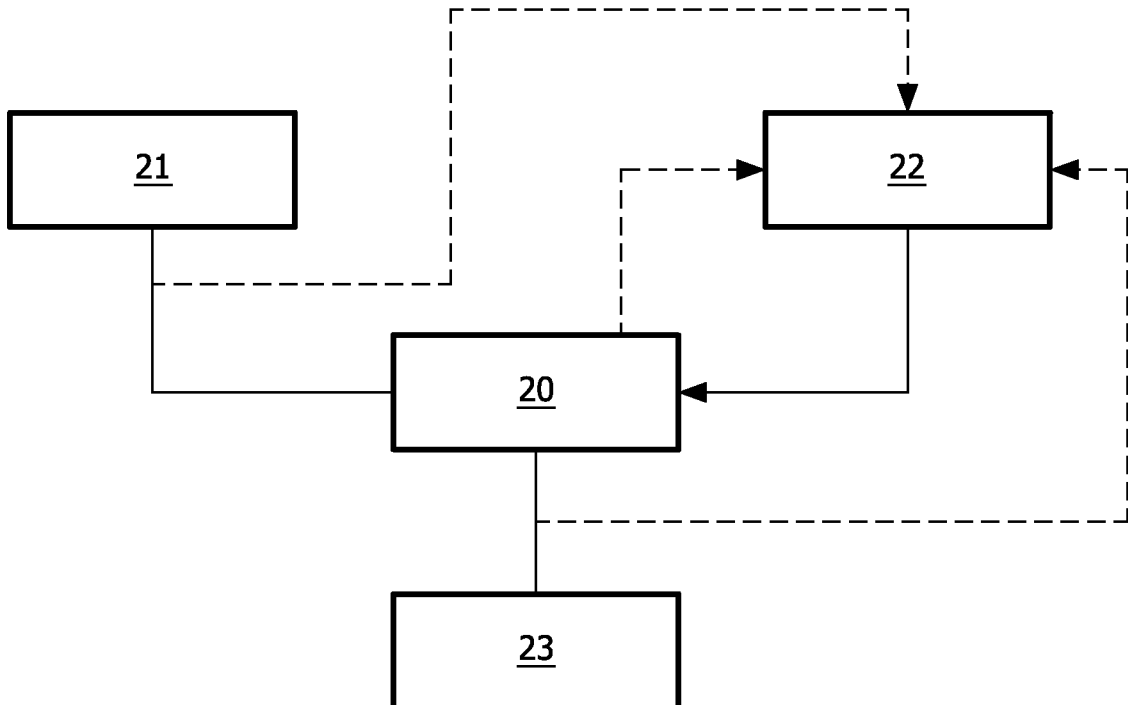


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2009/050080

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02J7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 297 630 A (MULLERSMAN FERDINAND H) 27 October 1981 (1981-10-27) column 5, line 40 - line 59; figure column 6, line 43 - line 62 -----	1-18
A	US 4 560 915 A (SOULTANIAN SETRAK D [US]) 24 December 1985 (1985-12-24) abstract; figure 3 -----	1-18
A	EP 1 487 080 A (KOLVIN IND LTD [CN]) 15 December 2004 (2004-12-15) cited in the application the whole document -----	1-18

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

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- *&* document member of the same patent family

Date of the actual completion of the international search

17 April 2009

Date of mailing of the international search report

28/04/2009

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2009/050080

Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
US 4297630	A	27-10-1981	NONE	
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EP 1487080	A	15-12-2004	CA 2431056 A1	30-11-2004
			US 2004239292 A1	02-12-2004