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GB 2315619 A GB 2275139 A EP 0637119 A2
US 5438248 A

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ONLINE - JAPIO, WPI

(54) Abstract Title
Discriminating between primary and secondary batteries

(57) In order to discriminate between a primary battery and a secondary battery in a portable communication apparatus which can use either as a power supply, the voltage of the battery 2 at the start of a period of use of the apparatus is loaded into a memory 4, then after a predetermined period of use the present battery voltage is subtracted 7 from the value in memory 4 to determine the voltage drop over that period. A comparator 8 compares the voltage difference with a threshold level. If the voltage difference is greater than the threshold, the battery is a primary battery and a charging switch 9 is held open, whereas if the voltage difference is less than the threshold, the battery is a secondary battery and the charging switch 9 is closed.

In an alternative arrangement (Fig.4), the period of time for the battery voltage to fall to a charging initiation voltage is determined and is compared with a threshold period. If the measured period is less than the threshold, the battery is determined to be a primary battery, whereas if the measured period is greater than the threshold, the battery is determined to be a secondary battery.

FIG.2

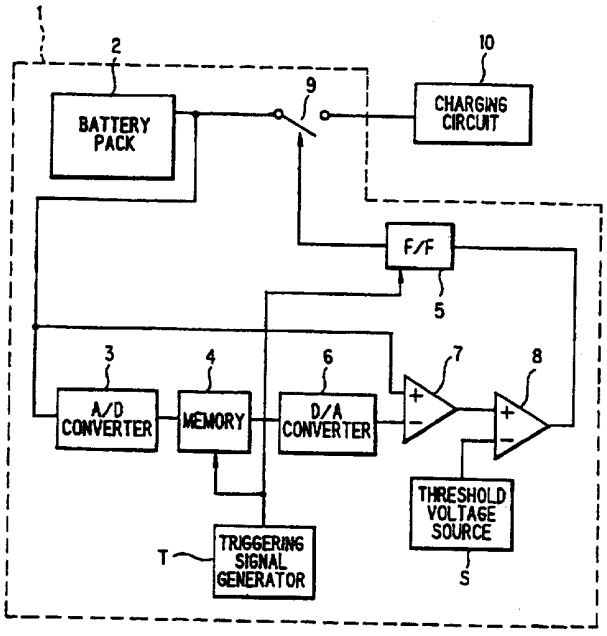

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FIG. 1A

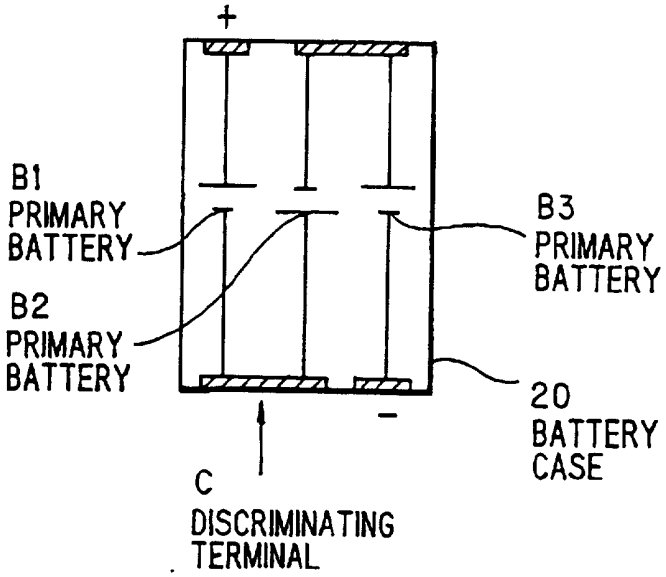

+
B1
PRIMARY
BATTERY
B2
PRIMARY
BATTERY
B3
PRIMARY
BATTERY
20
BATTERY
CASE
−
C
DISCRIMINATING
TERMINAL

FIG. 1B

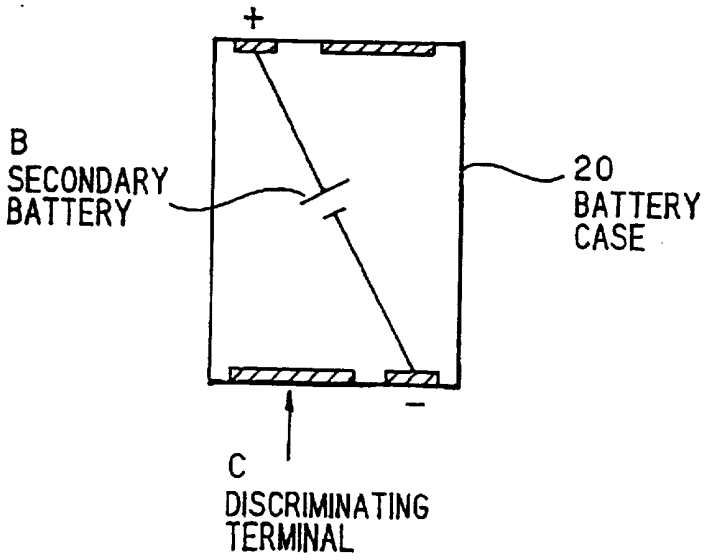

+
B
SECONDARY
BATTERY
20
BATTERY
CASE
−
C
DISCRIMINATING
TERMINAL

FIG. 2

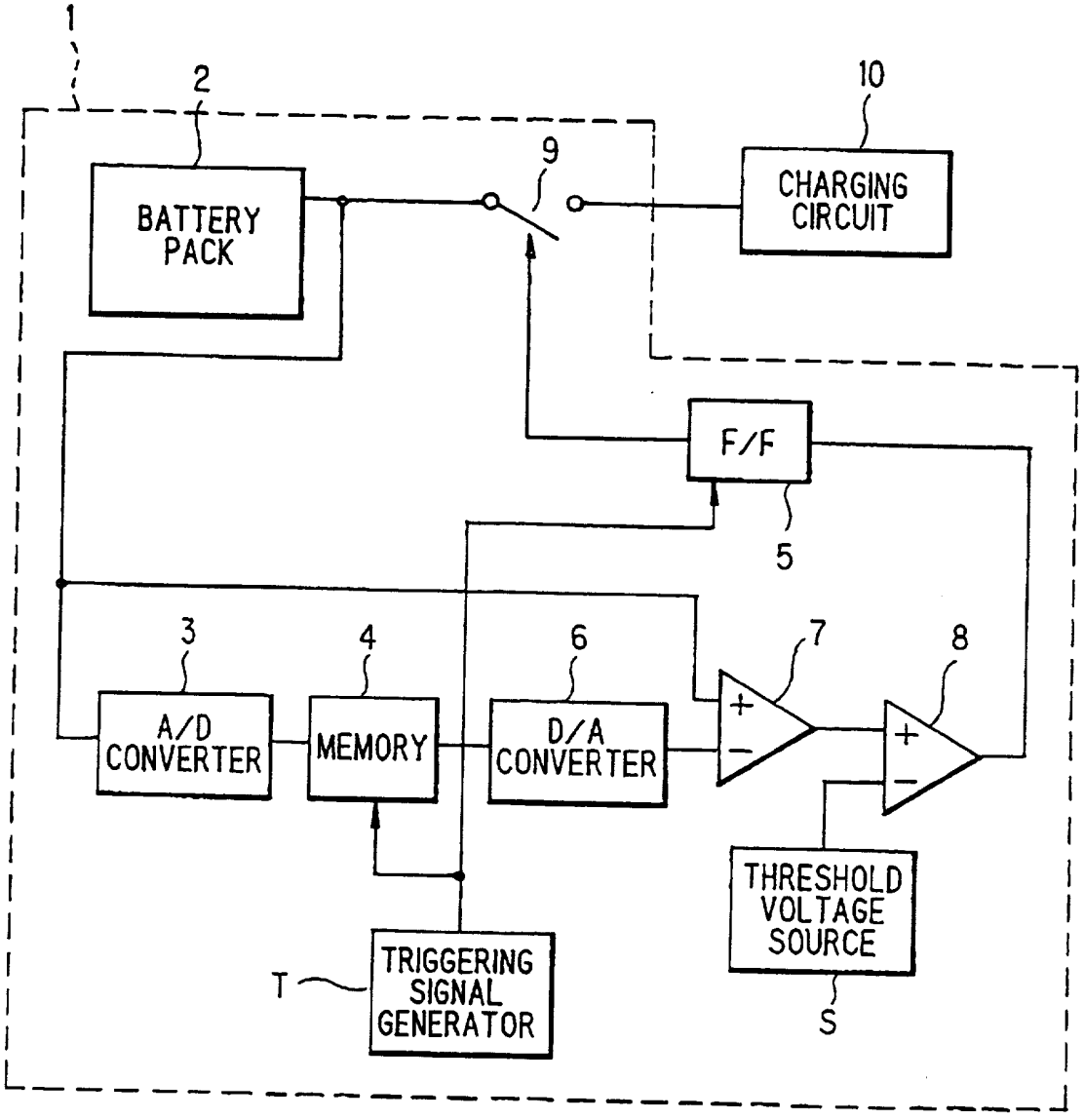

1
2
10
9
BATTERY PACK
CHARGING CIRCUIT
F/F
5
3
4
6
7
8
A/D CONVERTER
MEMORY
D/A CONVERTER
+
−
+
−
THRESHOLD VOLTAGE SOURCE
S
T
TRIGGERING SIGNAL GENERATOR

FIG. 3

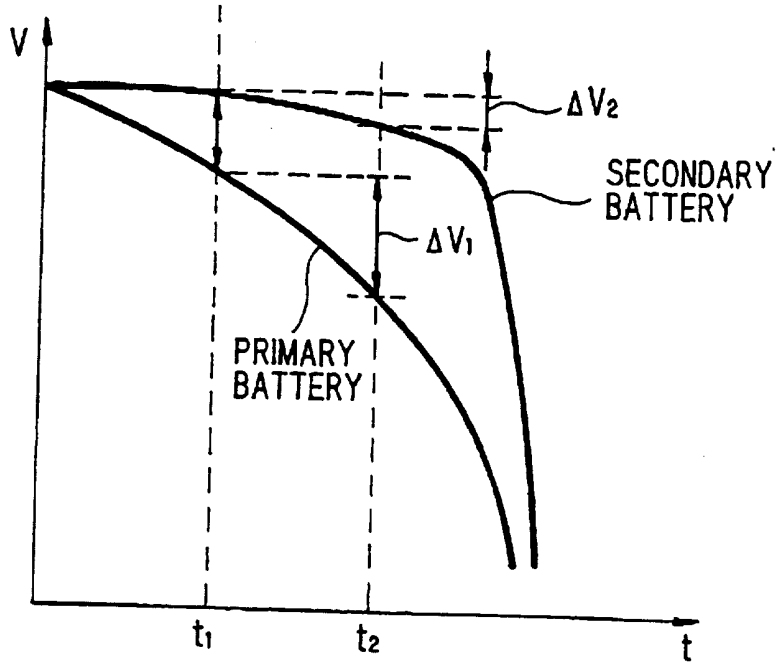
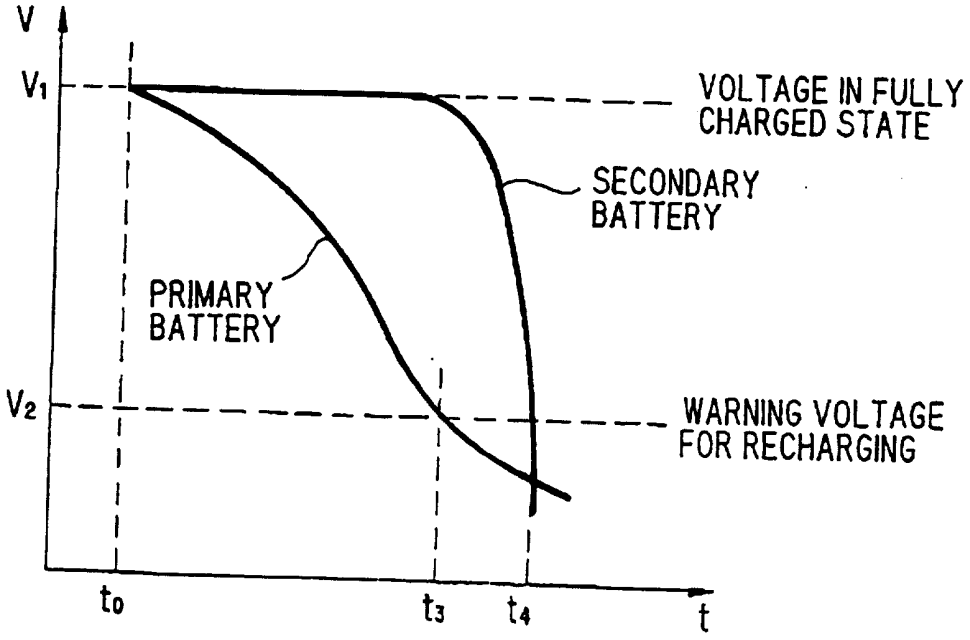

V
ΔV2
SECONDARY BATTERY
ΔV1
PRIMARY BATTERY
t1
t2
t

FIG. 4


V
V1
VOLTAGE IN FULLY CHARGED STATE
SECONDARY BATTERY
PRIMARY BATTERY
V2
WARNING VOLTAGE FOR RECHARGING
t0
t3
t4
t

APPARATUS FOR DISCRIMINATING BETWEEN PRIMARY AND SECONDARY BATTERIES

The invention relates to an apparatus for discriminating between primary and secondary batteries. An apparatus to be described below by way of example in illustration of the invention is able to determine whether a battery contained and loaded in a portable communication equipment is a primary battery or a secondary battery.

A previously proposed apparatus for discriminating between primary and secondary batteries is disclosed in the specification of Japanese Patent Application No. 187849/1996. In this previously proposed apparatus, discrimination between primary and secondary batteries is carried out on the basis of whether a voltage is present at a discriminating terminal.

In this previously proposed apparatus for discriminating between the primary and the secondary batteries, however, there is a disadvantage in that, since the discrimination is always performed on the basis of whether or not a voltage is present at the battery discriminating terminal, in some cases, the secondary battery cannot be recharged.

This is because, when the residual capacity of the primary battery has reached zero, the voltage at the battery discriminating terminal also becomes zero, causing such an erroneous discrimination that, even when the loaded secondary battery is a primary battery, the battery is erroneously regarded as a secondary battery.

An apparatus for discriminating between primary and secondary batteries to be described, by way of example, in illustration of the present invention is able to discriminate between primary and secondary batteries and, even when the residual capacity of the secondary battery has reached zero, the secondary battery can be recharged. A particular apparatus for discriminating between primary and secondary batteries in a portable communication equipment using a primary or a secondary battery pack as a power supply, and which is to be described below, by way of example in illustration of the invention includes a memory for storing the voltage of the battery pack at the start of the use of the portable communication equipment, a subtracter for determining the difference between the voltage stored in the memory and the voltage of the battery pack after the portable communication equipment has been used for a predetermined period of time, a comparator for comparing a threshold value, for discriminating between the batteries, with the voltage difference to determine whether the loaded battery is a primary battery or a secondary battery, and a switch which, when the output from the comparator has determined

that the battery is a secondary battery, permits the battery to be recharged and, when the output from the comparator has determined that the battery is a primary battery, renders a recharging operation invalid.

In an apparatus to be described below, when the voltage difference is smaller than the threshold voltage, the loaded battery is regarded as a secondary battery, and when the voltage difference is larger than the threshold voltage, the loaded battery is regarded as a primary battery.

An apparatus to be described below, by way of example in illustration of the invention, for discriminating between primary and secondary batteries in a portable communication equipment using a primary or secondary battery as a power supply, includes a battery voltage measuring means, time measuring means of measuring the service time taken from the start of the use of the portable communication equipment to the drop of the battery voltage to a charge initiation voltage, a comparator for comparing a threshold time value, for discrimination between the batteries, with the service time to determine whether the loaded battery is a primary battery or a secondary battery, and a switch which, when the output from the comparator has determined that the battery is a secondary battery, permits the battery to be recharged and, when the output from the comparator has determined that the battery is a primary battery, renders a recharging operation invalid.

In a particular apparatus to be described, when the service time value is smaller than the threshold time value, the loaded battery is regarded as a primary battery, while when the service time value is larger than the threshold time value, the loaded battery is regarded as a secondary battery.

A previously proposed arrangement, together with arrangements illustrative of the present invention and given by way of example will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic diagram showing the construction of a previously proposed apparatus for discriminating primary and secondary batteries,

Fig. 2 is a block schematic electrical circuit diagram of an apparatus for discriminating between primary and secondary batteries, and

Figs. 3 and 4 are graphs showing battery voltage characteristics for use in explaining the operation of different apparatuses for discriminating between primary and secondary batteries.

The aforementioned previously proposed apparatus for discriminating between primary and secondary batteries will first be described.

Referring to Figs. 1A and 1B, which illustrate the previous proposal, there is shown a discriminating terminal C in a battery case 20 of a portable communication equipment. When a primary battery is used, a battery pack constituted by three unit cells B1, B2,

and B3 is arranged as shown in Fig. 1A. This permits a voltage to be applied to the discriminating terminal C. On the other hand, when a secondary battery is used, as shown in Fig. 1B, a battery B is connected between a positive electrode and a negative electrode, so that no voltage is applied to the discriminating terminal C.

Thus, in the previously proposed apparatus for discriminating between primary and secondary batteries, discrimination between primary and secondary batteries is carried out on the basis of whether or not a voltage is applied to the discriminating terminal C, thereby always controlling a charging circuit.

Next, an apparatus for discriminating between primary and secondary batteries in a particular embodiment illustrative of the invention will be described.

Referring to Fig. 2 there is shown the circuit arrangement of an example of an apparatus for discriminating between primary and secondary batteries which is helpful in illustrating the invention.

In Fig. 2 there is shown, in an apparatus 1 for discriminating between primary and secondary batteries, contained in a portable communication equipment, a battery pack 2 which is loaded with a primary battery or a secondary battery. An analog to digital (A/D) converter 3 converts the voltage output from the battery pack 2 to digital data, and the digital data are stored in a memory 4 where they are held.

The digital data output from the memory 4 are converted by a D/A converter 6 to analog data. In a subtracter 7, voltage data output from the battery pack 2 are subtracted, after the elapse of a predetermined period of time, from the data output from the D/A converter 6, and the calculated value obtained from the subtracter 7 is compared with a battery discriminating threshold voltage provided by a threshold voltage source S in a comparator 8 to determine whether the battery used in the portable communication equipment is a primary battery or a secondary battery.

A flip-flop 5 latches a battery discriminating signal, output from the comparator 8, as a result of trigger timing given from a trigger signal generator T that, when the equipment is used for a predetermined period of time, generates a trigger signal. The output from the flip-flop 5 closes or opens a switch 9.

A charging circuit 10 is provided outside the apparatus 1 for discriminating between primary and secondary batteries. When the battery pack 2 is a secondary battery, the charging circuit 10 serves to charge the secondary battery from outside the apparatus 1.

Next, the operation of the above-described apparatus for discriminating between primary and secondary batteries, will be described with reference to Fig. 3.

The battery voltage output from the battery pack 2, that is, the voltage value at time t_1 shown in Fig. 3, is

fed into the A/D converter 3 where it is converted to digital data which are then stored in the memory 4.

The trigger signal generator T cumulates the service time of the portable communication equipment and, when the cumulated time exceeds a predetermined time and reaches time t_2 shown in Fig. 3, generates a trigger signal to cause the digital data stored in the memory 4 to be output.

The digital data are converted by the D/A converter 6 to analog voltage data, and the battery voltage output from the battery pack 2 is subtracted from the analog voltage data by the subtracter 7.

In a particular case, the voltage drop ΔV_1 of the primary battery, which results from the use of the portable communication equipment, in the period of time $(t_2 - t_1)$ is larger than the voltage drop ΔV_2 of the secondary battery in the same period of service time. Therefore, bringing the voltage provided by the threshold voltage source S to a value intermediate between ΔV_1 and ΔV_2 enables discrimination to be made between primary and secondary batteries, that is, it is made possible to determine whether the battery being used is a primary battery or a secondary battery.

The output from the comparator 8, i.e., the result of discrimination between the primary and secondary batteries, is latched by the flip-flop 5 at the time t_2, as shown in Fig. 3, and the output of the flip-flop 5 opens or closes the switch 9.

When the discrimination result indicates that the battery is a primary battery, the switch 9 is "opened," disengaging the charging circuit 10, while, when the discrimination result indicates that the battery is a secondary battery, the switch 9 is "closed" to connect the charging circuit 10, making it possible for the battery to be recharged.

The operation of apparatus for discriminating between primary and secondary batteries has been described above in detail with reference to one particular arrangement illustrative of the invention. The invention, however, may be carried out using other arrangements.

For example, as shown in Fig. 4, when the time between the time t_0 (output voltage of the battery: V_1), at which use of the portable communication equipment starts, and the battery voltage drops to the warning voltage V_2 for recharging, that is, the time $(t_3 - t_0)$ or the time $(t_4 - t_0)$, is measured, the time taken for the primary battery to reach the voltage for recharging is shorter than the time taken for the secondary battery to reach the same condition. Therefore, a time value intermediate these times may be used as a threshold time value for the discrimination between primary and secondary batteries.

As is apparent from the foregoing description, unlike the earlier proposal in which the discrimination between primary and secondary batteries is always being

carried out, discrimination between primary and secondary batteries is carried out, in the arrangements described above in illustration of the invention, after the elapse of a predetermined time after the loading or start of use of the battery, and is completed before the residual capacity of the battery becomes zero, thereby enabling the discrimination to be carried out with more certainty. Therefore, even though the residual capacity of the secondary battery falls to zero, the discrimination between primary and secondary batteries can be correctly carried out and the recharging operation can be initiated.

It will be understood that, although particular arrangements have been described in illustration of the invention by way of example, variations and modifications thereof, as well as other arrangements, may be conceived within the scope of the appended claims.

CLAIMS

1. An apparatus for use in discriminating between primary and secondary batteries in a portable communication equipment using a primary or a secondary battery pack to provide a power supply, in which the apparatus includes a memory for storing the voltage of the battery pack at the start of use of the portable communication equipment, a subtracter for determining the difference between the voltage stored in the memory and the voltage of the battery pack after the use of the portable communication equipment for a predetermined period of time, a comparator for comparing a threshold value, for use in discriminating between the batteries, with the voltage difference to determine whether the battery is a primary battery or a secondary battery, and a switch which, when the output from the comparator has determined that the battery is a secondary battery, permits the battery to be recharged and, when the output from the comparator has determined that the battery is a primary battery, renders a recharging operation invalid.

2. An apparatus as claimed in claim 1, wherein, when the voltage difference is smaller than the threshold voltage, the battery is regarded as a secondary battery, while when the voltage difference is larger than the

threshold voltage, the battery is regarded as a primary battery.

3. An apparatus for discriminating between primary and secondary batteries in a portable communication equipment using a primary or a secondary battery as a power supply, the apparatus including battery voltage measuring means, time measuring means for measuring the time taken from the start of the use of the portable communication equipment to that in which there is a reduction in the battery voltage to a charge initiation voltage to determine a service time, a comparator for comparing a threshold time value, for use in discriminating between the batteries, with the service time to determine whether the battery is a primary battery or a secondary battery, and a switch which, when the output from the comparator has determined that the battery is a secondary battery, permits the battery to be recharged and, when the output from the comparator has determined that the battery is a primary battery, renders a recharging operation invalid.

4. An apparatus as claimed in claim 3, wherein, when the service time value is smaller than the threshold time value, the battery is regarded as a primary battery, while when the service time value is larger than the threshold time value, the loaded battery is regarded as a secondary battery.

5. An apparatus as claimed in either claim 1 or claim 3 substantially as described herein with reference to Figs. 2 to 4 of the accompanying drawings.

The Patent Office

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Application No: GB 9812514.9
Claims searched: 1 to 5

Examiner: M J Billing
Date of search: 20 August 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H2H HAPD, HBCD, HBCE, HBCF, HBCG, HBCH.

Int Cl (Ed.6): G01R 19/165, 31/36; H01M 10/42, 10/44, 10/46; H02H 7/18, 11/00; H02J 7/00, 7/02.

Other: ONLINE - JAPIO, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB2315619A	(NEC) - Abstract	1,3
A	GB2275139A	(HEWLETT-PACKARD) - Abstract, page 2 line 29 to page 3 line 2	1,3
A	EP0637119A2	(EASTMAN KODAK) - Abstract	1,3
A	US5438248	(GOLDSTAR) - Abstract,column 3 line 57 to column 4 line 66	1,3

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