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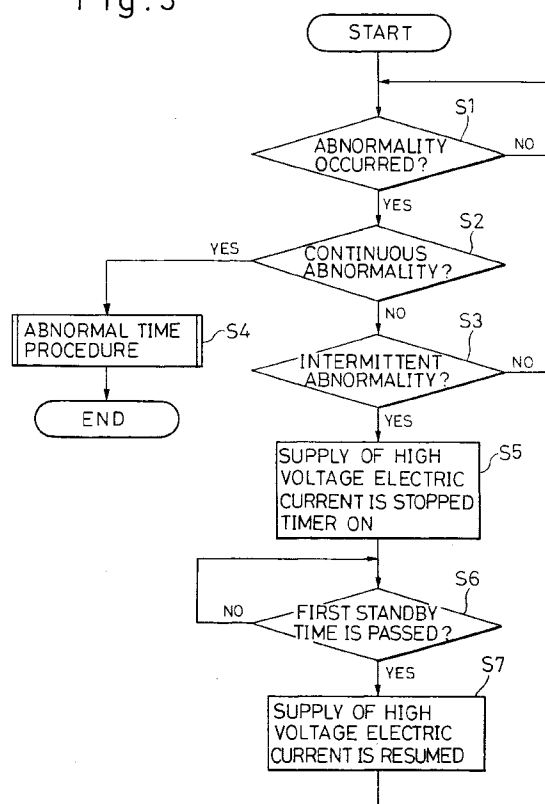
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Konan-machi, Osato-gun, Saitama-ken (JP)**(74) Representative: **Votier, Sidney David****CARPMAELS & RANSFORD****43, Bloomsbury Square****London WC1A 2RA (GB)**(54) **Method and apparatus for controlling electric dust collector**

(57) When it is judged that an abnormality occurs to an electric dust collector (1) in step S2, it is then judged whether the abnormality intermittently occurs a predetermined plurality of times or more within a predetermined second measuring time in step S3. If the judgment in step S3 is affirmative, the supply of high voltage electric current to one pair of opposing electrodes of the electric dust collector (1) is temporarily stopped in step S5, and after the passage of a first standby time, the supply of high voltage electric current to the one pair of opposing electrodes is resumed in step S7. If the judgment in step S2 is negative, it is judged whether or not the abnormality of the electric dust collector (1) is continued during a predetermined first measuring time in step S3. If the judgment in step S3 is affirmative, an abnormal time procedure is carried out with respect to the electric dust collector 1 in step S4.

Fig.3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a method and an apparatus for controlling an electric dust collector, and more particularly to a control method and a control apparatus capable of stopping the operation of an electric dust collector when an abnormality occurs thereto.

Related Art

In a conventional control apparatus for an electric dust collector, voltage between one pair of opposing electrodes of the electric dust collector is detected and an judgment is made as to whether or not the voltage thus detected is within a predetermined range. If the voltage is not within the range, the electric dust collector is stopped in operation by judging that an abnormality has occurred, and a failure is indicated (see Japanese Utility Model Examined Publication (KOKOKU) No. 45376/95).

The voltage between the opposing electrodes of the electric dust collector is sometimes departed from the predetermined range for only a short time. For example, when water drops are deposited on the opposing electrodes, the voltage between the opposing electrodes is lowered and departed from the predetermined range. However, this lowering of voltage between the opposing electrodes occurs for only a short time during which the water drops still remain deposited. The voltage will return to its original level when the water drops are evaporated. Even if a voltage abnormality should occur for only a short time as discussed, the electric dust collector would be, in most cases, in a normal condition.

However, the conventional control apparatus for an electric dust collector has such a problem that when the voltage between the opposing electrodes departs from the predetermined range even instantaneously, it stops the operation of the electric dust collector by judging the electric dust collector to be abnormal notwithstanding that the electric dust collector is in a normal condition.

SUMMARY OF THE INVENTION

The present invention aims at providing a control method and a control apparatus capable of excluding a short time abnormality of an electric dust collector from a real abnormality.

The feature of a control method of the present invention resides in a method for controlling an electric dust collector comprising a first step of judging whether or not the abnormality of the electric dust collector intermittently occurs a predetermined plurality of times or more during a predetermined second measuring time; and a second step of performing an abnormal time pro-

cedure with respect to the electric dust collector when the abnormality continues during the first measuring time.

Preferably, the control method further comprises a third step of judging whether or not the abnormality of the electric dust collector intermittently occurs a predetermined plurality of times or more during a predetermined second measuring time; and a fourth step of temporarily stopping the supply of a high voltage electric current to the one pair of opposing electrodes and resuming the supply of a high voltage electric current to the one pair of opposing electrodes after the passage of a predetermined first standby time when the judgment in the third step is affirmative.

The third step may be carried out after the first step is carried out, or the first step may be carried out after the third step is carried out.

Preferably, the control method further comprises a fifth step of judging whether or not a phenomenon of the abnormality of the electric dust collector being intermittently occurred a predetermined plurality of times or more during the second measuring time, occurs a predetermined plurality of times; and a sixth step of performing an abnormal time procedure with respect to the electric dust collector when the judgment in the fifth step is affirmative.

Preferably, the control method further comprises a seventh step of judging whether or not an abnormality of the electric dust collector continuing during the first measuring time occurs for the first time; and an eighth step of temporarily stopping the supply of a high voltage electric current to the one pair of opposing electrodes and resuming the supply of a high voltage electric current to the one pair of opposing electrodes after the passage of a predetermined second standby time when the judgment in the seven step is affirmative.

The feature of a control apparatus of the present invention resides in an apparatus for controlling an electric dust collector comprising abnormality detecting means for detecting an abnormality of the electric dust collector having one pair of opposing electrodes supplied with a high voltage electric current; continuous abnormality judging means for judging whether or not a detection of the abnormality of the electric dust collector by the abnormality detecting means continues during a predetermined first measuring time; and abnormal time procedure means for performing an abnormal time procedure with respect to the electric dust collector when the abnormality detecting means makes an affirmative judgment.

Preferably, the control apparatus further comprises intermittent abnormality judging means for judging whether or not the abnormality detecting means intermittently detects the abnormality of the electric dust collector a predetermined plurality of times or more during a predetermined second measuring time; and intermittent abnormal time procedure means for temporarily stopping the supply of a high voltage electric current to

the one pair of opposing electrodes when the intermittent abnormality judging means makes an affirmative judgment and resuming the supply of a high voltage electric current to the one pair of opposing electrodes after the passage of a predetermined first standby time.

The intermittent abnormality judging means may judge whether or not the abnormality of the electric dust collector continues during the predetermined second measuring time after the continuous abnormality judging means judges whether or not the abnormality of the electric dust collector intermittently occurs a predetermined plurality of times or more during the predetermined first measuring time, or it may judge whether or not the abnormality of the electric dust collector continues during the predetermined first measuring time after the intermittent abnormality judging means judges whether or not the abnormality of the electric dust collector intermittently occurs a predetermined plurality of times or more during the predetermined second measuring time.

Preferably, the control apparatus may further comprises number of times judging means for judging whether or not the intermittent abnormality judging means makes an affirmative judgment a plurality of times or more; and the abnormal time procedure means carries out the abnormal time procedure with respect to the electric dust collector when the number of times judging means makes an affirmative judgment.

Preferably, the control apparatus further comprises first time abnormality judging means for judging whether or not the affirmative judgment made by the continuous abnormality judging means is a first judgment; and first time abnormal time procedure means for temporarily stopping the supply of a high voltage electric current to the one pair of opposing electrodes when the first time abnormality makes an affirmative judgment and resuming the supply of a high voltage electric current to the one pair of opposing electrodes after the passage of a predetermined second standby time.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a general construction of one embodiment of the present invention,

Fig. 2 is an illustration of a flow chart for controlling an electric dust collector by a control apparatus according to the embodiment of Fig. 1;

Fig. 3 is an illustration showing a flow chart of another embodiment of the present invention; and

Fig. 4 is an illustration showing a flow chart of still another embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Embodiments of the present invention will be described hereinafter with reference to Figs. 1 through 4.

Referring first to Figs. 1 and 2, one embodiment of

the present invention will be described. An electric dust collector 1 to be controlled by a control apparatus 2 comprises, as in the conventional equivalent device, a charge unit 11 having one pair of opposing electrodes (not shown) consisting of a discharge electrode and a counterpart opposing electrode, and a high voltage power supply circuit 12 for supplying a high voltage to between the opposing electrodes. The charge unit 11 is provided with a voltage detecting means 13 for detecting a voltage between the one pair of opposing electrodes.

The control apparatus 2 judges whether or not an abnormality occurs to the dust collector 1, based on a detection voltage detected by the voltage detecting means 13. When the dust collector 1 is in an abnormal condition, the control apparatus 2 stops the supply of high voltage current to the opposing electrodes of the charge unit 11 by the high voltage power supply circuit 12 and resumes the operation later. When the abnormality of the dust collector 1 continues for a predetermined time, the control apparatus 2 judges the abnormality as a real abnormality and causes the buzzer 3 to buzz and an alarm lamp to light up to give a warning to the user of the electric dust collector 1.

The control operation made by the control apparatus 2 will be described in detail. The control operation is carried out in accordance with a program based on the flow chart of Fig. 1. When a predetermined time has passed after the actuation of the electric dust collector 1, the program based on the flow chart starts. Those memories related to this program are all initialized immediately after start of the program.

After the start of the program, it is judged in step S1 whether or not an abnormality occurs to the electric dust collector 1. This abnormality judgment is carried out by checking whether or not the voltage between the one pair of opposing electrodes is within a predetermined range in this embodiment. The abnormality judgment may be carried out based on an electric current flowing between the one pair of opposing electrodes or on an electric power as a product of the voltage and the electric current. When no abnormality occurs to the electric dust collector 1, the procedure in step S1 is repeated. That is, it is normally monitored whether or not an abnormality occurs to the voltage between the opposing electrodes.

When an abnormality occurs to the electric dust collector 1, it is judged in step S2 whether or not the abnormality is an intermittent abnormality which intermittently occurs a predetermined plurality of times or more within a predetermined second measuring time. This judgment is carried out to see whether or not the abnormality is temporarily occurred due to deposition of water drops, dusts, or the like on the one pair of opposing electrodes. The length of the second measuring time and the criteria of the number of occurrence of abnormality for judging a certain abnormality as an intermittent abnormality are appropriately established through testing.

If the abnormality occurs to the electric dust collec-

tor 1 is not an intermittent abnormality, it is judged in step S3 whether or not the abnormality is a continuous abnormality which continuously occurs within a predetermined first measuring time. This judgement is carried out to see whether or not the abnormality is continuous and requires repair, as caused by wire cutting, short circuit, or the like. The length of the first measuring time is established through testing such that a short time abnormality caused by water drops, or the like can be excluded. It is preferred that the length of the first measuring time is equal to the length of the second measuring time. By doing so, it can simultaneously be judged after the passage of the first measuring time whether the abnormality is an intermittent abnormality or a continuous abnormality.

In case the abnormality of the electric dust collector 1 is not a continuous abnormality, it is merely of an instantaneous nature and not a real abnormality. Thus, the program returns to step S1. Accordingly, the control apparatus 2 carries out no procedure with respect to the electric dust collector 1. The electric dust collector 1 is kept operated in an ordinary manner.

In case the abnormality of the electric dust collector 1 is a continuous abnormality, it is of a continuous nature and a real abnormality. Thus, an abnormal time procedure is carried out by the control apparatus 2 (step S4). This abnormal procedure is the same as in the conventional control apparatus. In this embodiment, the abnormal procedure includes stop of the supply of high voltage electric current to the one pair of opposing electrodes of the charge unit 11, actuation of the buzzer 3, and lighting of the alarm lamp 4. Thereafter, the program is ended, and the control operation carried out by the control apparatus 2 with respect to the electric dust collector 1 is finished.

If it is judged in step S2 that the abnormality occurs to the electric dust collector 1 is an intermittent abnormality, an intermittent abnormal time procedure is carried out in steps S5 through S7. That is, in step S5, the supply of voltage electric current to the one pair of opposing electrodes is stopped, and the timer is actuated. Then, in step S6, it is judged whether or not a predetermined first standby time is elapsed after the actuation of the timer. The length of the first standby time is long enough to remove an instantaneous abnormality caused by water drops, or the like deposited on the one pair of opposing electrodes and established through testing. With the passage of the first standby time, the supply of voltage electric current is resumed in step S7. Then, the program returns to step S1.

In the above control apparatus 2, since it is judged whether or not an abnormality is a continuous abnormality only after the abnormality of the electric dust collector 1 is detected and an abnormal time procedure is carried out only when the abnormality is a continuous abnormality, it never happens that an abnormality, which is of the nature to be removed with the passage of time as in the case where water drops are deposited on the

one pair of opposing electrodes, is judged as a real abnormality. Accordingly, it can be prevented that the electric dust collector 1 is stopped in operation notwithstanding that the electric dust collector 1 is in a normal condition. This makes it possible to reduce the frequency for collecting the electric dust collector 1 which is not required to be repaired.

In this embodiment, since the supply of high voltage electric current to the one pair of opposing electrodes is temporarily stopped when an intermittent abnormality occurs and the supply of high voltage electric current is resumed after the passage of the predetermined first standby time, the abnormality is removed within the first standby time. Thus, the electric dust collector 1 can be prevented from being operated in a state where an abnormality occurs intermittently and it can be operated only in a normal condition.

Other embodiments of the present invention will now be described with reference to Figs. 3 and 4.

In the embodiment shown in Fig. 3, the intermittent abnormality judgment and the continuous abnormality judgment are carried out reversely in order from that of Fig. 1. That is, in this embodiment, it is judged first in step S2 whether or not the abnormality is a continuous abnormality. If it is judged in step S2 that the abnormality is a continuous abnormality, an abnormal time procedure is carried out in step S4. In contrast, if it is judged in step S2 that the abnormality is not a continuous abnormality, it is then judged in step S3 whether or not the abnormality is an intermittent abnormality. If the abnormality is an intermittent abnormality, an intermittent abnormal time procedure is carried out in steps S5 through S7. In contrast, if the abnormality is not an intermittent abnormality, the program returns to step S1. The judgment as to whether or not the abnormality is a continuous abnormality, the judgment as to whether or not the abnormality is an intermittent abnormality, and the procedures for those occasions, are carried out in the same manner as in the embodiment of Fig. 1.

In the embodiment shown in Fig. 4, step S3' for judging whether the judgment for a continuous abnormality in step S3 is the first judgment or the second judgment afterward is inserted between step S3 for judging whether or not the abnormality is a continuous abnormality and step S4 for carrying out the abnormal time procedure.

If it is judged in step S3' that the judgment for continuous abnormality is the first judgment, the first abnormal time procedure is carried out. In this embodiment, the same procedure as the intermittent abnormal time procedure is carried out as the first abnormal time procedure based on steps S5 through S7. That is, in step S5, the procedures for stopping the supply of voltage to the one pair of opposing electrodes and for actuating the timer are carried out. It is judged in step S6 whether or not the predetermined first standby time (=second standby time) is passed. After the passage of the second standby time, the supply of voltage to the one pair

of opposing electrodes is resumed in step S7. Different procedures from the first abnormal time procedure in steps S5 through S7 may be carried out in different steps from steps S5 through S7 inasmuch as the procedure for temporarily stopping the supply of high voltage electric current to the one pair of opposing electrodes and the procedure for resuming the supply of high voltage electric current after the passage of the second standby time are carried out. The length of the second standby time may be different from the length of the first standby time.

If it is judged in step S3' that the judgment for a continuous abnormality is the second time judgment, the program proceeds to step S4 where the abnormal time procedure is carried out.

The judgment as to whether the judgment for a continuous abnormality is the first time judgment can be carried out by checking whether the content in a predetermined memory is 0 (first time) or 1 (second time). That is, since the content in a predetermined memory is cleared to 0 when the procedure in step S3' is executed first, due to initialization at the starting time of the program, the judgment for a continuous abnormality is judged to be the first time judgment. After the first execution of step S3', 1 is written in the predetermined memory mentioned above. As a consequence, it is judged that the judgment for a continuous abnormality is performed at least once when the step S3' is executed second time afterward.

The order for executing steps S2 and S3 may be reversed also in this embodiment as in the embodiment of Fig. 2.

In this embodiment, since the second standby time is allowed to pass in the state where the supply of high voltage electric current is stopped and without immediately judging that the abnormality of the electric dust collector 1 is a real abnormality when the continuous abnormality is the first time, it can be prevented that the electric dust collector 1 is judged to be in an abnormal condition even when a comparatively long time is required for the voltage between the one pair of opposing electrodes to return to its normal level as in the case where comparatively large water drops are deposited on the one pair of opposing electrodes.

The present invention is not limited to the above embodiments but many modifications can be made in accordance with necessity. For example, in the above embodiments, the program returns immediately to step S1 after the intermittent abnormal time procedures in steps S5 through S7 are carried out. It is an interesting alternative that a judgment is made as to whether or not the intermittent abnormal time procedure is carried out a predetermined plurality of times after step S7, and if the judgment is affirmative, the abnormal time procedure is carried out but if the judgment is negative (namely, only when the number of times for carrying out the intermittent abnormal time procedure does not reach a predetermined number), the program then returns to step S1.

Claims

1. A method for controlling an electric dust collector (1) CHARACTERIZED by comprising a first step of judging whether or not said abnormality of said electric dust collector (1) intermittently occurs a predetermined plurality of times or more during a predetermined second measuring time; and a second step of performing an abnormal time procedure with respect to said electric dust collector (1) when said abnormality continues during said first measuring time.
2. A method for controlling an electric dust collector according to claim 1, further comprising a third step of judging whether or not said abnormality of said electric dust collector (1) intermittently occurs a predetermined plurality of times or more during a predetermined second measuring time; and a fourth step of temporarily stopping the supply of a high voltage electric current to said one pair of opposing electrodes and resuming the supply of a high voltage electric current to said one pair of opposing electrodes after the passage of a predetermined first standby time when the judgment in said third step is affirmative.
3. A method for controlling an electric dust collector according to claim 2, wherein said third step is carried out after said first step is carried out.
4. A method for controlling an electric dust collector according to claim 2, wherein said first step is carried out after said third step is carried out.
5. A method for controlling an electric dust collector according to claim 2, further comprising a fifth step of judging whether or not a phenomenon of said abnormality of said electric dust collector (1) being intermittently occurred a predetermined plurality of times or more during said second measuring time, occurs a predetermined plurality of times; and a sixth step of performing an abnormal time procedure with respect to said electric dust collector (1) when the judgment in said fifth step is affirmative.
6. A method for controlling an electric dust collector according to claim 1, further comprising a seventh step of judging whether or not an abnormality of said electric dust collector (1) continuing during said first measuring time occurs for the first time; and an eighth step of temporarily stopping the supply of a high voltage electric current to said one pair of opposing electrodes and resuming the supply of a high voltage electric current to said one pair of opposing electrodes after the passage of a predetermined second standby time when the judgment in said seventh step is affirmative.

7. An apparatus for controlling an electric dust collector

CHARACTERIZED by comprising abnormality detecting means (13) for detecting an abnormality of said electric dust collector (1) having one pair of opposing electrodes supplied with a high voltage electric current; continuous abnormality judging means for judging whether or not a detection of said abnormality of said electric dust collector (1) by said abnormality detecting means (13) continues during a predetermined first measuring time; and abnormal time procedure means for performing an abnormal time procedure with respect to said electric dust collector (1) when said abnormality detecting means (13) makes an affirmative judgment.

8. An apparatus for controlling an electric dust collector according to claim 7, further comprising intermittent abnormality judging means for judging whether or not said abnormality detecting means (13) intermittently detects said abnormality of said electric dust collector (1) a predetermined plurality of times or more during a predetermined second measuring time; and intermittent abnormal time procedure means for temporarily stopping the supply of a high voltage electric current to said one pair of opposing electrodes when said intermittent abnormality judging means makes an affirmative judgment and resuming the supply of a high voltage electric current to said one pair of opposing electrodes after the passage of a predetermined first standby time.

9. An apparatus for controlling an electric dust collector according to claim 8, wherein said intermittent abnormality judging means judges whether or not said abnormality of said electric dust collector (1) continues during said predetermined second measuring time after said continuous abnormality judging means judges whether or not said abnormality of said electric dust collector (1) intermittently occurs a predetermined plurality of times or more during said predetermined first measuring time.

10. An apparatus for controlling an electric dust collector according to claim 8, wherein said continuous abnormality judging means judges whether or not said abnormality of said electric dust collector (1) continues during said predetermined first measuring time after said intermittent abnormality judging means judges whether or not said abnormality of said electric dust collector (1) intermittently occurs a predetermined plurality of times or more during said predetermined second measuring time.

11. An apparatus for controlling an electric dust collector according to claim 8, further comprising number of times judging means for judging whether or not said intermittent abnormality judging means makes

an affirmative judgment a plurality of times or more; and said abnormal time procedure means carries out said abnormal time procedure with respect to said electric dust collector (1) when said number of times judging means makes an affirmative judgment.

12. An apparatus for controlling an electric dust collector according to claim 7, further comprising first time abnormality judging means for judging whether or not the affirmative judgment made by said continuous abnormality judging means is a first judgment; and first time abnormal time procedure means for temporarily stopping the supply of a high voltage electric current to said one pair of opposing electrodes when said first time abnormality makes an affirmative judgment and resuming the supply of a high voltage electric current to said one pair of opposing electrodes after the passage of a predetermined second standby time.

Fig.1

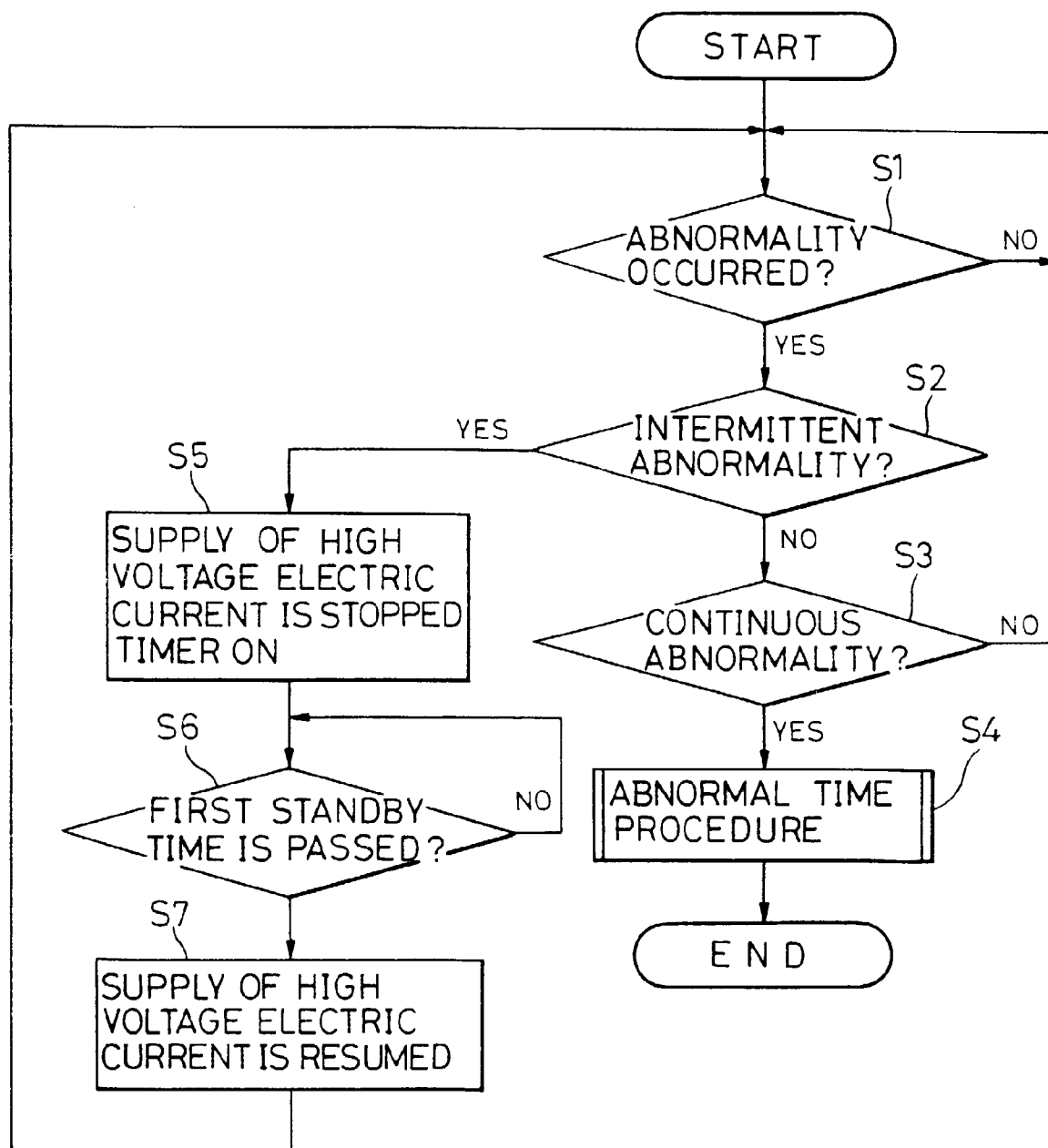


Fig. 2

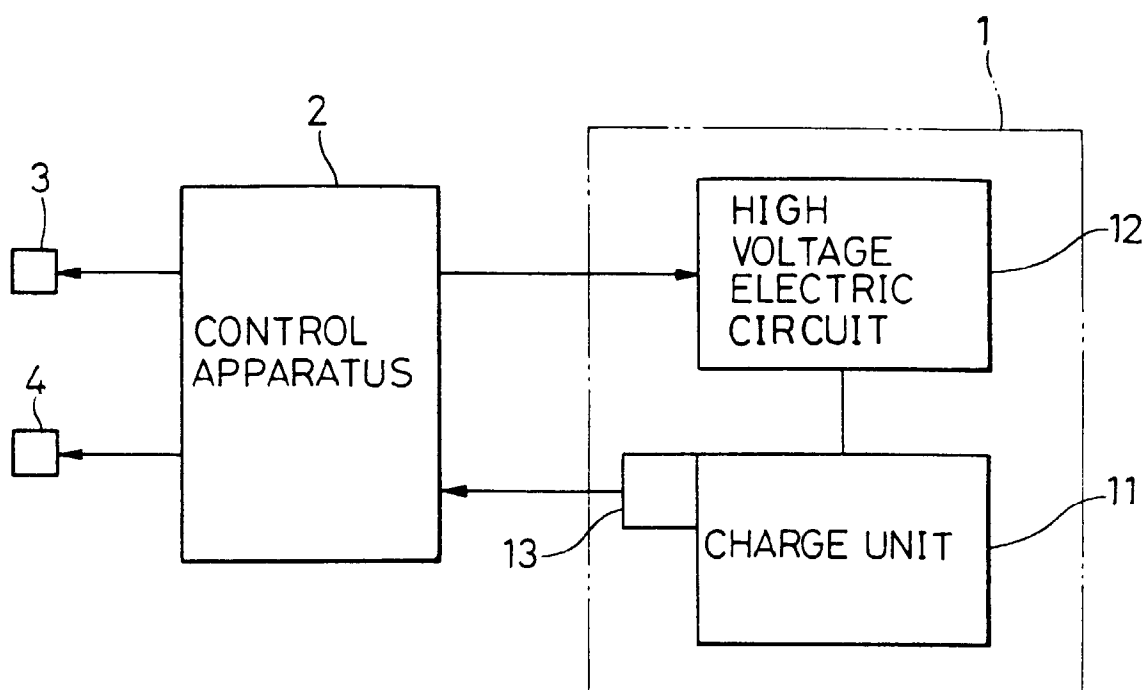


Fig. 3

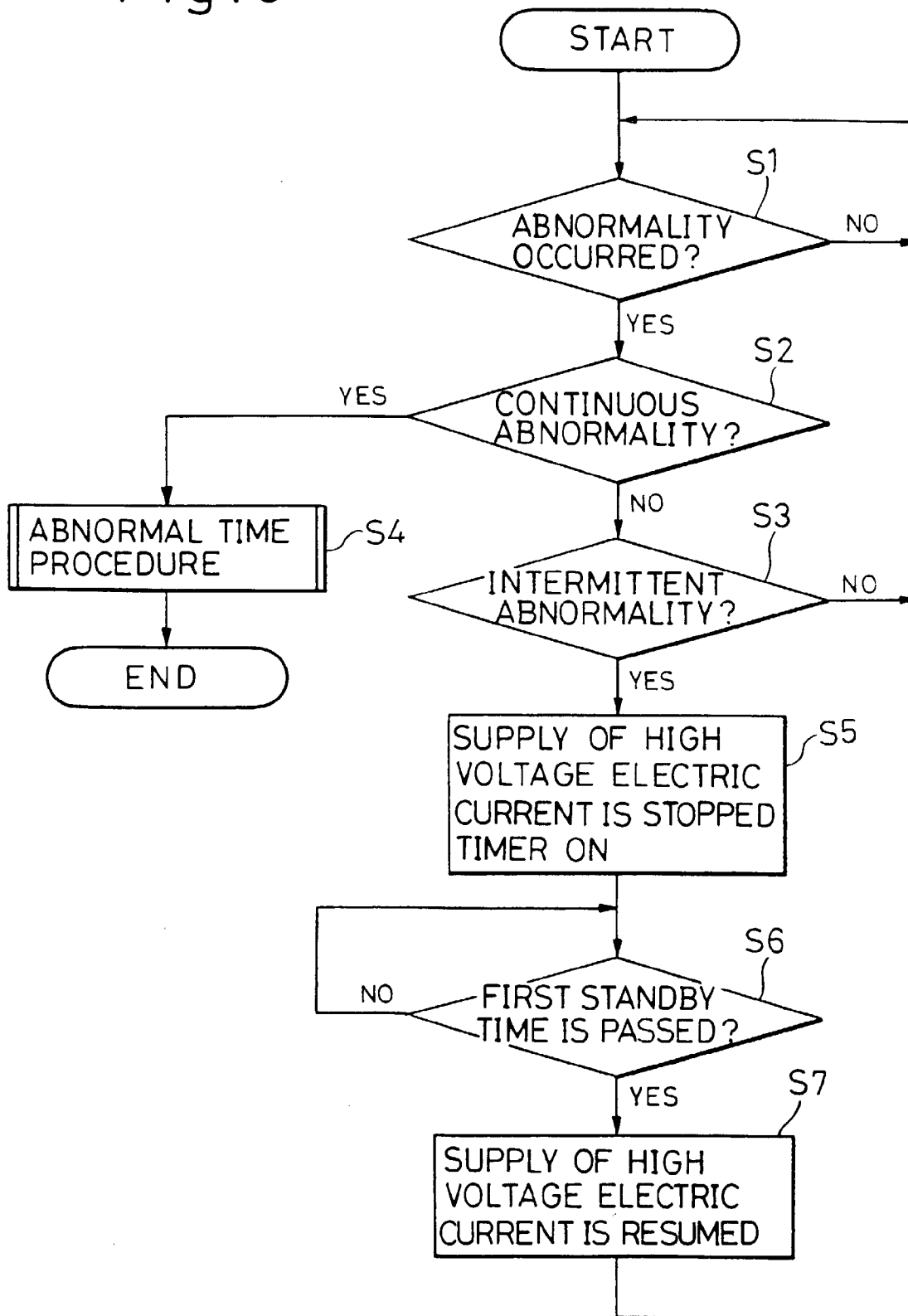


Fig.4

