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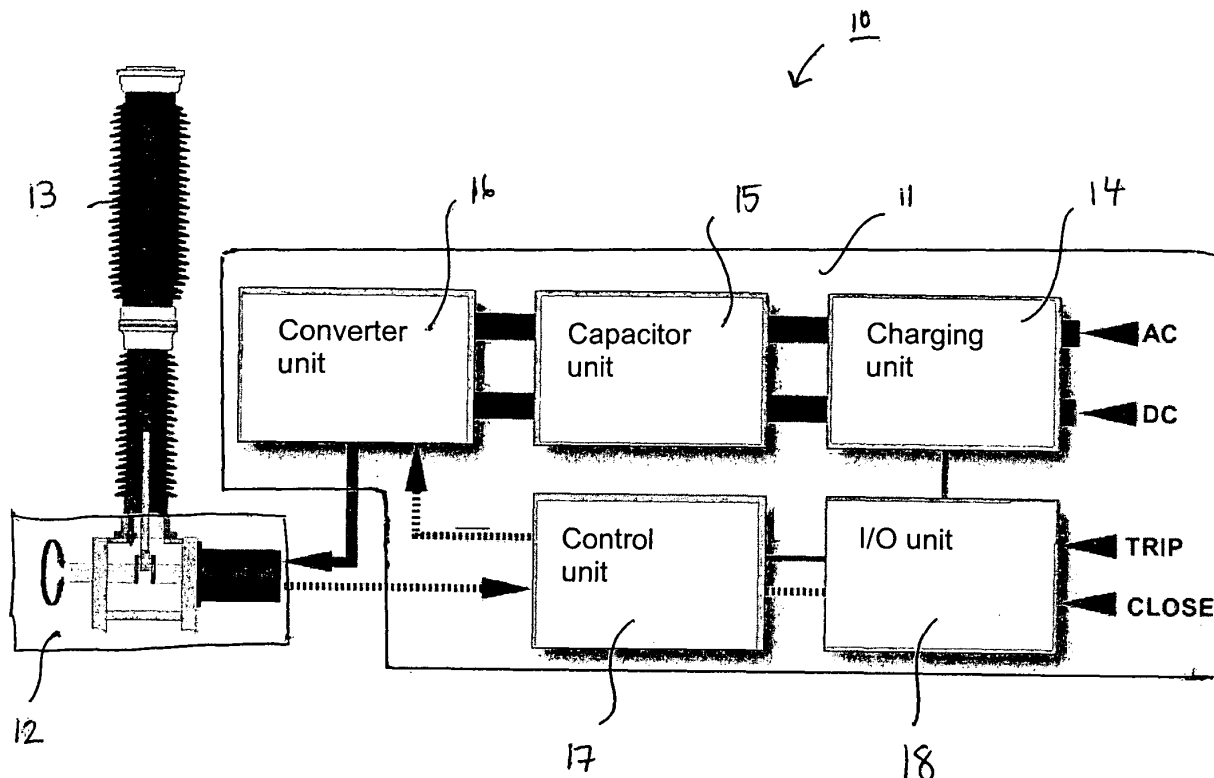
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A request for correction of drawing has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) **Power backup in a drive unit for a circuit breaker, and a circuit breaker**

(57) The invention relates to a drive unit (11) for a circuit breaker (10). The drive unit comprises a control unit (17) for controlling opening and closing operations

of the circuit breaker. The drive unit is characterised in that it comprises a separate power backup unit (19) for providing power backup to the control unit during a power failure.

**Fig. 2****EP 1 986 302 A1**

Description

Field of the invention

[0001] The invention generally relates to the field of high voltage circuit breakers. In particular, the invention is related to an improved means for keeping a drive unit of a circuit breaker drive system energized during power failure.

Background of the invention

[0002] Protective relays are used throughout electrical power distribution systems for providing protection and control. The protective relays detect and isolate faults on transmission and distribution lines by opening and closing circuit breakers. Circuit breakers are thus an important part of power distribution systems and protect the electrical systems from damage caused by for example overload or short circuit. The circuit breaker is operated by a suitable drive system, which performs the opening and closing of the circuit breaker.

[0003] The circuit breaker comprises contact devices arranged to interrupt the currents and a mechanism for opening and closing the contact devices. Figure 1 illustrates a known three-pole circuit breaker. The circuit breaker comprises three breaker poles 1, 2, 3 each having a circuit breaker contact device. The three poles 1, 2, 3 of the circuit breaker are mounted on a common support frame 4, which also supports the mechanism for opening and closing the contact devices. The mechanism is in the illustrated case a motor 5 controlled by a drive unit 6.

[0004] In case of an interrupted power supply to the drive unit 6 it is desirable to keep the drive unit 6 energized for a short period of time even during such complete power failure. For example, it may be desirable to be able to use the closing and opening function of the circuit breaker, i.e. to operate the motor 5, at least a few times even during the power failure.

[0005] The drive unit 6 is therefore kept energized for a short period of time even after a power failure. This is, in the prior art solution, accomplished by using an energy storage unit and an energy-charging unit of the drive unit 6. The energy storage unit and the energy charging unit are in normal operation used for providing operating energy to the motor 5 in order to move the circuit breaker contacts between the open and closed positions.

[0006] However, there are some drawbacks with this prior art solution. During a power failure, the energy for powering the drive unit 6 is thus taken from the energy storage unit used for powering the motor 5. This requires a rather complicated energy-charging unit since it has to be able to charge on one hand the energy storage before operation and on the other hand supply energy from the energy storage to the drive unit 6 during a power failure.

[0007] Further, the energy storage unit is dimensioned so as to meet the requirements for operating the circuit

breaker. This in turn means that the user cannot choose the length of the time period during which the drive unit 6 is self powered after a power failure. To enlarge the energy storage unit, i.e. to over dimension it in order to keep the drive unit 6 energized in case of power failure is an expensive solution.

[0008] In view of the above, it would be desirable to provide an improved means to ensure operation of the drive unit in case of a power failure of the main supply.

Summary of the invention

[0009] It is a general object of the invention to provide improved power backup means for a drive unit of a high voltage circuit breaker, overcoming or at least alleviating the above-mentioned drawbacks with the prior art.

[0010] It is an object of the invention to provide a power backup means for a drive unit of a high voltage circuit breaker, wherein the energy charging unit used for driving an opening and closing mechanism of a circuit breaker is simplified.

[0011] It is another object of the invention to provide a more cost-efficient drive unit of a high voltage circuit breaker.

[0012] It is still another object of the invention to provide a power backup means for a drive unit of a high voltage circuit breaker, wherein the operational duration of the drive unit during a power failure is variable in accordance with specific needs of a user.

[0013] It is yet another object of the invention to provide a power backup means for a drive unit of a high voltage circuit breaker providing improved security for on-site maintenance work.

[0014] These objects, among others, are achieved by a drive unit for a circuit breaker and by a circuit breaker as claimed in the independent claims.

[0015] In accordance with the invention, a drive unit for a circuit breaker is provided. The drive unit comprises a control unit for controlling opening and closing operations of the circuit breaker. The drive unit is characterised in that it comprises a separate power backup unit for providing power backup to the control unit during a power failure. In accordance with the invention, the energy storage unit of the drive unit is used only for operating the circuit breaker, whereby no energy needs to be taken from the energy storage unit in order to drive the control electronics. Further yet, no special charging unit is required and a simplified charging unit can be used. This provides a more cost-efficient solution. Still further, the separate power backup unit makes it possible to customise the hold up time of the control electronics in case of a power failure.

[0016] In accordance with an embodiment of the invention, high capacitive capacitors are used as the separate power backup unit. This provides a reliable power backup having a long service life and being able to withstand varying outdoor temperatures. Further, the use of high capacitive capacitors makes it possible to perform

a discharge operation of the energy in the energy storage unit in case of a service of the circuit breaker even during a complete power loss. The discharge can be made through the motor and the discharge can be performed fast. An improved security is thereby provided and it is possible to perform a service at shorter notice than in the prior art solution, where the energy storage unit has to self discharge during several hours.

[0017] In accordance with another embodiment of the invention, the separate power backup unit is arranged to also power a display unit of the drive unit. Important information may thereby be shown also in case of a power failure.

[0018] Further embodiments of the invention are defined in the dependent claims.

[0019] In accordance with a further aspect of the invention a circuit breaker is provided comprising a drive unit as above, whereby advantages similar to the above are achieved.

[0020] Further characteristics of the invention and advantages thereof will be evident from the detailed description of embodiments of the present invention given hereinafter and the accompanying figures, which are only given by way of illustration.

Brief description of the drawings

[0021]

Figure 1 illustrates a prior art drive system for a circuit breaker.

Figure 2 illustrates a drive system in accordance with an embodiment of the present invention.

Figure 3 illustrates schematically the setup of the separate powering device in accordance with the invention.

Detailed description of embodiments

[0022] The operating mechanism or actuator means for opening and closing the contact devices of the circuit breaker can be of different types, for example implemented by a spring, or hydraulic or pneumatic technologies or of a motorized type. The present invention is related to motorized drive systems, wherein the servomotor driving the operating actuator of the circuit breaker is controlled via electronics. The servomotor is used to directly drive the operating actuator of the circuit breaker.

[0023] Figure 2 illustrates an embodiment of a circuit breaker 10 in accordance with the present invention. The circuit breaker 10 comprises a drive unit 11, an energy transmission 12 and one or more circuit breaker poles 13 (only one shown in the figure). The breaker pole 13 comprises contact devices for opening (tripping) and closing the circuit breaker 10.

[0024] The energy transmission 12 is arranged to open

and close (trip and close) the circuit breaker contacts. The energy transmission 12 comprises a servomotor directly or by mechanical links moving the circuit breaker contacts. A control unit 17 of the drive unit 11 digitally controls the servomotor. A motor resolver is the interface between the control unit 17 and the servomotor. The connections between the different parts are indicated in the figure by arrows.

[0025] The invention is concerned with the drive unit 11 of the circuit breaker 10. The drive unit 11 comprises a charging unit 14, an energy buffer, which is in the following denoted capacitor unit 15, a converter unit 16, a control unit 17 and an I/O (input/output) unit 18.

[0026] The capacitor unit 15 provides feeding current to the servomotor of the circuit breaker 10. The capacitor unit 15 comprises a number of series/parallel connected electrolytic capacitors. For example, the capacitor unit 15 may comprise two groups connected in series, and wherein each group consists of 6 capacitors connected in parallel. The number of capacitors is chosen in dependence on the load and in order to meet the requirements for operating sequences specified in international standards.

[0027] The charging unit 14 is arranged to charge the capacitor unit 15. When a circuit breaker operation is performed, power is drawn from the capacitor unit 15. The voltage thereby decreases and the charging unit 14 is then activated for recharging the capacitor unit 15. The charging unit 14 is connected to a main supply (ac) and an additional supply (dc) serving as a backup.

[0028] The converter unit 16 converts the dc voltage from the capacitor unit 15 to a controlled switched ac voltage required by the servomotor.

[0029] The control unit 17 comprises one or more microprocessors for controlling the function of the circuit breaker 10. Examples of such functions include: to control and regulate the motor during operation, to take care of the communication, to monitor, the I/O functionality etc.

[0030] The I/O unit 18 provides an interface between the drive unit 11 and the user. Trip and close commands (indicated in the figure by a respective arrow) are received from a substation or a control centre and forwarded to the control unit 17, which then effectuates the required operations by transmitting suitable signals.

[0031] In accordance with the invention, the drive unit 11 further comprises a power backup unit 19 for powering the control unit 17 during a power failure. It is thereby possible for the motor drive to be operational for some time even though the main supply to the drive unit 11 is lost.

[0032] Figure 3 illustrates schematically the arrangement of the separate power backup unit 19 of the drive unit 11. The power backup unit 19 is connected to the charging unit 14 and to the control unit 17.

[0033] The power backup unit 19 preferably comprises one or more high capacitance capacitor modules, which have a high energy density when compared to common capacitors. A high capacitance capacitor is charged very

fast and provides a reliable operation. Further, it is suitable for use in environments with temperatures ranging from -50°C and +70°C, has favorable maintenance costs and also has a long service life. A high capacitance capacitor module may have values in the range of a few Farad (F) up to as much as 500 F.

[0034] By charging a bank of high capacitance capacitors, which are, as indicated above, placed on the power supply (e.g. 15 V) to the electronics of the control unit 17, an energy buffer is created. The energy in the energy buffer is then used by allowing a small drop in voltage on the power supply at power loss. This drop in voltage is compensated for by the electronics. With this solution only passive components are needed for the charging of the energy buffer and the charging unit 14 can be simplified. In particular, the charging unit 14 is simplified since it is only required to give a single voltage for the supply of electronics in the drive unit 11. No special charger is needed for the backup energy bank except some passive components for limiting the charging current to the backup. The present invention thus gives a cheaper design.

[0035] In another embodiment of the invention, the power backup unit 19 comprises batteries of lead acid, lithium-ion, NiMH or other type. However, as most users require a long service time of the equipment and also equipment that can withstand varying outdoor temperatures, the high capacitance capacitor modules are preferred.

[0036] The present invention also enables the customizing of the "holdup time", i.e. the time during which the control unit 17 is operable even in case of a power failure on the main supply. By adding more capacitors or larger capacitors, the user can achieve an increased service time of the motor drive during a complete loss of supply.

[0037] The power backup unit 19 may be arranged to also power a display unit of the drive unit 11. In accordance with the state of the art the control panel of a drive unit does not display any information during a power failure, since it is not powered during such failures. In accordance with the invention, the power backup unit 19 can be connected so as to also power a local user control panel (not shown in the figures). The whole control panel may be energized or only parts of it.

[0038] The present invention also brings about an improved security for performing maintenance work on the circuit breaker 10. In the prior art it is not possible to perform a discharge operation of the capacitor unit 15, when there is no supply power, since it is needed for providing backup energy to the control unit 17. A self-discharge would require several hours. In accordance with the invention, the capacitor unit 15 can be discharged very rapidly through the servomotor. Such discharge can be done within a minute, or even within approximately 30 seconds. Faults can thus be repaired quickly and an improved security is provided during the on-site maintenance.

[0039] In accordance with the invention, the power

backup unit 19 is a separate unit. In this context, the word "separate" is to be interpreted that the power backup unit 19 is provided so as to have the sole task of providing a backup energy to the drive unit 11 in case of a power failure. That is, the power backup unit 19 is normally not used during the usual operation of the circuit breaker 10.

[0040] The circuit breaker 10 described above is preferably a high voltage circuit breaker, suitable for outdoor use. By "high voltage" is generally meant, in power transmission work, 72,500 V and higher.

Claims

1. A drive unit (11) for a circuit breaker (10) comprising a control unit (17) controlling opening and closing operations of said circuit breaker (10), **characterised in that** said drive unit (11) comprises a separate power backup unit (19) for providing power backup to said control unit (17) during a power failure.
2. The drive unit (11) as claimed in claim 1, wherein said separate power backup unit (19) comprises one or more high capacitance capacitor modules.
3. The drive unit (11) as claimed in claim 1 or 2, wherein said separate power backup unit (19) is connected to a charging unit (14) of said drive unit (11).
4. The drive unit (11) as claimed in claim 3, wherein said separate power backup unit (19) is arranged to be charged during normal operation of said circuit breaker (10).
5. The drive unit (11) as claimed in any of the preceding claims, wherein said drive unit (11) further comprises a control panel for displaying information and wherein said separate power backup unit (19) is arranged to also power said control panel during a power failure.
6. The drive unit (11) as claimed in any of claims 3-5, wherein said charging unit (14) is arranged to charge an energy buffer unit (15), said energy buffer unit (15) in turn being arranged to power a servomotor arranged to effectuate said opening and closing operations of said circuit breaker (10).
7. The drive unit (11) as claimed in claim 6, wherein said energy buffer unit (14) is connected to said servomotor via a converter unit (16).
8. The drive unit (11) as claimed in claim 6 or 7, wherein a resolver in said servomotor constitutes an interface between said servomotor and said control unit (17).
9. The drive unit (11) as claimed in any of the preceding claims, wherein said circuit breaker (10) is a high-

voltage circuit breaker.

- 10.** A circuit breaker (10) comprising a drive unit (11) for controlling opening and closing operations of said circuit breaker (10), said drive unit (11) comprising a charging unit (14) and an energy buffer unit (15), wherein said charging unit (14) is arranged to charge said energy buffer unit (15), and said energy buffer unit (15) in turn being arranged to power a servomotor arranged to effectuate said opening and closing operations of said circuit breaker (10), **characterized by** that said drive unit (11) comprises a separate power backup unit (19) for providing power backup to said control unit (17) during a power failure.
- 11.** The circuit breaker (10) as claimed in claim 10, wherein said separate power backup unit (19) comprises one or more high capacitance capacitor modules.
- 12.** The circuit breaker (10) as claimed in claim 10 or 11, wherein said separate power backup unit (19) is connected to said charging unit (14) of said drive unit (11).
- 13.** The circuit breaker (10) as claimed in claim 12, wherein said separate power backup unit (19) is arranged to be charged during normal operation of said circuit breaker (10).

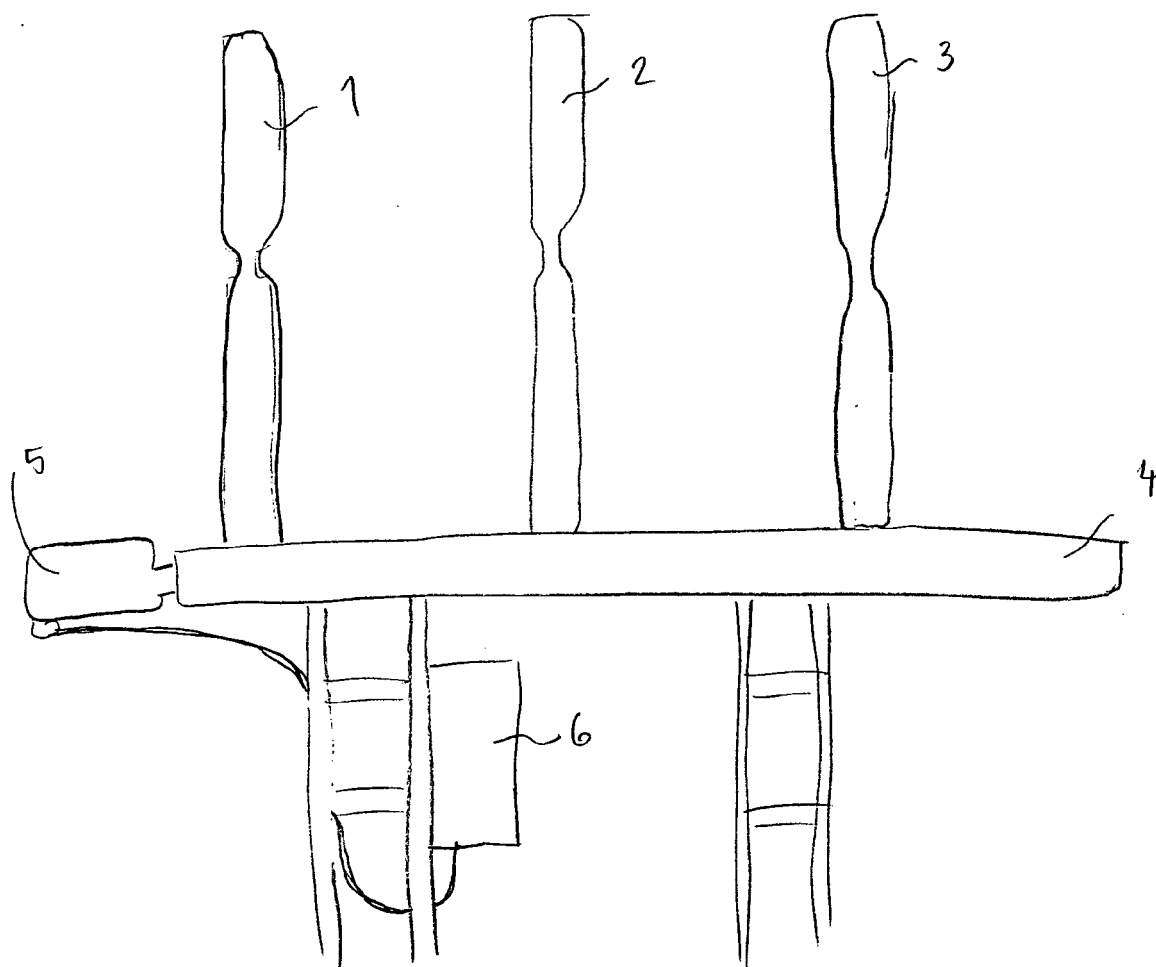


Fig. 1

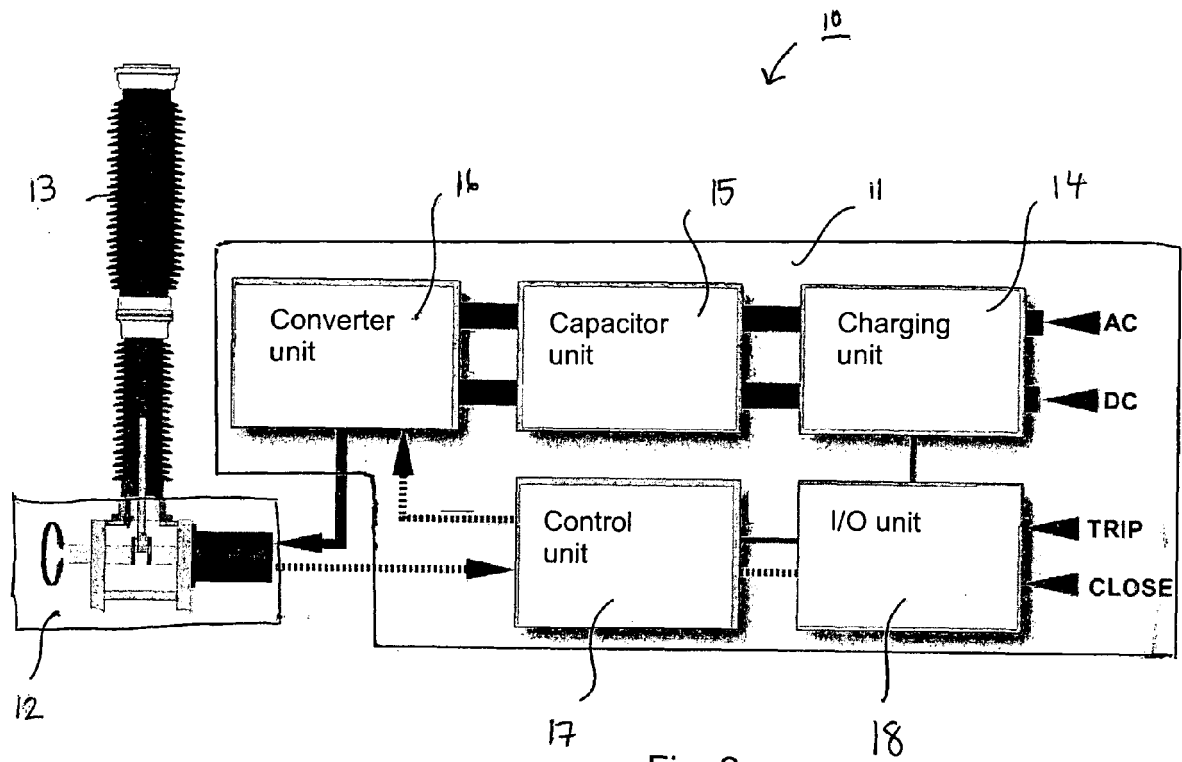


Fig. 2

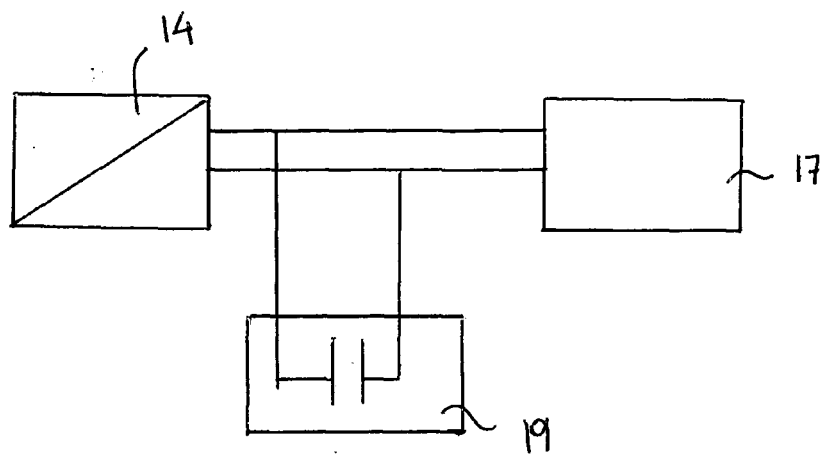


Fig. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 44 5016

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Munich		31 August 2007	Drabko, Jacek
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.92 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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