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DESCRIPTION

Technical field

[0001] The present disclosure relates to a power supply electric vehicle charging station having a connection from high and extra high voltage networks of 60 kV to 800 kV.

Background

[0002] The electrical vehicle charging station is a key infrastructure component for the transportation economy based on electrical energy.

[0003] The foreseen technical requirements of the charging stations include: large geographic coverage, enough power supply, economic efficiency, fast charging times and, high reliability and availability.

[0004] The installation of charging stations in large urban geographic areas has been solved by the available electrical distribution systems, with diminish additional investment. On the contrary, on rural and semi-urban geographic regions, the available electrical distribution system is weak or inexistent. The transmission network is present in these areas, where the transmission lines cross several roads and highways in numerous locations.

[0005] Normally, upsizing the local low voltage network to receive a electrical vehicle charging station has a domino effect that initiates a succession of similar upsizing of upstream network levels, in particular at the medium voltage level.

[0006] For example, document US 2017/0174090 A1 describes a utility tower for energy generation, management and distribution, the utility tower comprising: a vertical structure comprising: at least one energy storage, a communication network to communicate power requirements, power quality, power available or any combination thereof; a power source coupled to the at least one energy storage, a controller to calculate at least one power distribution criterion and to control the energy transfer from the at least one energy storage to one or more loads based on the at least one power distribution criterion. Optionally, the power source may be a renewable energy source or an electric grid. The disclosure of US 2017/0174090 A1 has the mentioned disadvantages.

[0007] Document US2012019203A1 discloses an energy storage system for a substation on an electrical power network. The energy storage system is coupled to receive and store electrical power. The stored electrical power may then be used to either charge vehicles or meeting the needs of other discretionary or interruptible loads with an electric propulsion. Document US2012019203A1 does not disclose using one or more power voltage transformers

arranged to supply low voltage receiving power directly from a high or extra high voltage transmission line, bypassing medium voltage network distribution, where high or extra high voltage is 60 kV to 800 kV and low voltage is below 1 kV.

[0008] Document US2016233685A1 discloses a method and a device for controlling a local voltage. The method includes: obtaining a first voltage value of a high-voltage side bus in a local transformer substation; determining a control strategy according to a starting threshold value for a voltage enhancement control, a starting threshold value for an under-voltage load shedding and the first voltage value of the high-voltage side bus; and performing the control strategy to control a charging power of an electric vehicle charging station corresponding to the local transformer substation, so as to control the local voltage of the local transformer substation. Document US2016233685A1 does not disclose using one or more power voltage transformers arranged to supply low voltage receiving power directly from a high or extra high voltage transmission line, bypassing medium voltage network distribution, where high or extra high voltage is 60 kV to 800 kV and low voltage is below 1 kV.

[0009] Document CN206623692U discloses an electric wire network electric automobile charging station of different forms of energy, at least including an electric network electric automobile charging station of different forms of energy unit modules, including a distribution module, energy storage module, distributed forms of energy electrical cell, load, distributed forms of energy electrical cell and electric network control management system. Document CN206623692U does not disclose using one or more power voltage transformers arranged to supply low voltage receiving power directly from a high or extra high voltage transmission line, bypassing medium voltage network distribution, where high or extra high voltage is 60 kV to 800 kV and low voltage is below 1 kV.

[0010] These facts are disclosed in order to illustrate the technical problem addressed by the present disclosure.

General Description

[0011] An electric vehicle charging station comprising a span of a high or extra high voltage transmission line of 60 kV to 800 kV according to the invention is characterised by the features recited in claim 1.

[0012] The present disclosure relates to a power supply electric vehicle charging station having a connection from high and extra high voltage networks of 60 kV to 800 kV networks, further in particular 72.5 kV to 400 kV networks.

[0013] The disclosed electric vehicle charging station for connecting to high or extra high voltage transmission line is able to directly power supply electric vehicle charging stations from extra high voltage networks and high voltage networks by tapping on the line span the three phases of the transmission lines to three-phase power voltage transformers with suitable

voltage ratio, avoiding in between the need for a distribution network avoiding a medium voltage stage, for example 1 kV to 69 kV networks, used for distribution in urban and rural areas.

[0014] By direct feeding the vehicle charging station from the extra high voltage network, the available power to the station is only limited by the installed nominal power of the power voltage transformers and by the short-circuit power at the transmission line tap.

[0015] The system, according to an embodiment, is arranged into three main parts combined according to the power flow: (1) the charging station tap (CST); (2) the charging station substation (CSS) and; (3) the Charging station park (CSP).

[0016] The charging station tap CST, according to an embodiment, includes all high voltage equipment and protection and automation equipment required to safely connect the power transformers to the transmission line and to integrate the high power electric vehicle charging station load into the transmission system. Additionally, according to an embodiment, it includes the communication links and equipment used to remotely operate and monitor the high power electric vehicle charging station.

[0017] The charging station substation CSS, according to an embodiment, includes all power transformers that are part of the high voltage electric vehicle charging station and the several low voltage feeders that will power supply the electric vehicle charging stations. The charging station substation, according to an embodiment, also includes the transformers protection, the low voltage feeder's protection, automation equipment, metering equipment and, the low voltage auxiliary power supply system. Additionally, , according to an embodiment, it includes the local area communication network equipment and communication links. It provides remote communication access to electric vehicle charging stations.

[0018] The charging station park CSP, according to an embodiment, includes the electric vehicle charging station loads (CS) connected to the low voltage feeders provided by the CSS. The CS, according to an embodiment, are series connected to each feeder and its number is limited by the feeder maximum power.

[0019] It is disclosed an electric vehicle charging station for connecting to a span of a high or extra high voltage transmission line, comprising:

a tap for connecting to the span of the transmission line;

a substation fed from said tap comprising one or more power voltage transformers for transforming the high or extra high voltage to a low voltage for feeding electric vehicle chargers;

a plurality of electric vehicle chargers fed from said substation.

[0020] A power voltage transformer, or also referred to as an ASVT, auxiliary services voltage transformer, is an intermediate transformer between a power transformer and a voltage transformer, able to supply at least several kVA at low voltage receiving power directly from a high voltage transmission line, thus enabling the bypass of medium voltage network distribution.

[0021] This kind of transformers combines the voltage ratio and insulation features of a voltage transformer with the power features of a power transformer. They are currently used to provide power to remote substations or, occasionally, remote villages, but are not normally used to power other kinds of loads or have usual application outside these specific situations.

[0022] Examples of power voltage transformers (power VTs) are ABB TIP, in particular for 72.5 - 550 kV; ARTECHE UG, in particular for 72,5 a 550 kV; SIEMENS-TRENCH PSVS, in particular for 123 a 550 kV.

[0023] In an embodiment, the one or more power voltage transformers are station service voltage transformers, auxiliary service voltage transformers, or power VTs.

[0024] In an embodiment, said power voltage transformers comprise a three-phase star-delta power voltage transformers or a three-phase star-star power voltage transformers.

[0025] In an embodiment, said power voltage transformers comprise set of three one-phase power voltage transformers connected as star-delta or a set of three one-phase power voltage transformers connected as star-star.

[0026] In an embodiment, said tap comprises, for each phase of the transmission line:

an insulator for linking a first and a second interrupted conductor points of an interrupted transmission line conductor;

a drop conductor connected between the first interrupted conductor point and said substation;

a shunt connector connected between the second interrupted conductor point and a point of the drop conductor or connected between the first and second interrupted conductor points.

[0027] In an embodiment, said tap is arranged such that, by overhead power line maintenance operation, the substation-connected drop conductor is switchable:

from being connected with the first interrupted conductor point,

to being connected with the second interrupted conductor point,

and vice-versa.

[0028] In an embodiment, said tap is arranged such that, by overhead power line maintenance operation, the shunt conductor is switchable:

from being connected between the second interrupted conductor point and a point of the drop conductor,

to being connected between the first and second interrupted conductor points, or

to being disconnected and removed from said tap.

[0029] In an embodiment, said tap comprises, for each phase of the transmission line:

an insulator for linking a first and a second interrupted conductor points of an interrupted transmission line conductor;

a drop conductor connected between the first interrupted conductor point and said substation;

a shunt connector arranged such that, when connected, the interrupted parts of the transmission line conductor are connected between each other, and, when disconnected or removed, the interrupted parts of the transmission line conductor are disconnected between each other.

[0030] An embodiment comprises a line disconnect switch between the transmission line and the tap, for connecting and disconnecting the substation from the high or extra high voltage transmission line when required, independently of the transmission line being energised or not.

[0031] A line disconnect switch, or high-voltage disconnecter is an off-load circuit disconnecting equipment that has a very low current-interruption capability, normally not being used for normal control of the circuit but for changing the network layout, for example, for maintenance or service purposes. In particular, a line disconnect switch normally lacks an electrical arc suppression mechanism and is intended to be used only after the network has been de-energised.

[0032] However, we have found that the stored magnetic energy in the voltage power transformer can be sufficiently low so that a line disconnect switch may have enough breaking and making capacity to interrupt and to establish the voltage power transformer ferromagnetic core current without the need of a circuit breaker.

[0033] An embodiment comprises a motorized earthing switch for securely earthing the charging station when it is electrically disconnected from the transmission line.

[0034] An embodiment comprises a current transformer for measuring the fault current in case of short-circuit in the high or extra high voltage part of the charging station.

[0035] An embodiment comprises an optical link interruption device for mounting in a transmission line tower adjacent to the tap span of the transmission line, wherein said device comprises a data communication optical link for linking the charging station and both ends of an interrupted optical link.

[0036] In an embodiment, the interrupted optical link is embedded within an earth conductor of the transmission line.

[0037] An embodiment comprises a local area communication network for data linking the charging station equipment.

[0038] An embodiment comprises protection equipment for protecting the charging station from electrical faults, protection equipment for protecting the transmission line from electrical faults of the charging station, and/or protection equipment for protecting the electric vehicle chargers from electrical faults.

[0039] An embodiment comprises data communication links for monitoring and operating remotely the charging station.

Brief Description of the Drawings

[0040] The following figures provide preferred embodiments for illustrating the description and should not be seen as limiting the scope of the invention.

Figure 1: Schematic representation of an embodiment of the disclosed electric vehicle charging station for connecting to a span of a high or extra high voltage transmission line.

Figure 2: Schematic representation of an embodiment of the charging station tap of the disclosed electric vehicle charging station.

Figure 3: Schematic representation of an embodiment of the charging station tap interrupted conductor point connections of the disclosed electric vehicle charging station.

Figure 4: Schematic representation of an electrical layout according to a first embodiment of the charging station tap.

Figure 5: Schematic representation of the electrical layout according to a second embodiment of the charging station tap.

Figure 6: Schematic representation of the electrical layout of the high voltage protection and automation according to a first embodiment of the charging station tap.

Figure 7: Schematic representation of the layout of the data communication circuits using Modbus Communication and according to a first embodiment of the charging station tap.

Figure 8: Schematic representation of the layout of data communication circuits using Ethernet Communication and according to a first embodiment of the charging station tap.

Figure 9: Schematic representation of the layout of data communication circuits using Modbus Communication and according to a second embodiment of the charging station tap.

Figure 10: Schematic representation of the layout of the data communication circuits using Ethernet Communication and according to a second embodiment of the charging station tap.

Detailed Description

[0041] The system, according to an embodiment, is arranged into three main parts combined according to the power flow: (1) the charging station tap (CST); (2) the charging station substation (CSS) and; (3) the Charging station park (CSP).

[0042] The charging station tap CST preferably includes all high voltage equipment and protection and automation equipment required to safely connect the power transformers to the transmission line and to integrate the high power electric vehicle charging station load into the transmission system. Additionally, it preferably includes the communication links and equipment used to remotely operate and monitor the high power electric vehicle charging station.

[0043] The charging station substation CSS preferably includes all power transformers that are part of the high voltage electric vehicle charging station and the several low voltage feeders that will power supply the electric vehicle charging stations. The charging station substation also preferably includes the transformers protection, the low voltage feeder's protection, automation equipment, metering equipment and, the low voltage auxiliary power supply system. Additionally, it preferably includes the local area communication network equipment and communication links. It preferably provides remote communication access to electric vehicle charging stations.

[0044] The charging station park CSP includes the electric vehicle charging station loads (CS) connected to the low voltage feeders provided by the CSS. The CS are preferably series connected to each feeder and its number is limited by the feeder maximum power.

[0045] The CST is placed at some point in the transmission line span. At this location, an insulation string, connected in between points A and B, interrupts the phase conductors. The insulation string length is defined according to the Basic Insulation Level of the transmission line. A conductor is attached to point A and the first insulation column of the high power electric

charging station at point C. The power supply of the high power electric vehicle charging station is made through this conductor. The shunt conductor between point B and D guarantees the transmission line electric continuity.

[0046] This tap arrangement allows making maintenance to the transmission line without placing the high power electric vehicle charging station out of service. The maintenance can be made by removing the conductor connecting point B and D. In case the maintenance is made to the transmission line to the right side of point B, the high power electric vehicle charging station is feed by the transmission line located left to point A by maintaining the connection between point A to C. In case the maintenance is made to the transmission line to the left side of point A, the conductor connecting point A and C is detached from point A and attached to point B.

[0047] Preparing the transmission line for tapping can be made prior to the high power electric vehicle charging station construction by installing the insulation string and connecting point A to B. The tap circuit is preferably connected to the high power electric vehicle charging station through a motorized line disconnecting switch LDS that is used to electrically isolate the station from the transmission line.

[0048] A motorized earthing switch ES is preferably installed close to the LDS to securely earth the station when it is electrically disconnected from the transmission line. In case of maintenance of the LDS, the connection of points A and B ensures the continuity of the operation of the overhead line, during the shutdown of the charging station.

[0049] The optical link available in the transmission line ground wire is preferably interrupted at one of the transmission line adjacent towers to the tap point, and it is installed an optical junction box JB at this location. A communication optical link between the high power electric vehicle charging station and each of the transmission line end substations is preferably established at this location. An optical fiber cable is preferably installed connecting the communication switch SWG located in the high power electric vehicle charging station and the junction box. All communications to the high power electric vehicle charging station are preferably made through this switch and link.

[0050] The communication switch SWG is preferably used to aggregate the Ethernet communication required for remote access and operation of the high power electric vehicle charging station.

[0051] A current transformer CT is preferably installed immediately after the ES to measure the fault current in case a short-circuit occurs in the EHV circuit of CSS or eventually in the power transformers' primary winding. In case the operation principle of the CT is the Faraday Effect, a Merging Unit device is preferably used to provide the protection and automation device PRTG the real-time measurement value according to the IEC 61869-9 standard.

[0052] The protection and automation device PRTG is preferably installed in the CST and used

for the following purposes:

to remotely open or close the motorized line and earth disconnect switches;

to monitor and supervise the line and earth disconnect switch positions and transmit this information to the transmission line end substations;

to detect a short-circuit in the EHV circuit of CSS or eventually in the power transformers' primary winding, using an overcurrent protection that compares the magnitude of the measured current, with a predefined threshold value. In case of a positive detection, it sends an autorecloser inhibit command to the transmission line end substations and also blocks the transmission line manual energization;

to supervise the auxiliary power supply status WD Ret.

[0053] The protection and automation device PRTG is preferably directly connected through an Ethernet link to the communication switch SWG.

[0054] One or more high power electric vehicle charging stations can be tapped to the same transmission line, by properly integrating its operation in the operation of the transmission line.

[0055] The high power electric vehicle charging station is preferably placed in service with prior confirmation of the network operator. To preferably place in service the station, both high voltage circuit breakers from the corresponding transmission line bays must be in open position, then the earthing switch ES is firstly opened and secondly the line disconnecting switch LDS is closed.

[0056] The high power electric vehicle charging station is placed out of service with prior information to the network operator. To place out of service the station, both high voltage circuit breakers from the transmission line bays must be opened, then the line disconnecting switch LDS is firstly open and secondly the earthing switch ES is close. After these operations, the line can be energized by closing of the high voltage circuit breakers from the transmission line bays.

[0057] The operation of the transmission line autoreclose functions at all line ends is preferably conditioned to a permit signal, being permanently sent by the PRTG in all high power electric vehicle charging stations taped to the transmission line. In the absence of at least one these signals, the autoreclose functions are preferably inhibited and no line circuit breaker close command is made after a transmission line fault. The permit signal is preferably suppressed in case the PRTG overcurrent protection operates. The signal is preferably suppressed until it is acknowledged in the tapped high power electric vehicle charging station where the operated PRTG is installed.

[0058] Transmission line energization is preferably made with confirmation, from all tapped

high power electric vehicle charging stations, that either their line disconnect switch is open, or if closed, receiving from the PRTG the autoreclose permit signal and a supervision signal stating that the device is healthy and in operation.

[0059] A first embodiment of the charging station substation includes more than one transformation unit TU. Each unit consists of a power transformer, a low voltage feeder, high power low voltage circuit breakers, protection, automation, and metering equipment.

[0060] The winding group of the transformation unit is preferably Yd to minimise the short-circuit current magnitude in a phase to ground fault. Additionally, it blocks all zero sequence harmonics of voltage and current, i.e. 3rd, 6th, 9th, etc. that flow from the low voltage to the EHV networks and vice versa.

[0061] Alternatively, the winding group of the transformation unit is preferably Yyn for systems that require a neutral connection in the low voltage circuit.

[0062] The high power low voltage circuit breaker CBG_i, being i the transformation unit number, is the main protection device of the low voltage circuit. This includes time delay and instantaneous overcurrent protection functions and overvoltage protection function. Remote operation of the CBG_i is also possible by means of serial or Ethernet communication, depending on the protocol used.

[0063] In case the low voltage circuit breaker CBG_i uses a serial communication protocol, it connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CBG_i directly connects to the communication switch SWG.

[0064] A metering device M_i measures all consumed load connected to bus B_i. This includes the feeder F_i load and the auxiliary power supply load ASP_i. Being i the transformation unit number.

[0065] The metering device M_i are directly connected through an Ethernet link to the communication switch SWG.

[0066] The high power low voltage circuit breaker CB_i, being i the transformation unit number, is the dedicated circuit breaker of feeder i. The feeder supplies a set of charging stations located in the charging station park. This includes time delay and instantaneous overcurrent protection functions. Remote operation of CB_i is also possible by means of serial or Ethernet communication, depending on the protocol used.

[0067] In case the low voltage circuit breaker CB_i uses a serial communication protocol, it connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CB_i directly connects to the communication switch SWG.

[0068] The management of the low voltage circuit breakers CBG_i and CBI is made by the controller CSSC. Remote access and operation of the controller CSSC is possible by means of serial or Ethernet communication, depending on the protocol used.

[0069] In case the controller CSSC uses a serial communication protocol, it connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CBI directly connects to the communication switch SWG and the CSSC directly connects to the communication switch SWG.

[0070] The auxiliary power supply unit ASPU includes an AC/DC converter R and the corresponding DC battery BAT, to provide DC power to all protection, automation and metering devices installed in the high power electric vehicle charging station. The input bus BAC connects to all transformation units buses B_i by the circuits APS_i. In normal operation, only one APS_i circuit is connected to bus BAC, and all the others are open. In case this circuit becomes unavailable, bus BAC will be power supplied by one of the other available APS_i. The output bus BDC provides DC voltage, protected by dedicated mini circuit breakers MCB_j, being j the circuit number, to the following needs:

Communication switch power supply V1 +/-

Controller CSSC and server gateway power supply V2 +/-

Protection and automation device PRTG power supply P +/-

Line and earth disconnect switch mechanical power supply C +/-

[0071] A second embodiment of the charging station substation includes one transformation unit TU, including a power transformer, a low voltage feeder, high power low voltage circuit breakers, protection, automation, and metering equipment.

[0072] The winding group of the transformation unit is preferably Y_d to minimise the short-circuit current magnitude in a phase to ground fault. Additionally, it blocks all zero sequence harmonics of voltage and current, i.e. 3rd, 6th, 9th, etc. that flow from the low voltage to the EHV networks and vice versa.

[0073] The high power low voltage circuit breaker CBG is the main protection device of the low voltage circuit. This includes time delay and instantaneous overcurrent protection functions and overvoltage protection function. Remote operation of the CBG is also possible by means of serial or Ethernet communication, depending on the protocol used.

[0074] In case the low voltage circuit breaker CBG uses a serial communication protocol, it

connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CBG directly connects to the communication switch SWG.

[0075] A metering device M measures all consumed load connected to bus B. This includes the feeders F_i load, being i the feeder number, and the auxiliary power supply load ASP.

[0076] The metering device M is directly connected through an Ethernet link to the communication switch SWG.

[0077] The high power low voltage circuit breaker CB_i , being i the feeder number, is the dedicated circuit breaker of feeder i . The feeder supplies a set of charging stations located in the charging station park. This includes time delay and instantaneous overcurrent protection functions. Remote operation of CB_i is also possible by means of serial or Ethernet communication, depending on the protocol used.

[0078] In case the low voltage circuit breaker CB_i uses a serial communication protocol, it connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CB_i directly connects to the communication switch SWG.

[0079] The management of the low voltage circuit breakers CBG_i and CB_i is made by the controller CSSC. Remote access and operation of the controller CSSC is possible by means of serial or Ethernet communication, depending on the protocol used.

[0080] In case the controller CSSC uses a serial communication protocol, it connects to the server gateway SG to facilitate the serial communication to the Ethernet communication provided by the communication switch SWG. Otherwise, the low voltage circuit breaker CB_i directly connects to the communication switch SWG and the CSSC directly connects to the communication switch SWG.

[0081] The auxiliary power supply unit APSU includes an AC/DC converter R and the corresponding DC battery BAT, to provide DC power supply to all protection, automation and metering devices installed in the high power electric vehicle charging station. The output bus BDC provides DC voltage, protected by dedicated mini circuit breakers MCB_j , being j the circuit number, to the following needs:

Communication switch power supply V1 +/-

Controller CSSC and server gateway power supply V2 +/-

Protection and automation device PRTG power supply P +/-

Line and earth disconnect switch mechanical power supply C +/-

[0082] The electric vehicle charging stations CSi, being i the charging station number, are installed in the charging station park, radially distributed by feeders. The charging stations CSi are power supplied by the AC voltage provided in each feeder. The CSi technology, being dependent on the CSi manufacture, do not affect the high power electric vehicle charging station system. The CSi input voltage tolerance is preferably, at least, 400 V +/-15%. Remote access to the CSi is possible through Ethernet communication that is provided by the CSS.

[0083] The disclosure should not be seen in any way restricted to the embodiments described and a person with ordinary skill in the art will foresee many possibilities to modifications thereof. The above described embodiments are combinable. The following claims further set out particular embodiments of the disclosure.

REFERENCES CITED IN THE DESCRIPTION

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**LADESTATION TIL ELKØRETØJ TIL TILSLUTNING TIL
HØJSPÆNDINGSTRANSMISSIONSLEDNING ELLER
EKSTRAHØJSPÆNDINGSTRANSMISSIONSLEDNING OG
FREM GANGSMÅDE TIL ANVENDELSE DERAFT**

5

PATENTKRAV

1. Ladestation til elkøretøj omfattende et spænd for en
højspændingstransmissionsledning eller
10 ekstrahøjspændingstransmissionsledning på 60 kV til 800 kV, og som
ligeledes omfatter:
et udtag (CST), der er forbundet med transmissionsledningens spænd;
en understation (CSS), der forsynes fra udtaget, omfattende én eller flere
spændingstransformere til omdannelse af højspændingen eller
15 ekstrahøjspændingen til en lavspænding under 1 kV til forsyning af
opladere til elkøretøjer;
én eller flere opladere til elkøretøjer (CSP), der forsynes fra understationen;
hvor den ene eller flere spændingstransformere er indrettet til at levere
lavspænding, hvor der modtages energi direkte fra
20 højspændingstransmissionsledningen, hvorved fordeling over
mellemspændingsnetværket omgås.
2. Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav,
hvor den ene eller flere spændingstransformere er
25 stationsservicespændingstransformere,
hjælpeservicespændingstransformere eller strømspændingstransformere.
3. Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav,
hvor spændingstransformerne omfatter trefasede spændingstransformere
30 med stjerne-trekantsforbindelse eller trefasede spændingstransformere
med stjerne-stjerneforbindelse.

4. Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav, hvor spændingstransformerne omfatter et sæt af tre enfasede spændingstransformere med stjerne-trekantsforbindelse eller et sæt af tre enfasede spændingstransformere med stjerne-stjerneforbindelse.
- 5
5. Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav, hvor transmissionsledningen omfatter én eller flere faser og udtaget omfatter, for hver fase af transmissionsledningen:
- 10 en isolator, der forbinder et første og et andet afbrudt lederpunkt af en afbrudt transmissionslednings leder;
- en dropleder, der er tilsluttet mellem det første afbrudte lederpunkt og understationen;
- en shuntforbindelse, der er indrettet til at kunne tilsluttes mellem det andet afbrudte lederpunkt og et punkt af droplederen, eller mellem det første og
- 15 andet afbrudte lederpunkt.
6. Ladestation til elkøretøj ifølge det foregående krav, hvor udtaget er således indrettet, at, ved vedligeholdelse af luftledningen, den understationsforbundne dropleder kan omkobles: fra at være forbundet
- 20 med det første afbrudte lederpunkt, til at være forbundet med det andet afbrudte lederpunkt, og omvendt.
7. Ladestation til elkøretøj ifølge det foregående krav, hvor udtaget er således indrettet, at, ved vedligeholdelse af luftledningen, shuntlederen kan omkobles:
- 25 fra at være tilsluttet mellem det andet afbrudte lederpunkt og et punkt af droplederen,
- til at være tilsluttet mellem det første og andet afbrudte lederpunkt, eller
- 30 til at være frakoblet og fjernet fra udtaget.

- 8.** Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav, hvor transmissionsledningen omfatter én eller flere faser og udtaget omfatter,
- for hver fase af transmissionsledningen:
- 5 en isolator, der forbinder et første og et andet afbrudt lederpunkt af en afbrudt transmissionslednings leder;
- en dropleder, der er forbundet mellem det første afbrudte lederpunkt og understationen;
- 10 en shuntforbindelse, der er således indrettet, at, når den er tilsluttet, de afbrudte dele af transmissionsledningens leder forbindes med hinanden, og, når den er afbrudt eller fjernet, de afbrudte dele af transmissionsledningens leder kobles fra hinanden.
- 9.** Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav,
- 15 hvilken ladestation omfatter en ledningsafbryderkontakt mellem transmissionsledningen og udtaget, til at koble understationen til eller fra højspændingstransmissionsledningen eller ekstrahøjspændingstransmissionsledningen, når det er påkrævet, uafhængigt af om transmissionsledningen er under spænding eller ej.
- 20
- 10.** Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav, hvilken ladestation omfatter en motoriseret jordslutter til sikker jording af ladestationen, når den er elektrisk frakoblet transmissionsledningen.
- 11.** Ladestation til elkøretøj ifølge et hvilket som helst af de foregående krav, hvilken ladestation omfatter en strømtransformer til måling af fejlstrøm i tilfælde af kortslutning i ladestationens høje eller ekstrahøje spændingsdel.
- 25
- 12.** Ladestation til elkøretøj ifølge et hvilket som helst af kravene 5-8, hvilken ladestation omfatter en optisk forbindelsesafbrydningsanordning til
- 30

montering i et transmissionsledningstårn stødende op til
transmissionsledningens udtags spænd,
hvor anordningen omfatter en optisk datakommunikationsforbindelse til at
forbinde ladestationen og begge ender af en afbrudt optisk forbindelse
5 indlejret i en transmissionslednings afbrudte jordleder.

13. Ladestation til elkøretøj ifølge et hvilket som helst af de foregående
krav, hvilken ladestation omfatter beskyttelsesudstyr til beskyttelse af
ladestationen mod elektriske fejl, beskyttelsesudstyr til beskyttelse af
10 transmissionsledningen mod elektriske fejl på ladestationen og/eller
beskyttelsesudstyr til beskyttelse af opladerne til elkøretøjer mod elektriske
fejl.

14. Fremgangsmåde til anvendelse af ladestationen til elkøretøj ifølge et
15 hvilket som helst af de foregående krav, hvilken fremgangsmåde omfatter
følgende trin:
tilførsel til understationen fra udtaget for at forsyne den ene eller flere
spændingstransformere til transformering af højspændingen eller
ekstrahøjspændingen til en lavspænding til tilførsel til opladeren eller
20 opladerne til elkøretøjer;
tilførsel af den ene eller flere af opladere til elkøretøjer forsynet fra
understationen.

15. Fremgangsmåde ifølge det foregående krav, hvilken fremgangsmåde
25 omfatter følgende trin:
lukning eller åbning af en ledningsafbryderkontakt mellem
transmissionsledningen og understationen til henholdsvis at koble
understationen til/fra højspændingstransmissionsledningen eller
ekstrahøjspændingstransmissionsledningen, uafhængigt af om
30 transmissionsledningen er under spænding eller ej.

DRAWINGS

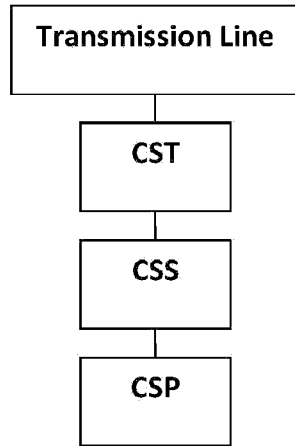


Fig. 1

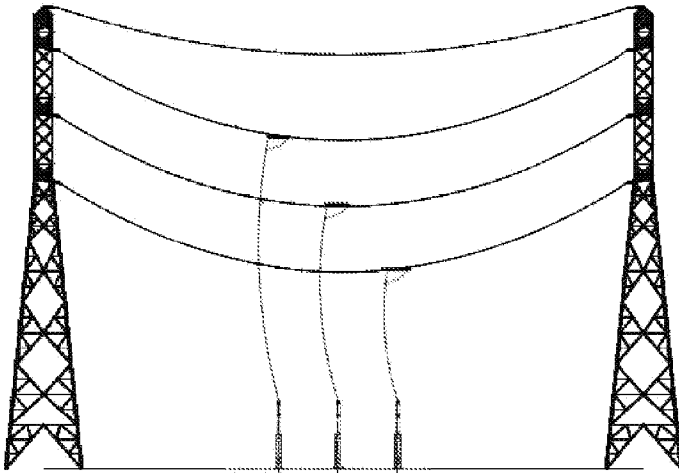


Fig. 2

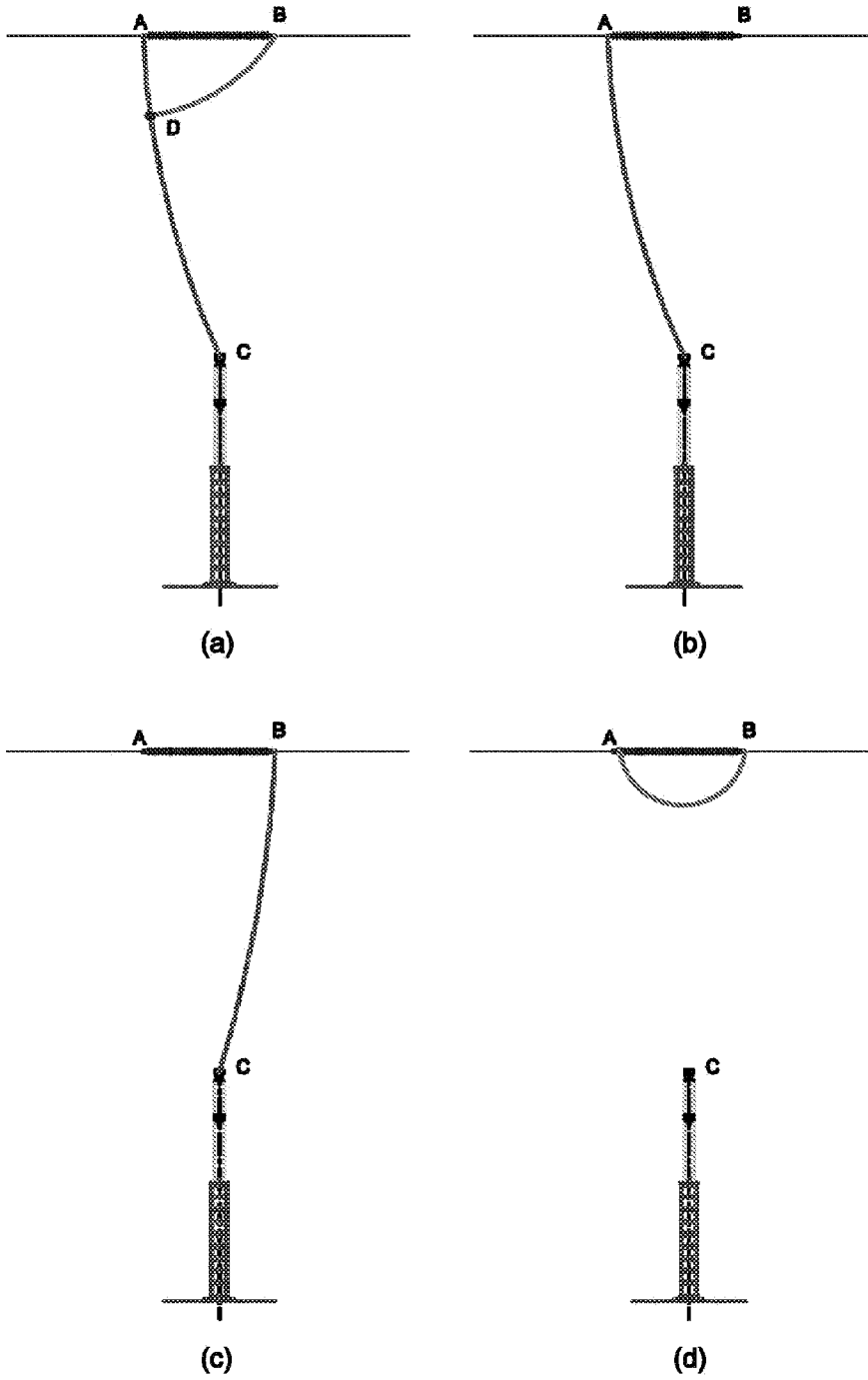


Fig. 3

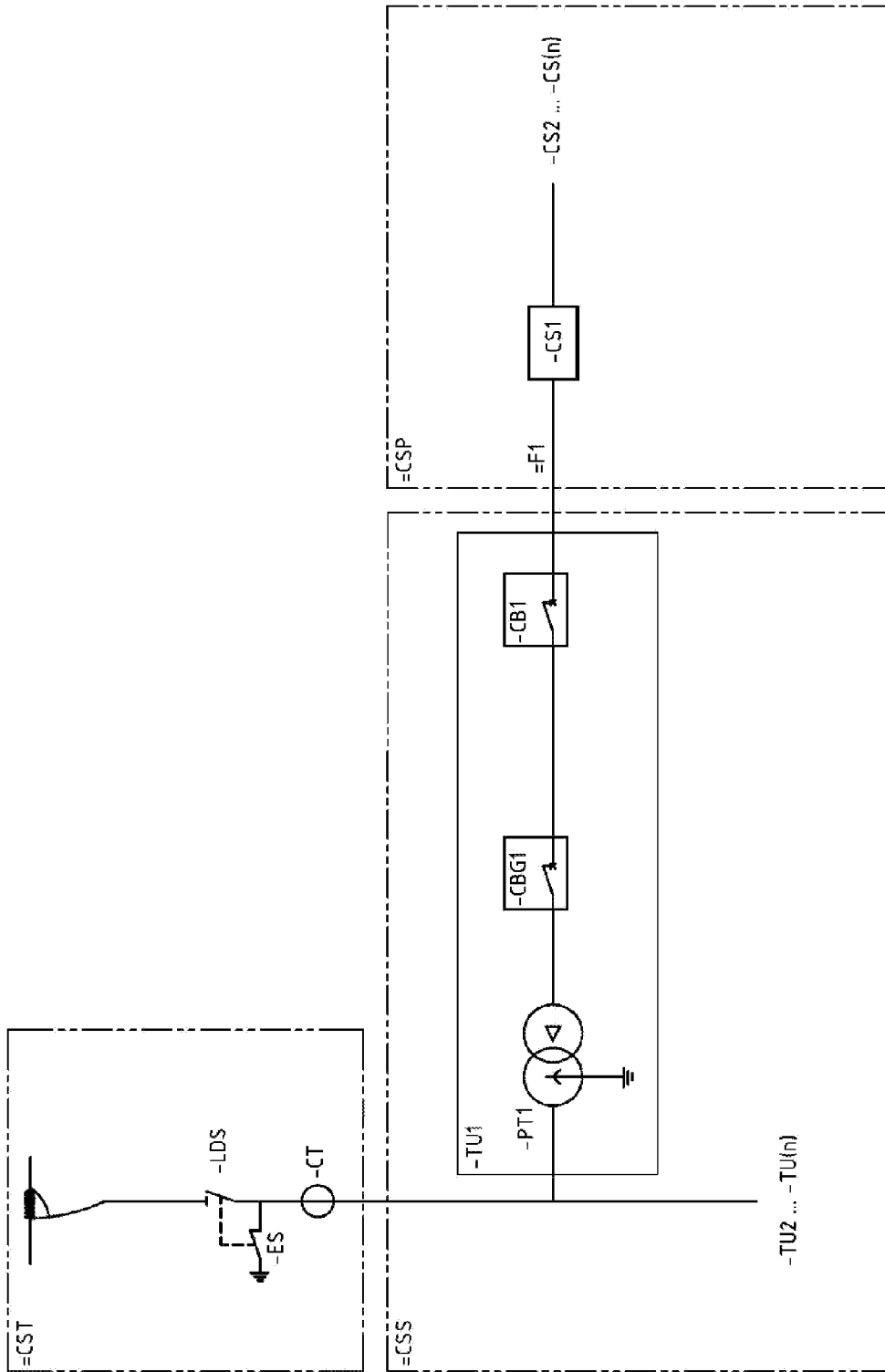


Fig. 4

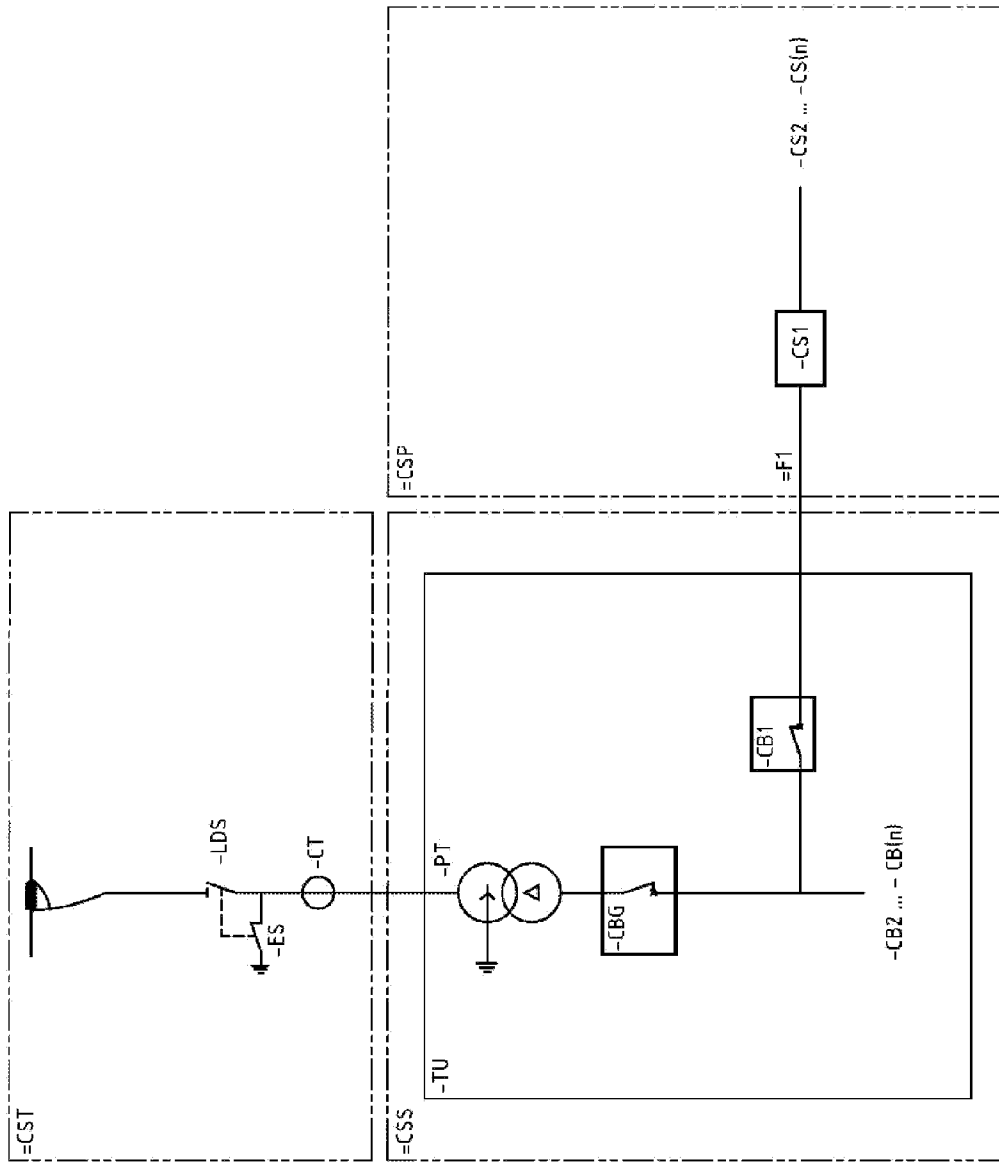


Fig. 5

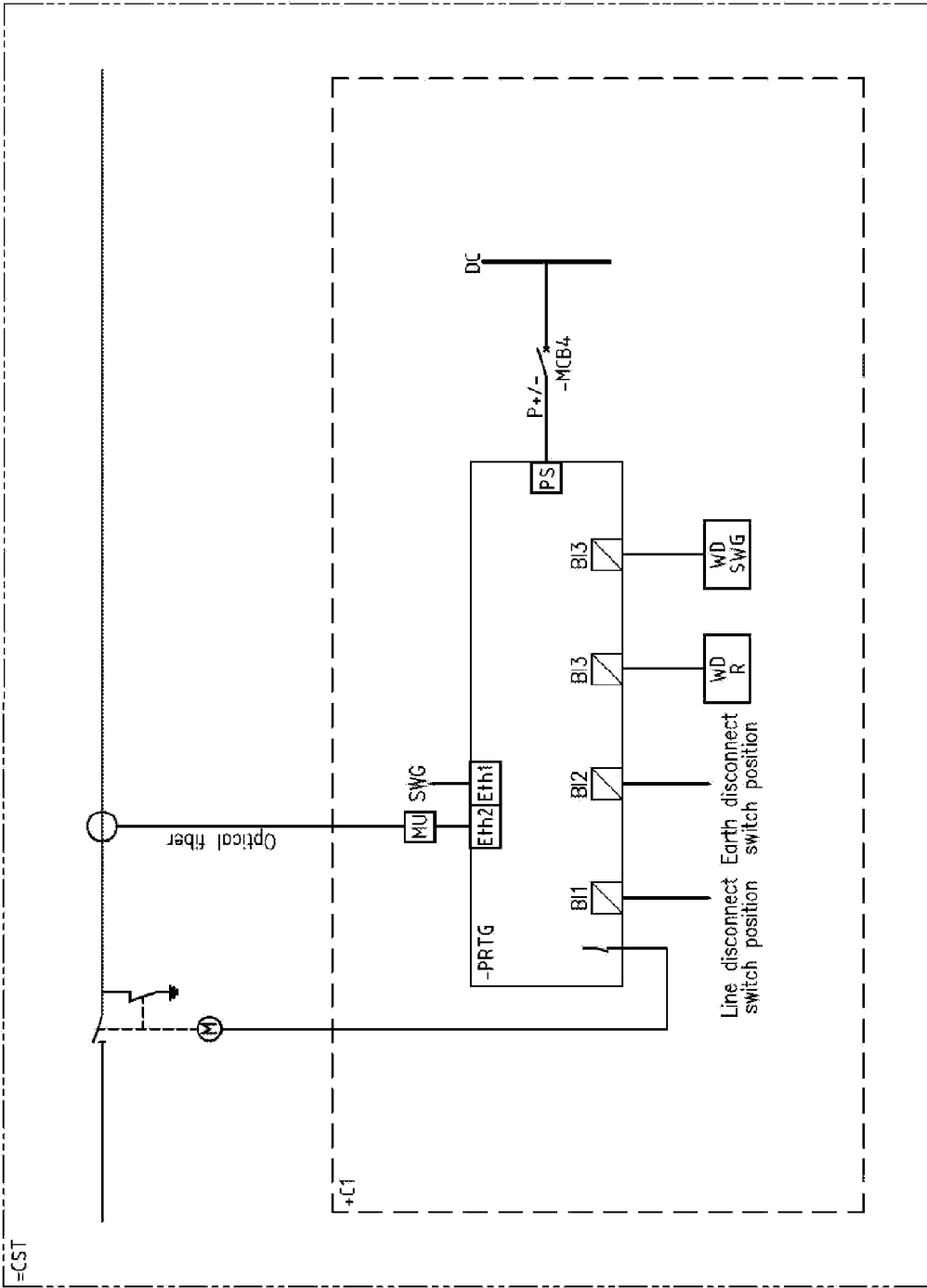


Fig. 6

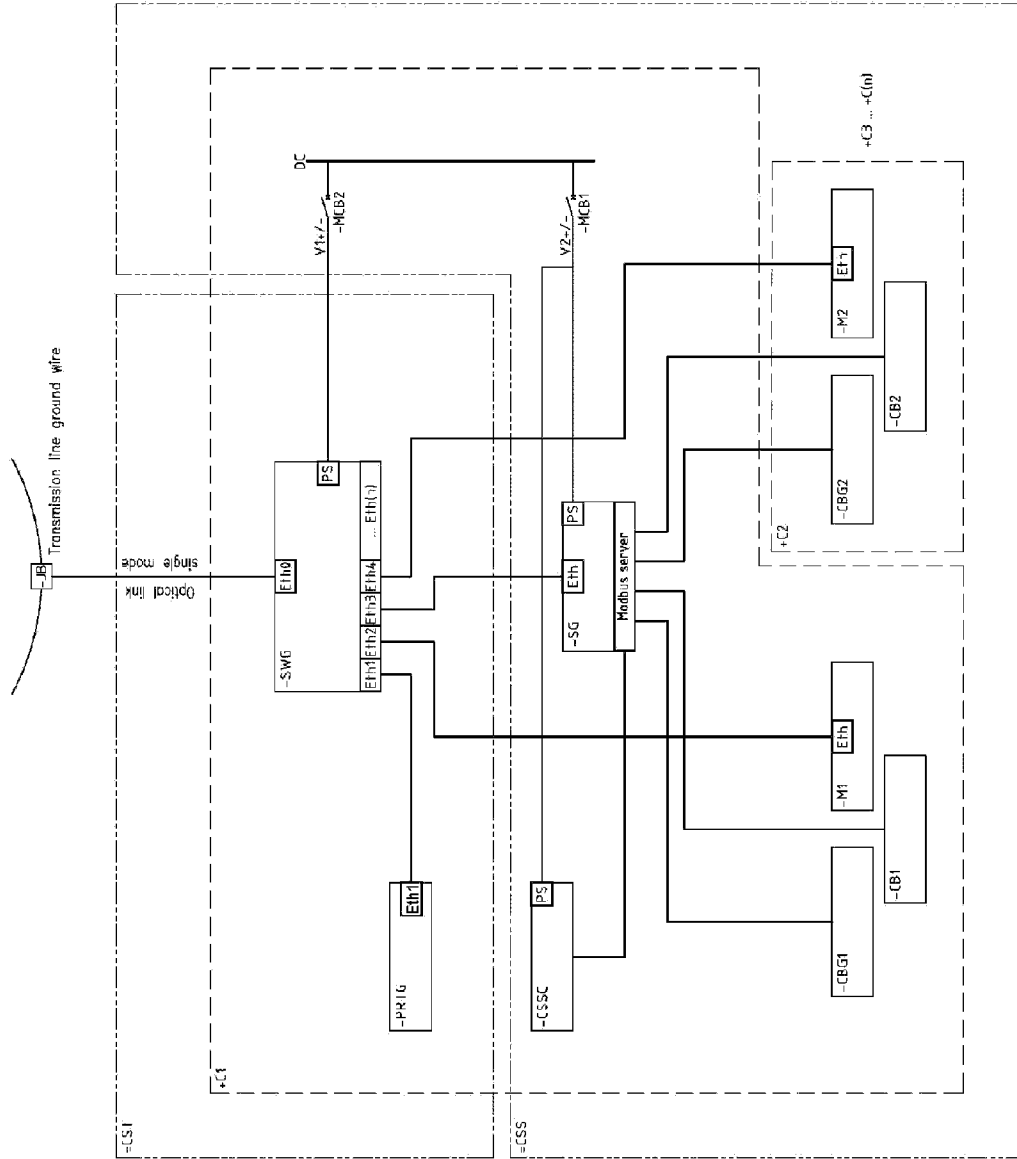


Fig. 7

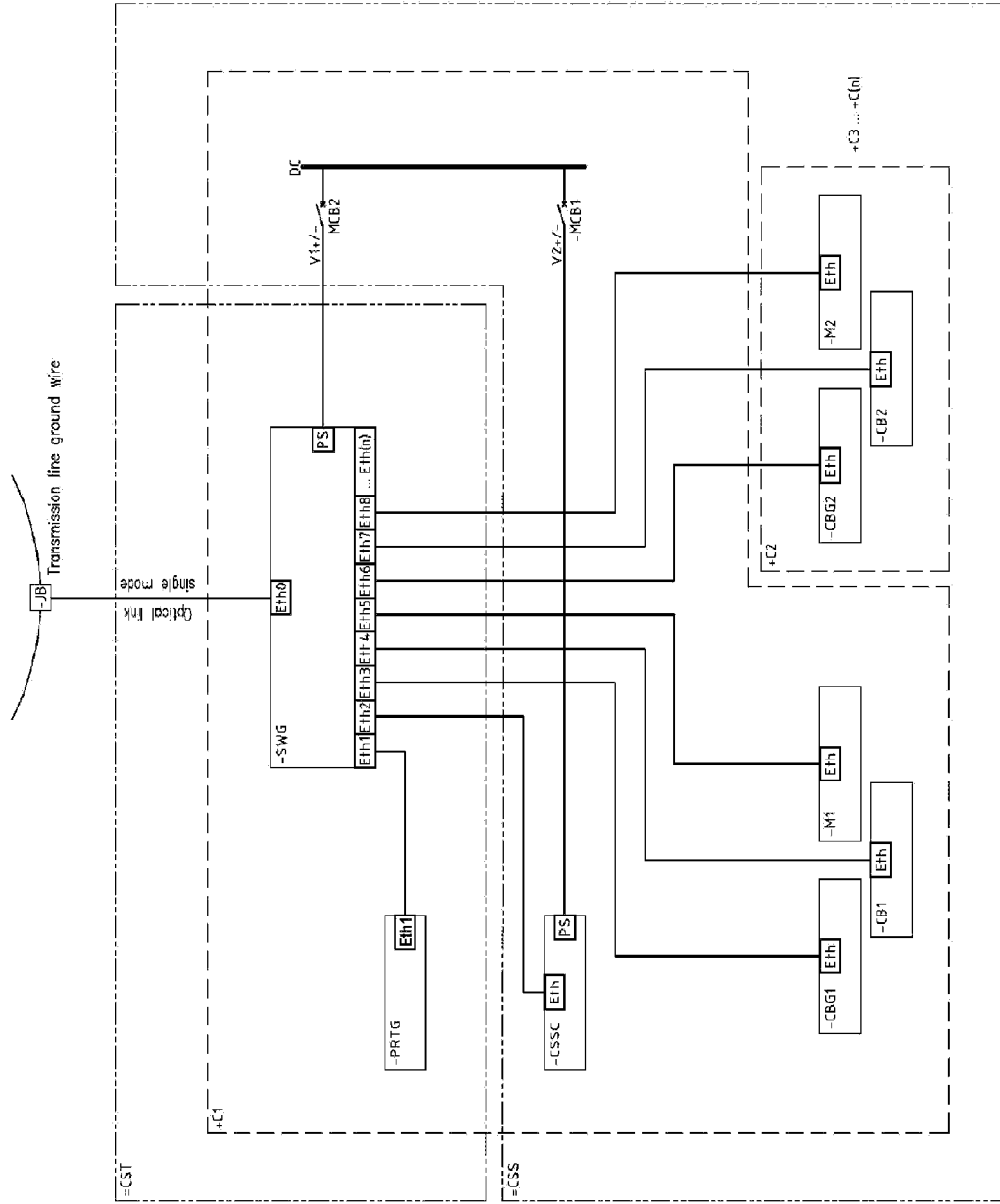


Fig. 8

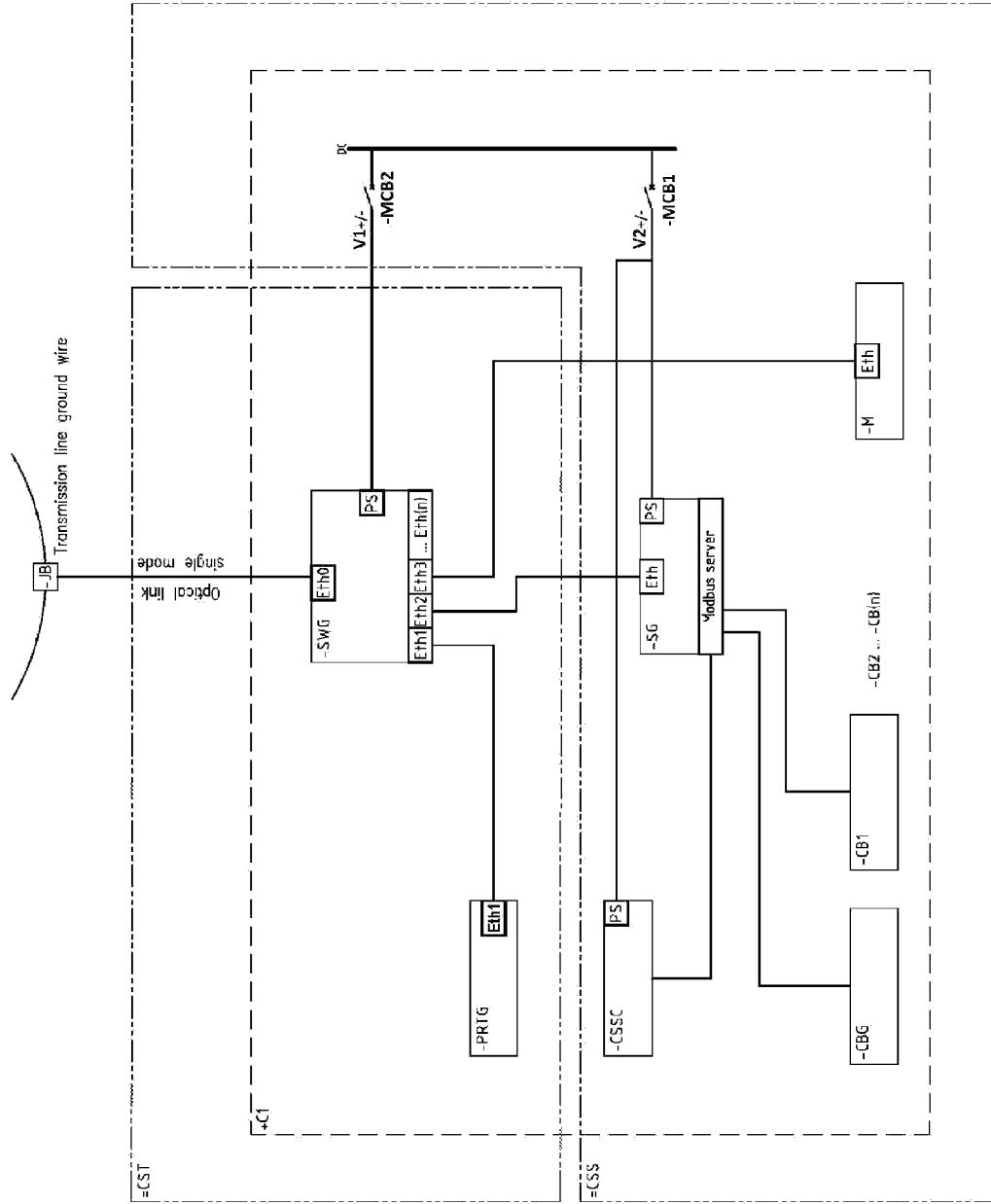


Fig. 9

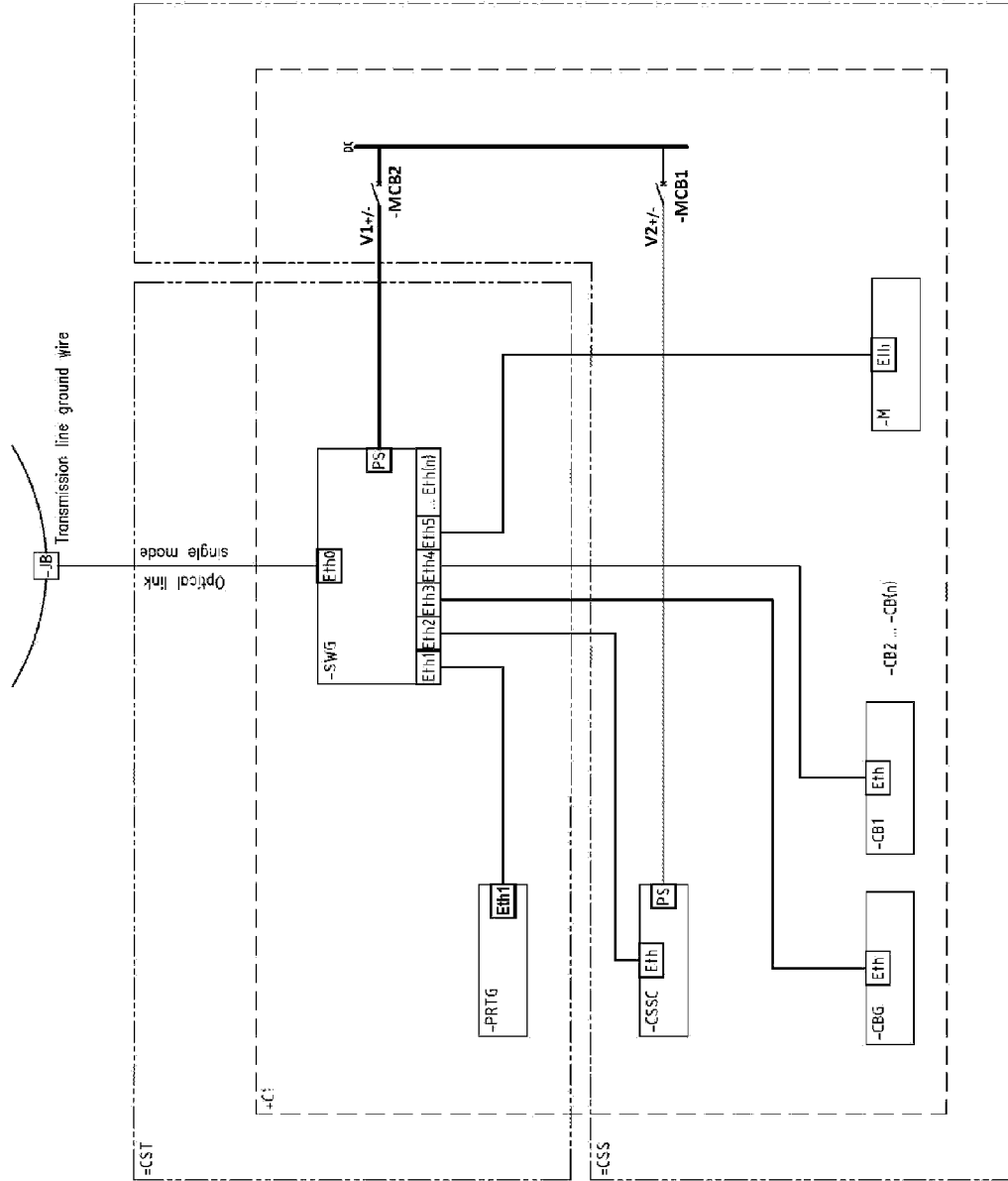


Fig. 10