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(71) Applicant: **ABB ADDA S.p.A.**
20075 Lodi (IT)

(72) Inventor: **Piazza, Costante**
26900 Lodi (IT)

(74) Representative: **Giavarini, Francesco**
ABB Ricerca S.p.A.
Viale Edison, 50
20099 Sesto San Giovanni (MI) (IT)

(54) Switch assembly for high-voltage electric power lines

(57) A switch assembly for high-voltage electric power lines, comprising a supporting base, which is supported by one or more supporting posts, and operating means for actuating a line disconnection maneuver. The switch assembly also comprising on the supporting base and arranged in two lateral rows and a central row:

- six insulating supporting columns, equally divided along the two lateral rows;
- three circuit breakers with a column insulator, mutually aligned along the central row on a substantially vertical plane which is perpendicular to the supporting base, a two-blade disconnector being associated with each one of the circuit breakers, a first one of the blades having an end which is connected to the moving contact of the circuit breaker and a second one of the blades having an end which is connected to the fixed contacts of the circuit breaker, the circuit breaker and the two blades associated therewith being rotatable together about the vertical axis of the circuit breaker, for a possible line disconnection actuated by the actuation means; and
- instrument transformers.

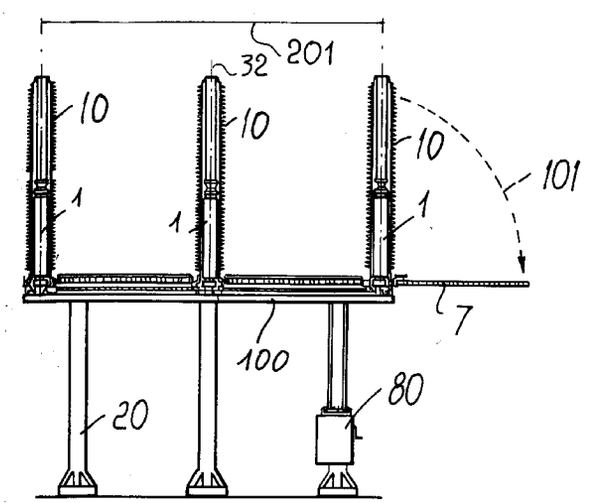

Fig.1

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Description

[0001] The present invention relates to a switch assembly for high-voltage electric power lines having particular characteristics and reduced dimensions.

[0002] It is known that a switch assembly of an electrical station is generally constituted by a supporting structure which comprises one or more posts which support, at a certain distance from the ground, a supporting base; on said supporting base there is provided a plurality of electrical devices, such as circuit breakers, line and grounding disconnectors, voltage transformers and current transformers. In the current state of the art, these devices are assembled on-site on mutually separate supports.

[0003] This solution entails using considerable space, which leads to an increase in the costs entailed for purchasing the land and, bearing in mind the large number of foundations and supports required, to an increase in constructive difficulties especially when the space available is limited and/or preparation of the foundations is difficult due to the very nature of the ground; moreover, the consequent environmental impact is highly negative.

[0004] A considerable factor in determining the space required for the provision of the switch assembly is constituted by line disconnectors, whose main function is to isolate a portion of the circuit from the rest of the system, as known. For high-voltage power lines with voltages higher than certain limits, the disconnectors used are of the column type, in which each column is substantially a ribbed insulator; in particular, in the case of a three-column disconnector, the central column can rotate about its own axis and supports a rigid horizontal arm, the ends of which enter the respective seats supported by the two lateral columns, to which the conductors of the circuit to be isolated are connected. The rotation of the central column and therefore the consequent isolation of a portion of the circuit are achieved by means of conventional lever systems with insulated transmission rods; in particular, the rods that provide the kinematic transmissions must be grounded and remain sufficiently spaced from the under voltage parts even in case of breakage. This type of disconnectors therefore requires a considerable use of space, the negative effect of which is an increase in the environmental impact of the switch assembly and in its production costs; moreover, owing to the large number of air-break insulators that are present, more frequent and difficult maintenance is necessary, especially when the switch assembly is located in particularly polluted regions, such as industrial areas and/or areas close to the sea, where the atmosphere is rich in dust or saline agents.

[0005] A certainly not negligible disadvantage of conventional constructive architectures of switch assemblies resides in the fact that, due to the large dimensions involved and to the spaces required, they do not allow to perform assembly and the associated testing directly at the factory, with subsequent transport to the installation site of the preassembled switch assembly; this of course leads to an increase in production times and costs.

[0006] The aim of the present invention is to provide a switch assembly for high-voltage electric power lines which allows to considerably reduce the space required and in particular combines, in the space currently required by a single three-column disconnector alone, the functions of the circuit breaker, of the line disconnector, of the grounding disconnector, of the current transformer and of the voltage transformer.

[0007] Within the scope of this aim, an object of the present invention is to provide a switch assembly for high-voltage electric power lines which allows to considerably reduce the number of foundations and supports required.

[0008] Another object of the present invention is to provide a switch assembly for high-voltage electric power lines which has reduced dimensions, so as to allow assembly and testing directly in the factory, at least for voltages up to 170 kV, thus reducing assembly times and costs.

[0009] Another object of the present invention is to provide a switch assembly for high-voltage electric power lines which has a reduced environmental impact once installed. Another object of the present invention is to provide a switch assembly for high-voltage electric power lines in which the number of components and parts to be used is reduced.

[0010] Another object of the present invention is to provide a switch assembly for high-voltage electric power lines in which maintenance can be performed simply and rapidly.

[0011] Another object of the present invention is to provide a switch assembly for high-voltage electric power lines which is highly reliable, relatively easy to manufacture and at competitive costs.

[0012] This aim, these objects and others which will become apparent hereinafter are achieved by a switch assembly for high-voltage electric power lines, comprising a supporting base, which is supported by one or more supporting posts, and operating means for actuating a line disconnection maneuver. The switch assembly also comprising on the supporting base and arranged in two lateral rows and a central row:

- six insulating supporting columns, equally divided along the two lateral rows;
- three circuit breakers with a column insulator, mutually aligned along the central row on a substantially vertical plane which is perpendicular to the supporting base, a two-blade disconnector being associated with each one of the circuit breakers, a first one of the blades having an end which is connected to the moving contact of the circuit breaker and a second one of the blades having an end which is connected to the fixed contacts of the circuit

breaker, the circuit breaker and the two blades associated therewith being rotatable together about the vertical axis of the circuit breaker, for a possible line disconnection actuated by the actuation means; and

- instrument transformers.

[0013] In this way a switch assembly is obtained, which is highly compact with an installation layout and a supporting framework which considerably reduce the space required, reducing the number of foundations and supports required in addition to reducing environmental impact.

[0014] Further characteristics and advantages of the invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of the switch assembly according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

- Figure 1 is a side view of a switch assembly for high-voltage electric power lines according to the present invention;
- Figure 2 is a front view of the switch assembly for high-voltage electric power lines according to the present invention; and
- Figure 3 is a top view of the switch assembly for high-voltage electric power lines according to the present invention.

[0015] With reference to the above figures, the switch assembly for high-voltage electric power lines according to the present invention comprises a supporting base 100 which is supported, in the illustrated embodiment, by three posts 20. The number of posts can vary conveniently according to requirements and to the specific needs.

[0016] Three insulating supporting columns 3, three insulating supporting columns 4 and three circuit breakers 1 are respectively arranged on the supporting base 100 along three separate rows, two lateral ones 31 and 30 and a central one 40 respectively. The insulating columns are in practice ribbed insulators which are preferably made of polymeric material.

[0017] -The three circuit breakers 1 are of the type with a column insulator 10, inside which the moving contacts and the fixed contacts, not shown in the figure, are arranged; advantageously, the insulator is made of polymeric material, and this allows to reduce the number of components. The three aligned circuit breakers are arranged along a vertical plane which is substantially perpendicular to the supporting base 100.

[0018] In a preferred embodiment, the circuit breakers comprise, inside the column insulator 10, two springs made of composite material: one spring is meant to open the contacts of said circuit breaker and the other spring is meant to close them. Said circuit breaker is the subject of a pending European Patent Application No. 98204267.3 in the name of the same applicant, the description of which is assumed included herein by reference.

[0019] A line disconnector 21 with two blades, respectively 6 and 6', is associated with each circuit breaker 1. The first blade 6 has an end 9 which is connected to the moving contacts of the circuit breaker 1 and the other end 8 which removably enters a suitable seat supported by an insulating column 3 which is arranged along the row 31; the second blade 6' has instead an end 8' which removably enters a suitable seat supported by an insulating column 4 which is arranged along the row 30 and the other end 9' which is connected to the fixed contacts of the circuit breaker 1; with this solution, the blades are mutually staggered with respect to the vertical axis of the circuit breaker to which they are coupled.

[0020] The grounding disconnectors 7 are also connected to the insulating supporting columns 3.

[0021] A control box 80, which contains suitable operating means, is rigidly coupled to one of the posts 20. Said operating means, by means of transmission systems designated schematically in Figure 3 by the reference numerals 105 and 106, actuate a kinematic chain which allows to perform disconnection if it is necessary to isolate a portion of circuits of which the switch assembly is an integral part. Said operating means and said transmission systems are well known in the art and are therefore not further described. Advantageously, the disconnection maneuver is performed by turning the pole of the circuit breaker 1 about its own vertical axis 32 rigidly with the two blades 6 and 6'. The disconnectors 21 therefore pass from a position, designated schematically by the reference numeral 102 in Figure 3, for connection to a line, to a position, schematically designated by the reference numeral 103 in Figure 3, in which the portion of circuit connected thereto is isolated. A corresponding actuation system turns the grounding disconnectors 7 in the direction indicated by the arrow 101 in Figure 1, allowing to ground the isolated part of the circuit. In the rotation to produce line disconnection, the plane that contains the circuit breaker and the two blades of the disconnector associated therewith rotates, with respect to the position in which the disconnector is connected to the line, by an angle which ensures dielectric separation longitudinally and among the phases. Advantageously, the fact that the blades of each disconnector are mutually staggered allows to obtain the distance required to ensure dielectric separation even with highly compact switch assembly configurations; when disconnection is performed, the rotation in fact causes a blade 6 (or 6) associated with one circuit breaker to face the blade 6' (or 6) associated with the circuit breaker that is adjacent thereto along the row 40 but is vertically staggered and therefore already spaced.

[0022] Closure of the disconnector can be achieved by performing the operation in reverse, thus returning the blades 6 and 6' to the initial position designated by the reference numeral 102.

[0023] With this constructive solution, the circuit breaker 1 performs the function performed by the central column in case of a three-column disconnector; this, together with the above-described geometric arrangement, allows to obtain a symmetry and compactness in the architecture of said switch assembly both when the disconnectors are connected and when they are disconnected.

[0024] In particular, as shown in Figures 1 and 2, and for voltages up to 170 kV, the distance 200 between the two lateral rows 30 and 31 along which the insulating columns are arranged is equal to or less than 2.5 m; the distance 201 between the first circuit breaker and the last circuit breaker on the central row 40 is less than 5 m.

[0025] The switch assembly for high-voltage electric power lines according to the invention is also provided with instrument transformers; in particular, three current transformers 2 and three voltage transformers 5. Advantageously, the current transformers 2 and voltage transformers 5 that are used are of the optoelectronic type; this allows a further reduction in the number of components and parts required for the complete production of the switch assembly. Moreover, in a preferred embodiment shown in Figure 2, each one of the voltage transformers is conveniently accommodated in a corresponding insulating column 4 (or 3), while each one of the current transformers 2 is arranged inside the insulating column 10 of a circuit breaker 1 and is arranged on the fixed part of the moving contacts of the circuit breaker. This solution is particularly advantageous as regards the constructive simplicity and compactness of the switch assembly.

[0026] As an alternative, the current transformers 2 can be arranged on the supporting columns 3 or 4.

[0027] In practice it has been observed that the switch assembly for high-voltage electric power lines according to the present invention fully achieves the intended aim, since it allows to considerably reduce the dimensions involved, thus allowing to reduce the space required and the consequent environmental impact. Moreover, thanks to its reduced dimensions, the described constructive solution allows, even for voltages up to 170 kV, to assemble the switch assembly and test it directly in the factory. Moreover, the adoption of insulators made of polymeric material, combined with an overall reduction in the supports required, allows to reduce the number of components that can be used and facilitates their maintenance.

[0028] The switch assembly for high-voltage electric power lines thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may also be replaced with other technically equivalent elements.

[0029] In practice, the materials used, as well as the dimensions, may be any according to requirements and to the state of the art.

Claims

1. Switch assembly for high-voltage electric power lines, comprising a supporting base, which is supported by one or more supporting posts, and operating means for actuating a line disconnection maneuver, characterized in that it comprises, on said supporting base and arranged in two lateral rows and a central row respectively:

   - six insulating supporting columns, equally divided along the two lateral rows;
   - three circuit breakers with a column insulator, mutually aligned along the central row on a substantially vertical plane which is perpendicular to said supporting base, a two-blade disconnector being associated with each one of said circuit breakers, a first one of said blades having an end which is connected to the moving contact of the circuit breaker and a second one of said blades having an end which is connected to the fixed contacts of the circuit breaker, the circuit breaker and the two blades associated therewith being rotatable together about the vertical axis of said circuit breaker, for a possible line disconnection actuated by said operating means; and
   - instrument transformers.

2. Switch assembly for high-voltage electric power lines according to claim 1, characterized in that said two blades are mutually staggered with respect to the vertical axis of the circuit breaker to which they are connected.

3. Switch assembly for high-voltage electric power lines according to claim 1, characterized in that said instrument transformers comprise three current transformers of the optoelectronic type which are accommodated in the column insulators and are arranged on the fixed part of the moving contacts of the circuit breaker.

4. Switch assembly for high-voltage electric power lines according to claim 1, characterized in that said instrument transformers comprise three current transformers of the optoelectronic type arranged on said insulating supporting columns.

5. Switch assembly for high-voltage electric power lines according to claim 1, characterized in that said instrument transformers comprise three voltage transformers of the optoelectronic type which are arranged on said insulating supporting columns.

6. Switch assembly for high-voltage electric power lines according to one or more of the preceding claims, characterized in that for voltages up to 170

kV the distance between the two lateral rows along which the insulating columns are equally divided is equal to or less than 2.5 m.

7. Switch assembly for high-voltage electric power lines according to one or more of the preceding claims, characterized in that for voltages up to 170 kV the length of the row along which the three circuit breakers are arranged is less than 5 m.

8. Switch assembly for high-voltage electric power lines according to claim 1, characterized in that the column insulators and the insulating supporting columns are made of polymeric material.

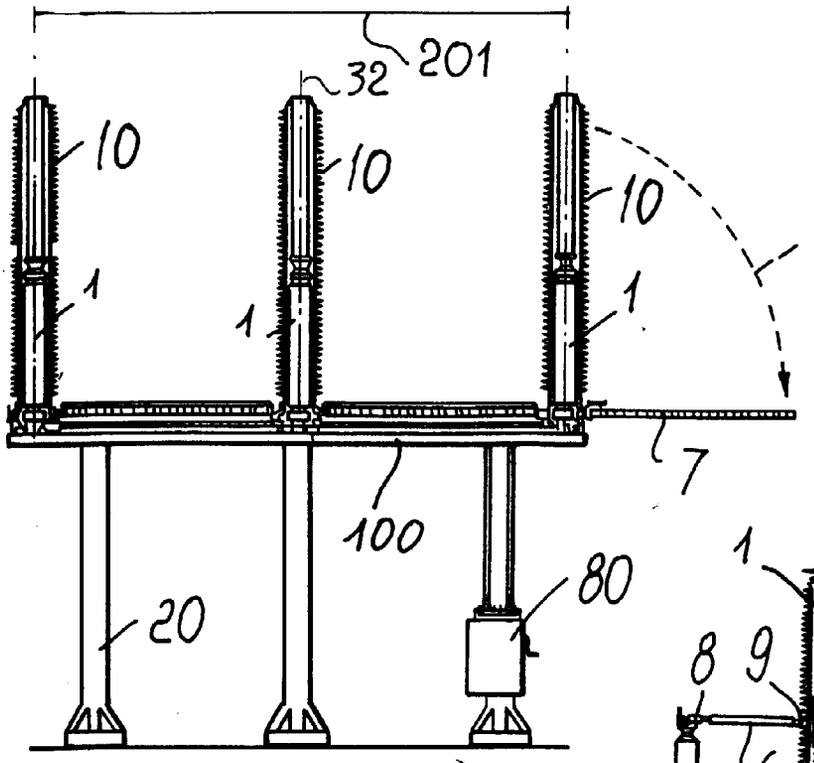

Fig.1

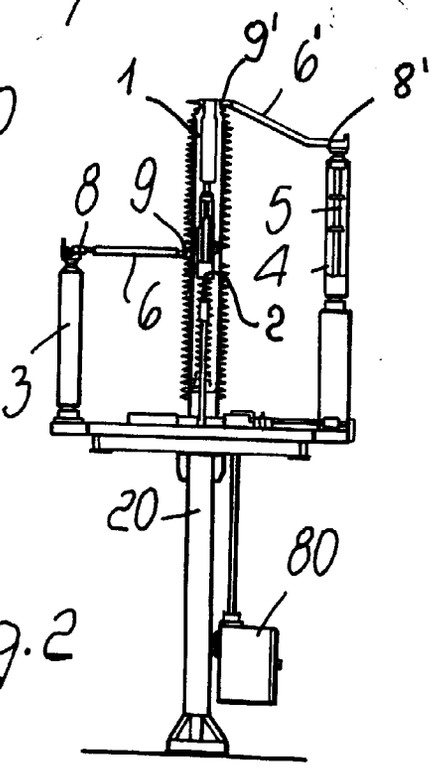

Fig.2

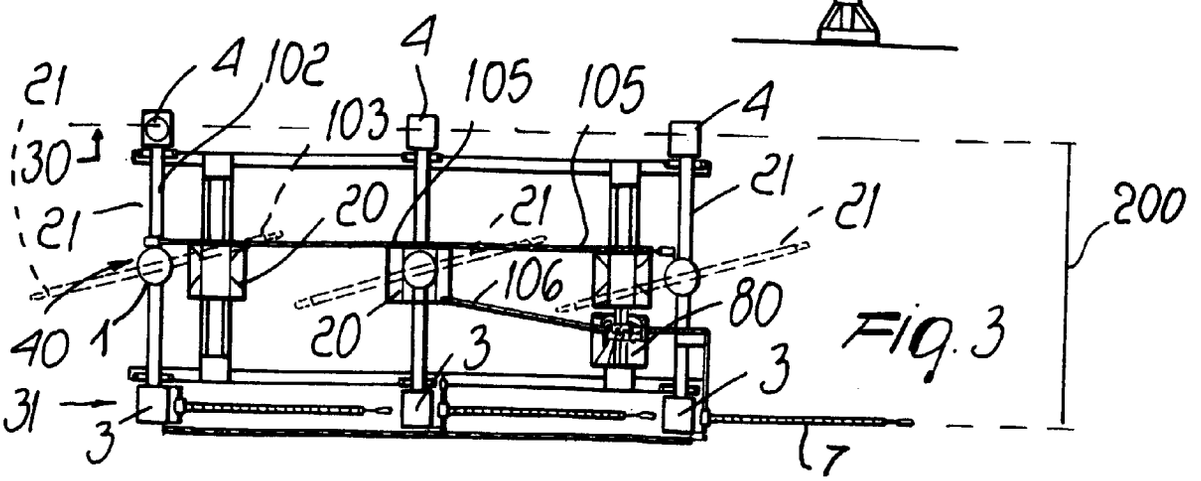

Fig.3