

Switchgear

The invention relates to a switchgear according to the preamble of claim 1.

Switchgears are known which in the case of a short circuit in a line network disconnect the line network from a supply network in order to prevent the further supply of electric current. Such switchgears therefore comprise a so-called short-circuit release apparatus which upon response triggers a mechanical disconnection apparatus which disconnects the switching contacts of the switchgear and prevents further current flow. The short-circuit release apparatus usually acts in a mechanical manner on a mechanical release of the disconnection apparatus.

Short-circuit releases apparatuses are arranged as an electromagnetic apparatus for example, e.g. as an elongated cylindrical coil, in the interior of which a movable armature is arranged. In case of a short-circuit, the current reaches a strength of a few thousand amperes, which makes the armature move, which triggers the disconnection apparatus. The disadvantageous aspect in such short-circuit release apparatuses with an elongated cylindrical coil is the complex construction which leads to complex production and the bearing of the armature within the coil.

DE 10 2006 005697 A1 describes a device for tripping a switchgear which is arranged as a short-circuit release with a U-shaped yoke which is arranged in the region of an input terminal and actuates a hinged armature. DE 100 36 352 A1 discloses a magnetic trip device for circuit breakers with a U-shaped yoke and a hinged armature. US 4 691 182 A discloses a circuit breaker with an adjustable magnetic trip device.

It is therefore the object of the invention to provide a switchgear of the kind mentioned above with which the mentioned disadvantages can be avoided and which has a simple constructional configuration.

This is achieved in accordance with the invention by the features of claim 1.

A switchgear can thus be formed which has a simple constructional configuration. Such a configuration can be built with considerably higher tolerances as compared with the state of the art, with full functionality and operational reliability being ensured. Such a switchgear can therefore be produced at low cost with simple machines.

The dependent claims, which simultaneously form a part of the description like claim 1, relate to further advantageous developments of the invention.

The invention is explained in closer detail by reference to the enclosed drawings which merely show preferred embodiments by way of example, wherein:

Fig. 1 shows a preferred embodiment of a switchgear in accordance with the invention in an axonometric exploded view;

Fig. 2 shows a preferred embodiment of a short-circuit release apparatus and an overcurrent release apparatus together with a first switching contact in a partly sectional axonometric view.

Fig. 3 shows the arrangement according to Fig. 2 in a non-sectional axonometric view;

Fig. 4 shows a detail of the arrangement according to Fig. 2 in a side elevation with a view that is partly broken open in sections;

Fig. 5 shows an arrangement of a preferred embodiment of a short-circuit release apparatus and an overcurrent release apparatus with a disconnection apparatus in a side elevation;

Fig. 6 shows a preferred embodiment of a hinged armature spring in a vertical sectional view, and

Fig. 7 shows the arrangement according to Fig. 2 in a vertical sectional view.

Fig. 1 shows a switchgear 1 which is especially arranged as a power circuit breaker, comprising at least one input terminal 2 and at least one output terminal 3 for connecting electrical conductors, and a first switching contact 4 and a second switching contact, said switching contacts closing, in a closed position, a current path between the input terminal 2 and the output terminal 3, with a disconnection apparatus 5 being provided for disconnecting the first switching contact 4 and the second switching contact, and with a short-circuit release apparatus 7 being provided which is in operative mechanical connection with the disconnection apparatus 5 in order to enable the triggering of the same, and with the short-circuit release apparatus 7 being arranged in the region of the at least one input terminal 3, and with the short-circuit release apparatus 7 comprising at least one U-shaped yoke 8 and a movable hinged armature 9.

A switchgear 1 can thus be formed which has a simple constructional configuration. Such a configuration can be built with considerably higher tolerances as compared with the state of the art, with full functionality and operational reliability being ensured. Such a switchgear 1 can therefore be produced at low cost with simple machines.

Fig. 1 shows a number of modules of a preferred embodiment of a switchgear 1 in accordance with the invention in an axonometric exploded view. It shows an arrangement of a switchgear 1 with three switching paths or current paths. Any predeterminable number of switching paths or switchable current paths can be provided. Preferably, the switchgears 1 in accordance with the invention are provided with one, two, three or four current paths. The same number of

input terminals 2 and output terminals 3 is provided according to the number of current paths. The drawings merely show the parts of the input terminals 2 and output terminals 3 which are fixed to the housing. The respective input terminals 2 and output terminals 3 usually each comprise at least one clamping screw and preferably at least one clamping jaw movable by means of the clamping screw, this being in addition to the illustrated parts.

In the illustrated preferred embodiment, the switchgear 1 comprises an insulating-material housing which in the preferred embodiment comprises a bottom housing shell 23 and an upper housing shell 24. The at least one first switching contact 4 lies in the closed position on the at least one second switching contact which in the illustrated embodiment is arranged in a non-visible way within the module of the arc-quenching chamber 25.

Switchgears 1 in accordance with the invention have a short-circuit release apparatus 7. Figs. 1 to 4 show an especially preferred embodiment of an arrangement consisting of an overcurrent release apparatus 6 and a short-circuit release apparatus 7 which will be described below. It is also possible to provide a short-circuit release apparatus 7 without an overcurrent release apparatus 6, as will be described below.

The short-circuit release apparatus 7 is formed by a U-shaped yoke 8 and a hinged armature 9, with the U-shaped yoke 9 being fastened to a first conductor 10 of the current path which is preferably associated with input terminal 2 and/or the output terminal 3.

When a short circuit occurs, the currents through the switchgear 1 are so high that the U-shaped yoke 8 will attract the hinged armature 9, through which a second lever arm 12 of the hinged armature 9 is deflected and said first second lever arm 12 of the hinged armature 9 causes the further tripping of the disconnection apparatus 5 and consequently the disconnection of the switching contacts 4.

It is preferably provided that the U-shaped yoke 8 is riveted together with the first conductor 10 by means of at least one rivet 30. It can also be provided that the U-shaped yoke 8 is screwed or welded together with the first conductor 10. The U-shaped yoke 8 is formed by comprising a material which causes a concentration and/or reinforcement of the electromagnetic effect, preferably paramagnetic or ferromagnetic materials, comprising iron, stainless steel or so-called dynamo sheets for example.

The hinged armature 9 is rotatably held on the U-shaped yoke 8, with the U-shaped yoke 8 comprising two mounting openings 31 for this purpose, through which a pivot 17 of the hinged armature 9 is guided. Such an arrangement is very easy to produce and very easy and flexible to adjust, and can therefore also be produced with higher production tolerances. The hinged armature 9 comprises in the preferred embodiment a first lever arm 11 and a second lever arm 12, with the first lever arm 11 comprising a contact surface 13 for contact with the U-shaped yoke 8, and the second lever arm 12 is arranged as a tripping projection 14 for the at least indirect tripping of the disconnection apparatus 5.

The contact area 13 is preferably arranged as a planar surface area. It can be provided that the contact area 13 is an area which is integrally arranged with the hinged armature 9. It can be provided however, as is also the case in the illustrated embodiment, that the hinged armature 9 comprises a contact part 32 and the contact area 13 is a part of the contact part 32. The contact part 32 is preferably fastened to the first lever arm 11, preferably riveted to the same. It is preferably provided that at least the contact part 32 is made of a material according to the materials for the U-shaped yoke 8.

The second lever arm 12 is arranged in respect of shape and dimension in such a way that for tripping the disconnection apparatus 5 in the case of a short circuit it acts either directly on the same or at least moves a tripping lever 26 in such a way that said tripping lever 26 triggers the disconnection apparatus, as will be described below in closer detail. The second lever arm 12 which is arranged as a tripping projection 14 for the at least indirect tripping of the disconnection apparatus 5 does not act directly on the disconnection apparatus 5 in the preferred embodiment of the switchgear 1 but via the tripping lever 26. The hinged armature 9, and especially the second lever arm 12, is made of a non-magnetic material, preferably comprising copper or aluminum.

The hinged armature 9 is forced by a hinged armature spring 15 to an idle position as shown in Fig. 3 for example, in which idle position the hinged armature 26 protrudes from the U-shaped yoke 31. The idle position is designated as a position of the hinged armature 26 which is assumed by the same without any short-circuit in the line network. In particular, the second lever arm 12 is pressed against a stop 16 in the idle position, and the first lever arm 11 is pressed away from the U-shaped yoke 8. The stop 16 is formed by a projection 21 which the U-shaped yoke 8 has in the direction of extension of the second lever arm 12. Such a

configuration allows integrating several functions in the U-shaped yoke 8 and it is possible to omit further components.

Any kind of spring can be provided as a hinged armature spring 15, e.g. a leaf spring, a coil spring or a torsion spring. It is preferably provided that the hinged armature spring 15 is arranged as a torsion spring which is arranged about a pivot 17 of the hinged armature 9. The arrangement of the torsion spring about the pivot can securely prevent a loss of the hinged armature spring 15 which would lead to an impairment in the function of the switchgear 1. A projection 21 is arranged on the second lever arm 12 of the hinged armature 9. A first hinged armature spring leg 18 of the hinged armature spring 15 acts on the projection. A second hinged armature spring leg 35 of the hinged armature spring 15 is fixed to the U-shaped yoke 8. It can be provided especially that the U-shaped yoke 8 comprises a receiver 36 for the second hinged armature spring leg. This is shown in Fig. 5.

A pressure spring is provided in a further embodiment of the invention (not shown), which spring presses the hinged armature 9 against the U-shaped yoke 8. It can thus be achieved that no vibrations or humming can occur as a result of the alternating current in the typical supply networks, which vibrations or humming would be produced by continual movement of the hinged armature 9 between the legs of the U-shaped yoke 8. It is preferably provided that pressure spring acts in the direction of the pivot 17 of the hinged armature 9, thus ensuring a substantially moment-free pressure loading of the hinged armature 9. It can thus be prevented that the hinged armature 9 would get jammed and its mobility in relation to pivoting would be limited.

It is provided in an especially preferred manner, and as shown in Figs. 6 and 7, that the hinged armature spring 15 and the pressure spring are arranged in an integral manner. The hinged armature spring 15 is arranged as a combined torsion/pressure spring and presses the hinged armature 9 in the direction of the pivot 17 of the hinged armature 9 against the U-shaped yoke 8. Fig. 6 shows an especially preferred embodiment of such a hinged armature spring 15 which is arranged as a combined torsion/pressure spring in a substantially relaxed state. The helically wound middle part 37 of the hinged armature spring 15 also acts as a torsion spring. Fig. 7 shows an arrangement of a short-circuit release apparatus 7 and an overcurrent release apparatus 6, with a hinged armature spring 15 according to Fig. 6 being arranged. It can

clearly be seen how the helically wound middle part 37 of the hinged armature spring 15 is compressed in comparison with the relaxed state according to Fig. 6, with the hinged armature spring 15 which is arranged as a combined torsion/pressure spring pressing the hinged armature 9 against the U-shaped yoke 8. It can thus further be ensured that the hinged armature 9 is pressed against the stop 16 and cannot be moved away from the same.

It is preferably provided that switchgears in accordance with the invention further comprise an overcurrent release apparatus 6 in addition to a short-circuit release apparatus. The overcurrent release apparatus 6 comprises a bimetallic element 22 which is preferably fastened to a first conductor 10. It is especially preferably provided that the bimetallic element 22 is riveted to the first conductor 10 by means of at least one rivet 30. The further end of the bimetallic element 22 which is opposite of the fastening of the bimetallic element 22 with the first conductor 10 is connected with a flexible conductor 20 which is connected with a contact support 33, on which the first switching contacts 4 are arranged. In the illustrated preferred embodiment, the current flows directly through the bimetallic element 22, i.e. it is a part of the current path itself, and is directly heated by the current. It can also be provided that the bimetallic element 22 is heated completely or additionally indirectly in that a current-bearing conductor is arranged on the bimetallic element 22. It is bent increasingly with rising heating of the bimetallic element 22 as a result of the current flow. At a predetermined degree of bending of the bimetallic element 22 which is proportional to a predeterminable heating of the line network, it will move the control projection 28 of the tripping lever 26 which, as already explained, causes the further tripping of the disconnection apparatus 5 and consequently the disconnection of the switching contacts 4. In the preferred embodiment of a switchgear in accordance with the invention as shown in Figs. 1 to 4, it is further provided that the bimetallic element 22 is arranged within the U-shaped recess of the U-shaped yoke 8, so that an especially compact arrangement of an overcurrent release apparatus 6 can be achieved together with a short-circuit release apparatus 7.

In the switchgear 1 in accordance with the invention, the overcurrent release apparatus 6 and/or the short-circuit release apparatus 7 do not act directly upon the disconnection apparatus 5 but rather via a tripping lever 26 which comprises at least one control projection 28 and at least one actuating projection 29, as is shown in Fig. 5 for example. In a preferred

embodiment of a switchgear 1 in accordance with the invention, the second lever arm 12 of the hinged armature 9 acts upon the control projection 28 of the tripping lever 26. One control projection 28 is provided for each switching path. The actuating projection 29 is provided for tripping the disconnection apparatus 5.

In the illustrated, especially preferred embodiment of the invention as shown in Fig. 5, the disconnection apparatus 5 is arranged as a breaker mechanism. The breaker mechanism is an energy-storing link between an actuating lever 27 and the switching contacts 4. The breaker mechanism is tensioned in the present embodiment in a first step by means of movement of the actuating lever 27 in a first direction of movement, with a spring energy storage device being tensioned which ensures a rapid and secure disconnection of the switching contacts 4 upon tripping of the breaker mechanism. The tensioning process is ended by a latching, engaging or catching of the latch on a part of the breaker mechanism which is fixed to the housing. The switching contacts are closed in a second step by means of the movement of the actuating lever 27 in a second direction. The latching connection of the latch with the part of the breaker mechanism which is fixed to the housing is arranged in such a way that a predeterminable movement of the latch in a predeterminable direction will unlatch the breaker mechanism, through which the spring energy storage device is released and the switching contacts are disconnected. Such a breaker mechanism 17 which is preferably used has been described in the German published patent applications DE 42 27 213 A1 and the German patent specification DE 44 42 417 C1. When the tripping lever 26 is moved by a motion of the overcurrent release apparatus 6 and/or the short-circuit release apparatus 7, especially by a motion of the hinged armature 9 and/or the bimetallic element 22, the actuating projection 29 comes into engagement with the latch after a predeterminable motion of the tripping lever 26, and moves the latch so far that the latched connection with the part of the breaker mechanism which is fixed to the housing is released, so that the breaker mechanism is unlatched, the spring energy storage device is released and the switching contacts 4 are disconnected.

Further embodiments in accordance with the invention merely have a part of the described features. Any combination of features can be provided, especially also such of different described embodiments.

CLAIMS:

1. A switchgear (1), comprising at least one input terminal (2) and at least one output terminal (3) for connecting electrical conductors, and a first switching contact (4) and a second switching contact, said switching contacts (4) closing, in a closed position, a current path between the input terminal (2) and the output terminal (3), with a disconnection apparatus (5) being provided for disconnecting the first switching contact (4) and the second switching contact, and with a short-circuit release apparatus (7) being provided which is in operative mechanical connection with the disconnection apparatus (5) in order to enable the triggering of the same, and with the short-circuit release apparatus (7) being arranged in the region of the at least one input terminal (3), and with the short-circuit release apparatus (7) comprising at least one U-shaped yoke (8) and one movable hinged armature (9), characterized in that a pressure spring is provided which presses the hinged armature (9) against the U-shaped yoke (8), and the pressure spring acts in the direction of a pivot (17) of the hinged armature (9).
2. A switchgear (1) according to claim 1, characterized in that the U-shaped yoke (8) is fastened to a first conductor (10) of the current path, and the first conductor (10) is associated with the first input terminal (2) and/or the second output terminal (3).
3. A switchgear (1) according to claim 1 or 2, characterized in that the hinged armature (9) is rotatably mounted on the U-shaped yoke (8).
4. A switchgear (1) according to claim 1, 2 or 3, characterized in that the hinged armature (9) comprises a first lever arm (11) and a second lever arm (12).
5. A switchgear (1) according to claim 4, characterized in that the first lever arm (11) comprises a contact area (13) for the contact with the U-shaped yoke (8), and the contact area (13) is arranged as a planar surface area.

6. A switchgear (1) according to claim 4 or 5, characterized in that the second lever arm (12) is arranged as a tripping projection (14) for the at least indirect tripping of the disconnection apparatus (5).
7. A switchgear (1) according to one of the claims 4 to 6, characterized in that a hinged armature spring (15) is provided which presses the second lever arm (12) against a stop (16) and presses the first lever arm (11) away from the U-shaped yoke (8).
8. A switchgear (1) according to claim 7, characterized in that the hinged armature spring (15) is arranged as a torsion spring which is arranged about a pivot (17) of the hinged armature (9).
9. A switchgear (1) according to claim 7 or 8, characterized in that a first hinged armature spring leg (18) acts on a hook-like projection (19) on the second lever arm (12) of the hinged armature (9).
10. A switchgear (1) according to one of the claims 7 to 9, characterized in that a second hinged armature spring leg is fixed to the U-shaped yoke (8).
11. A switchgear (1) according to one of the claims 7 to 10, characterized in that hinged armature spring (15) is arranged as a combined torsion/pressure spring and presses the hinged armature (9) in the direction of the pivot (17) of the hinged armature (9) against the U-shaped yoke (8).
12. A switchgear (1) according to one of the claims 4 to 11, characterized in that the U-shaped yoke (8) comprises a projection (21) in the direction of extension of the second lever arm (12), which projection forms the stop (16) for the second lever arm (12).
13. A switchgear (1) according to one of the claims 1 to 12, characterized in that it comprises an overcurrent release apparatus (6) which is in operative mechanical connection with the same for tripping the disconnection apparatus (5).

14. A switchgear (1) according to claim 13, characterized in that the overcurrent release apparatus (6) comprises a bimetallic element (22) which is fastened to the first conductor (10) of the current path.
15. A switchgear (1) according to claim 14, characterized in that the bimetallic element (22) is arranged within the U-shaped recess of the U-shaped yoke (8).
16. A switchgear (1) according to one of the claims 1 to 15, characterized in that it is arranged as a power circuit breaker.