Minimum-oil circuit-breaker
with spring operation mechanism

Instruction
for erection and operation

SBS 12.12.20  SBS 24.12.20
SBS 12.08.25  SBS 24.16.20
SBS 12.12.25  SBS 24.12.25
SBS 12.16.25  SBS 24.16.25
SBS 12.16.40
Important notes

1. The circuit-breaker can be guaranteed to operate reliably only if the following instructions on erection, operation and maintenance are observed.

2. All the procedures described in Section «B Installation and preparatory measures» must be completed before commencing operation.

3. We disclaim all responsibility for any immediate damage arising from incorrect operation of this circuit-breaker, even if these instructions contain no specific indications in this respect.

4. You are kindly requested to consult us or our representatives in the event of any defects for which the remedy is not described in these instructions.

5. We reserve the right to make technical modifications.

6. These instructions may not be transmitted, reproduced, reprinted or copied, either wholly or in part, without our written permission.
Minimum-oil circuit-breaker with spring operation mechanism

Instruction for erection and operation

First edition, first printing
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MINIMUM-OIL CIRCUIT BREAKER
WITH SPRING OPERATING MECHANISM

SBS 12.12.20   SBS 24.12.20
SBS 12.08.25   SBS 24.16.20
SBS 12.12.25   SBS 24.12.25
SBS 12.16.25   SBS 24.16.25
SBS 12.16.40

1. GENERAL

The type SBS minimum-oil circuit-breaker with spring operating mechanism is simple, reliable and quick-acting. It is used in high for on-load circuit-breaking voltage installations as power circuit-breaker.

It is designed for indoor operation and is available for rated voltages of 12 and 24 kV at rated currents of 800 A, 1250 A and 1600 A and breaking capacities of 250, 350, 500, 750 and 1000 MVA.
### TECHNICAL DATA

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<td>kV</td>
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<tr>
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<td>kV</td>
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<td>kV sw</td>
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<td>1250 1250 1600</td>
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<tr>
<td>- <strong>Balanced breaking current</strong></td>
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<td>kA</td>
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<tr>
<td></td>
<td>21.6/18.0 21.6/18.0</td>
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<td>kA</td>
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<tr>
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<td>29.0 29.0</td>
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3. **Construction**

a) **Extinction chamber pole**

Each extinction chamber pole has its own interrupter chamber. All three extinction chambers of a triple-pole breaker are arranged vertically and are mounted on supports 48a and 48b in Fig. 1.

The extinction chamber cylinder 12 (Fig. 1 and 7) carries the extinction chamber poles and is made of glass-fiber-reinforced epoxy resin. It also carries the connecting flanges 12n and 12l (Fig. 1) which, on the one hand, connect the current flow path from the pole to the busbars and, on the other, permit assembly of the extinction chamber pole to the operating mechanism through the moulded resin rod insulators 11. The operating mechanism housing 19 is fixed to the lower connecting flange 12l (Fig. 1). This houses the parts required for operating the switch rod, the switch rod itself 18 (Fig. 7d), the roller contact 17g (Fig. 7b) and the guide tube 20. The switch rod has a replaceable tip at the upper end 18a (Fig. 7d). It is somewhat tapered at the lower end and is damped by the oil-filled guide tube 20 as the circuit is broken. The guide tube also serves as oil drain plug. The roller contact 17g is following, low-friction type contact which guarantees a constant current flow from the lower connecting flange 12l through the mechanism housing 19 to the switch rod 18 (Fig. 7d). The contact retainer 13 is situated on the upper connecting flange 12n (Fig. 1). It carries the static contact which consists of several fingers in the shape of a tulip 14c. The upper connection forms the pressure equalizing chamber 15 (Fig. 1 and 7d) which is fitted with an oil level inspection window 15c (Fig. 2 and 7d) and an oil separator 16.

b) **Operating mechanism**

The circuit-breaker is fitted with a spring operating mechanism which, apart from the normal "open" - "close" cycle, also allows for "open" - "close" - "open" auto-reclosing cycles when used in conjunction with a reclosing relay. The operating mechanism can be charged either by hand or by means a motor. It consists of the following sub-assemblies:
The control unit 31 (Fig. 9) with mechanical and electrical trip mechanism; interlock 24 (Fig. 9) and tensioning device; spring assembly 27 d-g (Fig. 6 and 8) for opening and closing the circuit; the hand and motor-driven charging mechanism 25 resp. 30 (Fig. 6) with ratchet and pawl; differential gearing and chain 21n (Fig. 6 and 8) for charging the spring assembly; drive shaft with cams 21d; auxiliary switch 29 (Fig. 6); indicator and terminal strip 52 (Fig. 6); additional closing spring 28u, 28v (Fig. 9).
**4. Principle**

Fig. 7d shows a extinction chamber pole in the open operation. The active part of the pole is submerged in oil. When the breaker trips, the switch rod 18 (Fig. 7d) is withdrawn very rapidly from the extinction chamber. Arcing occurs between the moving contact and the tulip shaped fixed contact 14c (Fig. 7) thus evaporating some of the oil. The extinction chamber 12 and 19 is divided into cells which ensures that the gas bubbles cannot expand and that the evaporation surface is confined to the immediate vicinity of the arc. The arc is rapidly cooled and extinguished by the generation of gas and the intensive oil flow. The energy generated in opening the circuit is absorbed by the damping effect of the oil-filled guide tube at the end of the stroke.

**IMPORTANT:** The breaker must not be operated unless there is sufficient oil in the extinction chambers as otherwise the quenching system can not function properly and the breaker could suffer mechanical damage. (See instruction plate on the side of the breaker which states: **Do not operate without oil!**)

**a) Switching Operation**

The necessary energy for opening the breaker is provided by the charged spring assembly 27 d-g (Fig. 6 and 9). As previously stated, the energy in the springs is sufficient for an autoreclosing cycle ("open" - "close" - "open"). The springs 27 d-g exert a constant pressure upon the pinion 21z (Fig. 8) during the switching operation through the chain 21n and cam 21h (Fig. 6 and 8). The pinion is in mesh with the two bevel gears. The right-hand gear 21i (Fig. 6) is mounted on the shaft by a roller bearing and its sole purpose is for loading the springs 27 d-g by means of the motor 30 or the crank handle 25g. The left-hand bevel gear 21g transmits the torque to the drive shaft 21a (Fig. 6, 8 and 9), and the potential energy is stored by the cam 21c (Fig. 9). The breaker is opened or closed by rotating the switch shaft 28 through approximately 50° which releases the cam 21c on the drive shaft 21a (Fig. 6, 8 and 9) from the locking device, allowing it to engage with the operator 22. The power for the switch rod 18
(Fig. 7) is transmitted through the cam 21d to the switch shaft 28 and the switch rods 28h through the linkage to the switch rod 18 (Fig. 7).

b) A closing command, given through the bush-button 31b or the magnet 32 in the control unit 31, actuates the release pawl 31a (Fig. 6 and 9) which in turn releases the remaining pawl 31h at the control unit power source (Fig. 9). This consists of a toggle joint 31d and 31e and the intermediate springs 31f which through the lever 31g downwards. The operator 22 (toggle joint) is released by the release rod 26 (Fig. 9).

The switch shaft 28 is rotated by the action of the springs 27 d-g (Fig. 8) through the main shaft 21 and the cam 21d. The switch rod 18 (Fig. 7) is moved into the "on" position with force through the lever system by the process. The breaker is now closed.

c) For switching off

The same process is repeated from the "off" button of the control unit 31.

d) Charging the springs by hand with the crank 25g (Fig. 6 and 9) requires approximately 75 turns, until the spring assembly are fully charged.

e) Charging the springs 27 d-g by means of a motor

The electric motor is controlled automatically. It is switched on by the limit switch 49 (Fig. 6) as soon as the tension on the springs dips below maximum, and switched off again as soon as maximum tension is reached again.

f) Spring charging indicator

The indicator plate 27m (Fig. 8) only shows "charged" when the springs 27 d-g are charged to the maximum. When it shows "discharged" it indicates that the spring tension is somewhere between maximum and minimum. It is dangerous to manipulate the mechanism or the contacts when the springs are under tension. ALWAYS ENSURE THAT THE SPRINGS ARE COMPLETELY FREE FROM TENSION!
g) **Blocking of closure**

The control unit 31 (Fig. 9) only transmits closing commands when springs 27 d-g are adequately charged i.e. it can cut out the command immediately after it has been given. Closure is prevented at insufficient spring tension by the blocking device 24 (Fig. 6 and 9). This disengages the release cam 31a through a linkage. Deliberate blockage of closure for specific control purpose can be effected by the control magnets Fig. 10e which hold the release cam 31a out of engagement when the coil voltage fails.

h) **Available models** (to suit customers' requirements)

**Electrical Control Components**

a) Closing magnet d.c. (Fig. 10a)
b) Closing magnet a.c. (Fig. 10b)
c) Tripping magnet (or current transformer release) d.c./a.c. (Fig. 10c)
d) Second tripping magnet current transformer release with second magnet (Fig. 10d)
e) Blocking magnet to prevent closure (Fig. 10e)
f) No-voltage release (Fig. 10f)

i) **Electrical release**

These are available in various forms (see electrical control components above). The magnetic arrangements 10a, 10b, 10c, or 10d release through an electrical command from an auxiliary supply.

The current transformer trip Fig. 10c or 10d in fed by the main and auxiliary transformer, which renders auxiliary supply unnecessary.
The no-voltage trip Fig. 10f, also known as closed-circuit trip, requires constant coil voltage.

Arbitrary remote control is blocked as shown in Fig. 10e.
5. **Erection and Operation**

The breaker frame 48a/b (Fig. 1 and 2) is a bolted construction for supporting the extinction chambers and also for fixing the complete unit (see attachment holes 47 in Fig. 1) in its various forms for indoor installation. The power supply should be connected to the upper terminal screws 12e (Fig. 1) and to the lower connecting screws 12m.

The wiring should be connected up in accordance with the wiring diagram packed with the breaker.

The earthing connection, which is painted yellow and located in the driving mechanism (not visible in the illustrations) should be suitably earthed in accordance with the regulations in force.

Breakers are delivered in the switched-off condition.

a) **Filling with oil**

Before use, all three extinction chambers must be filled with pure and dry transformer oil of good quality, after loosening the threaded oil separator housing 16 (Fig. 1, 2 and 7). The oil should be poured in slowly until the level reaches the red spot on the inspection window 15c (Fig. 2 and 7). Each interrupter chamber requires approximately 5.2 litres of oil. The breaker should be tested for correct functioning under operating conditions. Several opening and closing operations should be carried out and all parts inspected for positive engagement. If the results of these tests are satisfactory, the breaker may be connected to the supply and put into operation.
All mechanical parts operate with complete reliability and are not affected by dust or temperature changes under normal conditions.

Maintenance can be limited to a periodic cleaning and lubrication of the individual components, which is quite sufficient to prevent premature wear. Servicing must be carried out with the breaker in the open condition.

We recommend that the following checks and servicing should be carried out:

a) **Half-yearly checks**

The oil level should be checked at the inspection window 15c (Fig. 2 and 7) and the oil topped up as necessary to the marked level. For filling instructions see paragraph 5a.

b) **Changing the arcing contacts**

The deterioration of the arcing contacts and the pollution of the oil depend to a great extent on the demands made on the breaker with respect to the breaking power and the number of switching cycles. The contacts can survive one thousand switching cycles at normal operating power (rated current). The contact life expectancy is reduced correspondingly when overloads are interrupted.

It is essential to inspect the contacts for damage after four or five short-circuit interruptions. This should be carried out as follows:

1. Drain the oil from the three extinction chambers into a clean receptacle by removing the three oil drain plugs 20 (Fig. 1 and 7d).

2. After loosening the four screws 12c (Fig. 7d), lift out the complete pressure equalizing chamber 15 (Fig. 1 and 7d) and the interrupter chamber 13 (Fig. 7d).
3. The contact fingers 14c (Fig. 7a) are easily accessible after removing the interrupter chamber 13 and can, if necessary, be replaced.

4. It is recommended that the individual poles of the breaker be brought into the "closed" position which gives better accessibility to the contact tip 18a (Fig. 7d). The switch rods 28h (Fig. 1 and 6) must be loosened. Under no circumstances may be brought out of adjustment. Make sure when reassembled, that they are in exactly the same position as before.

5. The unserviceable tip 18a can be removed with an Allen key and replaced by a new one.

c) General overhaul

After draining the oil from the extinction chambers, and apart from the work described under 6b, the four screws 12d (Fig. 1 and 7d) must also be loosened. This permits withdrawal of the active part of the pole, together with the switch rod 18, which can then be disassembled into its various component parts as shown in Fig. 7b, c and d. The reverse procedure is adopted for reassembly.

The quenching oil should also be checked the more frequently the more often the breaker operates, and if it is found to be very polluted it should be changed. The insulating capacity of the oil is best tested in an oil testing apparatus.

Insulating oil properties can be tested by the method described in IEC Publ. 156. The recommended test equipment comprises electrodes (12.5 - 13.0 mm dia.) spaced 2.5 mm apart, which are immersed in the oil under test in a container and its dielectric strength is measured on application of the test voltage.

Insulating oil must shown a dielectric strength of at least 50 kV to be considered suitable for filling a breaker pole. It will require changing when its dielectric strength has fallen to below 15 kV.
Lubrication

The switching mechanism should be lubricated once a year, or after every 1000 switching cycles, with BBC lubricating oil spez 2 or Molycote Paste Rapid. The operating mechanism in the extinction chamber needs no lubrication as it is constantly submerged in oil. All lubricating holes marked red (on the control unit 31), as well as all joints, shaft bearings, ball bearings and gear wheels should be lubricated with the previously mentioned lubricant according to lubrication chart Fig. 11.

The specification of BBC lubricating oil spez 2 is as follows:

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<td>Pensky-Martens flash point</td>
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<td>Kinematic viscosity at 40 °C (ISO)</td>
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Spare Parts

We recommend that adequate supplies of the following spare parts be carried in stock as they are subject to wear and tear or could conceivably become damaged. Considerable delays can be avoided by carrying this small stock of spares. Spare parts should be ordered from our appointed agents quoting the following details:

1. Equipment for which the spare parts are required

2. Its type designation and

3. Works serial number.

The data should be carefully noted from the identification plate.

4. Quantity required

Description

Item numbers of the desired spare parts (if quoted in the prevent instruction)

NOTE: The information required under 1, 2 and 3 must be quoted even if the order is accompanied by a sample, as otherwise it is not possible to establish the exact type of the apparatus. We further request that the type designation and works serial number be quoted in any correspondence associated with spare parts.
## LIST OF SPARE PARTS

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<td>Motor</td>
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CAPTIONS TO ILLUSTRATIONS

Fig. 1  Minimum-oil circuit-breaker type SBS 12.12.25 with spring operating mechanism, viewed from the extinction chamber side.

Fig. 2  Minimum-oil circuit-breaker type SBS 12.12.25 with spring operating mechanism, viewed from the mechanism side.

Fig. 4  Minimum-oil circuit-breaker type SBS 12.12.25 mounted on a trolley for metalclad installation, viewed from the extinction chamber side.

Fig. 6  Spring operating mechanism for minimum-oil circuit-breaker type SBS 12.12.25.

Fig. 7a,b,c and d Assembly diagrams of extinction chamber of one pole of a type SBS 12.12.25.

Fig. 8  Dismantled main parts of the spring actuating mechanism.

Fig. 9  Diagrammatic view of spring operating mechanism, spring under tension. Breaker in "OFF" position.

Fig. 10 Coils in control unit.

Fig. 10a Closing magnet (d.c.).

Fig. 10b Closing magnet (a.c.).

Fig. 10c Tripping magnet (a.c./d.c.) (or current-transformer trip).

Fig. 10d Second tripping magnet or current-transformer trip with second trip magnet.

Fig. 10e Blocking magnet for switch interlocking.

Fig. 10f No-voltage trip.

Fig. 11 Lubrication chart.
COMPONENT PARTS

10    Trolley
11    Supporting insulator
12    Extinction chamber assembly
12a   Washer
12b   Spring washer
12c   Screw
12d   Screw
12e   Upper connection screw
12f   Washer
12g   Spring washer
12h   Clamping plate
12i   Screw
12k   Screw
12l   Lower connecting flange
12m   Lower connection bolt
12n   Upper connection flange
13    Contact holder assembly
13a   Sealing ring
13b   Retaining ring
13c   Steel ball
13d   Screw
13e   Spring washer
13f   Washer
14    Retainer for contact fingers
14a   Sealing ring
14b   Spring
14c   Replaceable contact fingers 14c/1 for 800 A and 1250 A 14c/2 for 1600 A
15    Pressure equalizing chamber assembly
15a   Retaining ring
15b  Sealing ring
15c  Inspection window (oil level gauge)
15d  Ring
15e  Oil level marks
16   Oil separator assembly
16a  Seal
17   Roller contact assembly
17a  Conducting stud
17b  Plate
17c  Plate
17d  Washer
17e  Hex. Nut
17f  Hex. Nut
17g  Roller assembly
17h  Angle piece
17i  Screw
18   Switch rod assembly 18/1 for 800 A and 1250 A
     18/2 for 1600 A
18a  Contact-tip
18b  Compression spring
18c  Switch rod with guide
19   Mechanism housing assembly
19a  Switch lever assembly
19b  Split pin
19c  Pin
19d  Washer
19e  Pole shaft
19f  Locking key
19g  Retaining ring
19h  Seal
19i  Threaded bush
19k  Sealing ring
19l  Lever assembly
19m  Retaining ring
19n  Spring ring
20   Guide tube assembly (oil drain screw)
20a  Seal
21   Drive shaft assembly
21a  Drive shaft
21b  Key
21c  Cam
21d  Cam disc assembly
21e  Split pin
21f  Loading shaft
21g  Bevel gear
21h  Sprocket assembly
21i  Bevel gear assembly
21k  Bush
21l  Spring ring
21m  Clip
21n  Roller chain
21o  Spring link
21p  Ball bearing
21q  Ball bearing
21r  Screw
21s  Nut
21t  Spring washer
21u  Retaining ring
21v  Washer
21w  Castle nut
21x  Splint pin
21y  Washer
21z  Pinion
22   Lock assembly
22a  Link left
22b  Link right
22c  Link
22c  Lever
22d  Lever
22e  Pin
22f  Pin
22g  Pin
22h  Pin
22i  Roller
22k  Spacer tube
22l  Spacer tube
22m  Spacer ring
22n  Stop
22o  Tension spring
22p  Washer
22q  Retaining ring
22r  Retaining ring
23  Gearing assembly
23a  Gear shaft
23b  Bevel pinion
23c  Bush
23d  Spacer bolt
23e  Peg
23f  Tension spring
23g  Nut
23h  Spring washer
23i  Locking pin
23k  Retaining ring
23l  Damper
24  Interlock complete
24a  Interlock shaft
24b  Spring washer
24c  Indicator rod
24d  Blocking rod
24e  Interlock rod
24f  Guide
24g  Nut
24h  Spring ring
24i  Retaining ring
24n  Spring ring
25  Hand crank assembly
25a  Bearing bracket assembly
25b  Shaft
25c  Bush
25d  Bush
25e  Angle bracket
25f  Stop
25g  Crank
25h  Sleeve
25i  Angle bracket
25k  Locking pin
25l  Locking pin
25m  Cyl. pressure spring
25n  Bevel gear wheel
25p  Cyl. pressure spring
25q  Bush
25r  Retaining ring
25s  Retaining ring
25t  Retaining ring
25u  Retaining ring
25v  Washer
25w  Split pin
25x  Nut
26  Release mechanism assembly
26a  Release rod
26b  Release lever, left
26c  Pin, right
26d  Sleeve
26e  Shaft
26f  Washer
26g  Split pin
27 Spring frame (with power storage mechanism)
27a Spring frame
27b Pulley
27c Shaft
27d Compression spring
27e Compression spring
27f Compression spring
27g Compression spring
27h Spring plate
27i Chain retainer
27k Shaft
27l Top plate
27m Indicator plate (Charged-Discharged)
27n Indicator plate (I - 0)
27σ Indicator rod
27p Screw
27q Nut
27r Nut
27s Spring washer
27t Retaining ring
28 Switch shaft
28a Switch shaft assembly
28b Bush assembly
28c Bearing bush
28d Washer
28e Bolt
28f Cam
28g Diaphragm
28h Switch rod
28i Adjusting bush
28k Washer
28l Ball bearing
28m Cheese-head screw
28n Peg
28o  Peg
28p  Retaining ring
28q  Washer
28r  Spring washer
28s  Spring ring
28t  Washer
28u  Additional "ON" spring
28v  Pull-rod
28w  Washer
28x  Split pin
29  Auxiliary switch
30  Motor
31  Control unit assembly
31a  Release pawl
31b  Push-button "ON"
31c  Push-button "OFF"
31d  Toggle joint
31e  Toggle joint
31f  Compression spring in the control unit
31g  Lever
31h  Retaining pawl
32  Tipping coil
33  Coil
34  Armature
34a  Armature with short-circuit ring
35  Magnet armature
35a  Tension spring
36  Magnet Armature
36a  Tension spring
38  Loading cam in the control unit
39  Relay loading cam
40 Cam for actuating the no-voltage trip magnet
47 Fixing holes
48a Upper support
48b Lower support
49 Limit switch
50 Inspection cover
52 Terminal strip
53 (Not in the picture)
55 Roller
56 Tulip contact