



1ZSE 5492-129 en, Rev. 7

On-load tap-changers, type UC

Repair guide

Original instruction

The information provided in this document is intended to be general and does not cover all possible applications. Any specific application not covered should be referred directly to ABB, or its authorized representative.

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Recommended practices

ABB recommends careful consideration of the following factors when installing on-load tap-changers:

Before you install or commission a unit, make sure that the personnel doing the job have read and fully understood the installation and commissioning guide provided with the unit.

To avoid damaging the unit, never exceed the operating limits stated in delivery documents and on rating plates.

Do not alter or modify a unit without first consulting ABB.

Follow local and international wiring regulations at all times.

Use only factory authorized replacement parts and procedures.

Safety warnings

The following warnings and notes are used in the manual:



WARNING

WARNING indicates an imminently hazardous situation, which if not avoided will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING also indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.



CAUTION

CAUTION indicates a potentially hazardous situation, which if not avoided may result in minor or moderate injury. It may also be used to alert of unsafe practices.

CAUTION may also indicate property-damage-only hazards.



INFO provides additional information to assist in carrying out the work described and to provide trouble-free operation.

Safety precautions



WARNING

Before any work is carried out on the tap-changer: Make sure that the transformer is disconnected and that grounding is properly conducted. Obtain a signed certificate from the engineer in charge.



WARNING

The relevant technical documents should be read and understood before any work is started, and the procedures in this document should be followed at all times.



WARNING

Before starting any work in the the tap-changer, the LOCAL/REMOTE switch in the motor-drive mechanism must be set to 0. It is also recommended to shut the door of the motor-drive mechanism and pad lock it when work is carried out on the tap-changer. The key should be kept by the operator. This is done to avoid unexpected start of the motor-drive mechanism.



WARNING

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off.

NOTE: The motor, contactors and heating element may be energized from separate sources.



WARNING

Be aware of the risk for slipperiness caused by oil spillage for instance when working on the transformer cover.



CAUTION

ABB recommends that only service engineers with appropriate skills about tap-changers carry out the repairs, and that only maintenance engineers trained by ABB carry out the contact replacement.

During service



WARNING

Small amounts of explosive gases may be emitted from the breathing devices (dehydrating breather or one-way breather). Make sure that no open fires, hot surfaces or sparks occur in the immediate vicinity of the breathing devices.



WARNING

If a power supply failure occurs during operation, the operation will be completed when the power returns.



WARNING

The hand crank must not be inserted during electrical operation.



WARNING

If the tap-changer is not at its exact position and the hand crank is pulled out, the motor-drive mechanism will start and go to the exact position if the power supply is on.



CAUTION

After a pressure relay trip, follow the instructions in the chapter "Trip or alarm from supervisory devices" in the user's manual.

During oil handling



WARNING

Unused transformer oil is harmful. Fumes from unused warm oil may irritate the respiratory organs and the eyes. After long and repeated contact with transformer oil, skin becomes very dry.

Used tap-changer oil from diverter switch housings and selector switch housings contains harmful substances. Fumes are irritating to the respiratory organs and the eyes and are highly flammable. Used transformer oil may well be carcinogenic. Avoid contact with the oil and use oil-tight protective gloves when handling the oil.

First aid:

Skin contact: Wash your hands. Use skin cream to counteract drying.

In the eyes: Rinse your eyes in clean water.

Swallowing: Drink water or milk. Avoid vomiting. Call a doctor.

Collect used oil in oil drums.

Waste and clean-up: Should be absorbed by an absorber. Treat it as hazardous to the environment.

In the event of fire: Any fires should be extinguished with powder, foam or carbonic acid extinguishing agents.



WARNING

When oil that has been used in a tap-changer housing is pumped out, grounded conducting tubes and hoses should be used to avoid the risk of explosion due to the gases produced by arcs during service.



WARNING

The oil in the selector switch compartment may be hot. Be cautious!

WARNING

There is always a cushion of explosive gases over the oil surface. This is sucked into the tap-changer tank during draining of the oil. No open fire, hot surfaces or sparks may be present when the top cover is opened.

CAUTION

Do not fill the tap-changer housing with oil if the transformer tank is under vacuum and the diverter switch housing is not.

CAUTION

Do not fill the transformer tank with oil if the tap-changer housing is under vacuum and the transformer tank is not.

CAUTION

Leave a gas cushion on top of the oil in the diverter switch housing.

CAUTION

Take care to avoid ingestion of moist air when oil is drained. If the ambient air is moist, let incoming air pass through a dehydrating breather with slow air flow to obtain proper dehydration.



Check the oil level one month after filling. It is usual for the oil level of the oil conservator to fall due to gas absorption in the oil from the gas cushion in the diverter switch housing, if the tap-changer is not operated. Restore the gas cushion and the oil level according to section 3.3.

Mounting of gaskets**CAUTION**

Sealing surfaces and gaskets must be clean and undamaged. Diametrically opposed bolts in sealing joints must be tightened alternately several times, beginning with a low tightening torque and finally with the recommended tightening torque as described in section 1.6.

After oil filling**CAUTION**

Do not energize the transformer earlier than three hours after oil filling at atmospheric pressure. This waiting period is needed to allow air bubbles to dissipate.

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1. Introduction

1.1 General

The UC range of on-load tap-changers manufactured by ABB has been developed over many years to provide maximum of reliability. The simple and rugged design gives a service life equal to the service life of the transformer. Minimum maintenance is required for trouble-free operation. The only parts requiring maintenance are contacts that might need replacement during the service life, the insulating oil and the motor-drive mechanism.

The design allows excellent access to all parts, making inspection and maintenance quick and simple.

The on-load tap-changers, type UC, are housed in the transformer tank. The motor-drive mechanisms, types BUE or BUL2 are attached to the transformer tank and connected to the on-load tap-changer by means of drive-shafts and a bevel gear, see Fig. 1.

1.2 Repair categories

Repairs on the UC range of tap-changers fall into two categories:

- Repairs. Repairs are to replace worn or end-of-service-life parts.
- Modifications. Modifications are only issued by ABB to improve the already very high standard of reliability and to assist in prolonging the service life of the equipment.

The modifications fall into two areas:

- Immediate, where the modification should be completed at the earliest possible opportunity.
- Routine, where the modification should be completed during a routine service.

1.3 Serial number

Before consulting ABB for technical advice to assist with repairs or to order spare parts to complete the repairs, the tap-changer serial number must be known. The serial number can be found on the following locations:

- Rating plate on the motor-drive mechanism
- Tap-changer top flange
- Diverter switch
- Tap selector

If the tap-changer serial number cannot be obtained, the transformer serial number should be used (only if the transformer is manufactured by ABB in Ludvika, Sweden).



One of these serial numbers must be quoted in all correspondence with ABB. Failure to use the serial number may cause delays.

1.4 Spare parts list

For information about spare parts and how to order them, please refer to the Spare parts list 1ZSE 5492-133. The Spare parts list also contains several exploded views, which can be very handy when making repairs.

1.5 Maintenance guide

Inspection and overhaul of the UC range of on-load tap-changers are carried out according to the instructions in the appropriate Maintenance guide. You will need the Maintenance guide since references are made to it.

1.6 Tightening torque

The following tightening torques are recommended:

For metallic screw joints:	M6	10 Nm	±10 %
	M8	24.5 Nm	±10 %
	M10.....	49 Nm	±10 %
	M12.....	84 Nm	±10 %
For non-metallic screw joints:	M10.....	9 Nm	±10 %
	M12.....	13 Nm	±10 %
	M16.....	22 Nm	±10 %

if not otherwise stated in this guide.

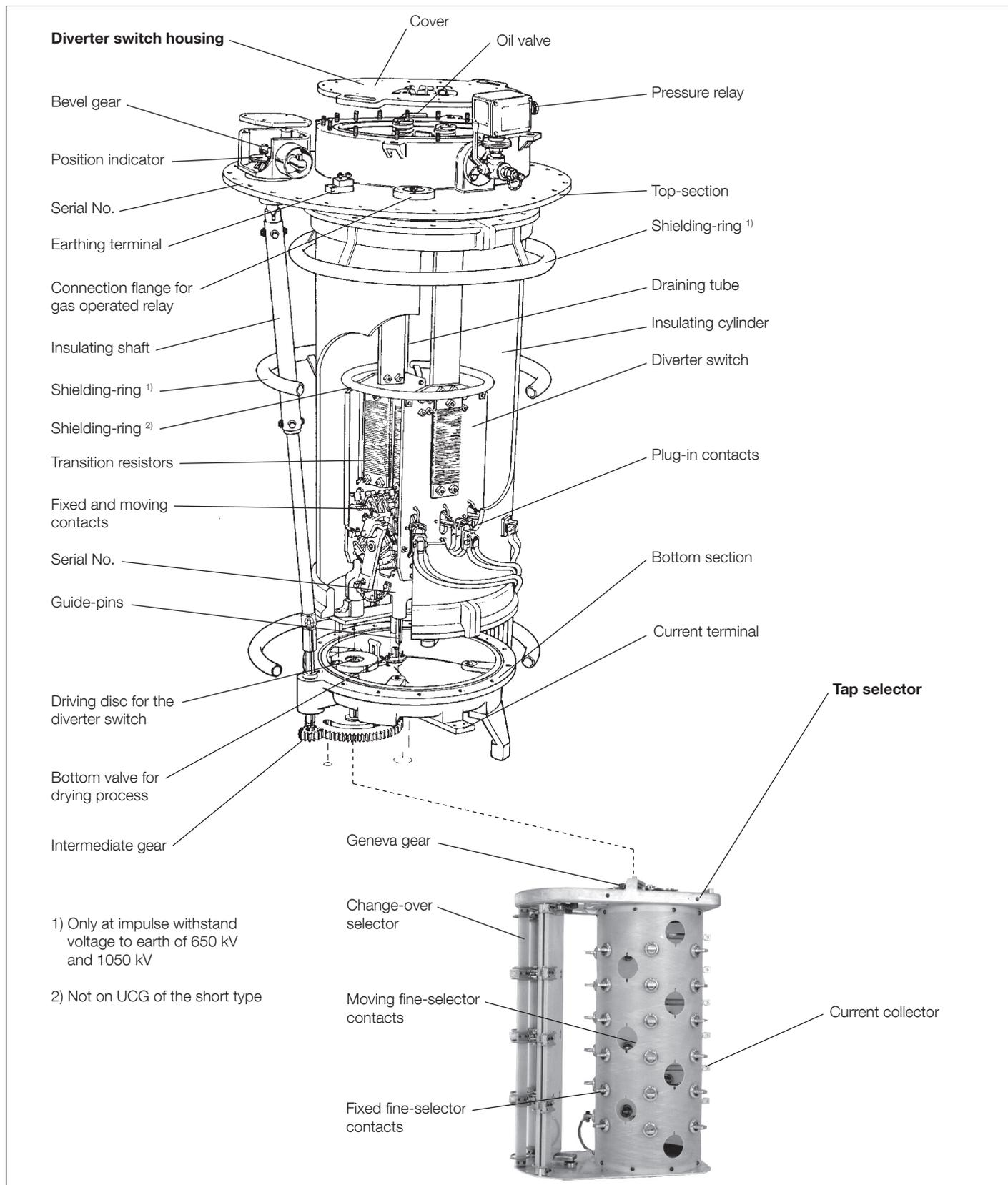


Fig. 2. General arrangement of on-load tap-changer, type UC.

2. Trouble-shooting

This chapter mainly contains information used to locate a fault. Instructions for correcting the fault, replacement of parts etc. are contained in chapter 3, Repairs and Adjustments.

2.1 Tap-changer

Error condition	Fault finding procedure
High oil level alarm	<p>A rising oil level in the tap-changer oil conservator may indicate a leakage between the tap-changer and the transformer tank.</p> <p>Make sure that the cause for the alarm is not over-filling at commissioning or overhaul. This can be checked by adjusting the oil level according to the Installation and commissioning guide, section "Correct oil level", and then rechecking some time later.</p>
Low oil level alarm	<p>A lowering oil level in the tap-changer may indicate a leakage. If there is no visible leakage, adjust the oil level according to the Installation and commissioning guide, section "Correct oil level", and recheck some time later.</p>

2.2 Pressure relay

Error condition	Fault finding procedure
The pressure relay has tripped during normal operation	<p>Tools required:</p> <ul style="list-style-type: none">- Air pump- Manometer- Screwdriver- Megger (500–2 000 V) <hr/> <p> CAUTION</p> <p>To take the transformer into service after a pressure relay trip without carrying out a careful investigation of the selector switch by lifting it out of the selector switch housing, and repairing faults, if any, may cause severe damages to the tap-changer and the transformer.</p> <hr/> <p> CAUTION</p> <p>It is not permissible to replace only the microswitch within the pressure relay.</p> <hr/> <ol style="list-style-type: none">1. After a pressure relay trip, the tap-changer and the transformer must be carefully investigated. Examine the selector switch according to section 3.3 in this guide. If both the tap-changer and the transformer are functioning properly, continue with the next step.2. Carry out the insulation test of the pressure relay. Proceed as follows:<ul style="list-style-type: none">- Remove the cover of the relay housing. Disconnect from the terminals all wires coming from the control cabinet of the transformer.- Connect terminal NO (identified 61) on the pressure relay block to earth. Terminal C (identified 62) should be electrified with the megger (500-2000 V for one minute).- Connect the pressure relay housing to earth. Short-circuit the four terminals and apply test voltage 500-2000 V on them for one minute. Remove the shortcircuit from the terminals and reconnect the wires from the control cabinet.3. Carry out the function test. Proceed as follows:<ul style="list-style-type: none">- Set the valve handle to the test position as shown on the information plate.- Connect the air pump and the pressure gauge to the test tap on the pressure relay. (Thread R 1/8").- Raise the pressure until the pressure relay trips the circuit breakers of the transformer.- Read the pressure on the manometer and check against the pressure stated on the information plate. Max. permitted deviation is $\pm 10\%$. If the deviation is greater, the pressure relay should be replaced.- Check that the signal disappears when the pressure is released.- After finishing the check, turn back the valve handle to service position.4. If the pressure relay fails to pass the insulation test and/or the function test, the pressure relay has to be replaced. See instruction 1ZSC000562-AAD.

2.3 Motor-drive mechanism

Examples of connection diagrams and contact timing diagrams are available in the Maintenance guide for motor-drive mechanisms, 1ZSC000498-ABH. The product specific diagrams are included in every delivery. They can also be obtained from the manufacturer, provided that the serial number is stated.

2.3.1 Control system

Error condition	Fault finding procedure		
LOCAL operation or REMOTE operation is not possible.	<ol style="list-style-type: none"> 1. LOCAL operation is not possible when the control selector switch is in position REMOTE or "0", and REMOTE operation is not possible in position LOCAL or "0". 2. Check the power supply both for control and motor. 3. Check if the protective motor switch has been released. 4. Check if the emergency stop has been pressed. Release by turning clockwise and reset the protective motor switch. 5. Check if the running-through protection has been released. Reset by setting the LOCAL/REMOTE switch to 0 and then back to previous position and after that reset the protective motor switch. 6. If the motor-drive has been handcranked against the mechanical endstop, handcrank back to end-position. 		
The tap-changer performs more steps than ordered, or operates towards the end stop.	<ol style="list-style-type: none"> 1. Check that the maintaining contact releases after operation. <hr/> <p style="text-align: center;">WARNING</p> <p style="text-align: center;"> Dangerous voltage!</p> <hr/> <ol style="list-style-type: none"> 2. Check that the raise and lower contactors function properly (see circuit diagram and contact timing diagram). <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top; width: 50%;"> <p>BUE:</p> <ol style="list-style-type: none"> 3. Check that the brake disc stops in its middle position with a tolerance of $\pm 25^\circ$. For information about how to adjust the brake, refer to the Maintenance Guide. 4. Check that the starting contact functions properly (see circuit diagram and contact timing diagram). </td> <td style="vertical-align: top; width: 50%;"> <p>BUL2:</p> <ol style="list-style-type: none"> 3. Check that the roller on the brake arm stops in the middle of the notch in the cam disc. For information about how to adjust the brake, see the Maintenance Guide. </td> </tr> </table>	<p>BUE:</p> <ol style="list-style-type: none"> 3. Check that the brake disc stops in its middle position with a tolerance of $\pm 25^\circ$. For information about how to adjust the brake, refer to the Maintenance Guide. 4. Check that the starting contact functions properly (see circuit diagram and contact timing diagram). 	<p>BUL2:</p> <ol style="list-style-type: none"> 3. Check that the roller on the brake arm stops in the middle of the notch in the cam disc. For information about how to adjust the brake, see the Maintenance Guide.
<p>BUE:</p> <ol style="list-style-type: none"> 3. Check that the brake disc stops in its middle position with a tolerance of $\pm 25^\circ$. For information about how to adjust the brake, refer to the Maintenance Guide. 4. Check that the starting contact functions properly (see circuit diagram and contact timing diagram). 	<p>BUL2:</p> <ol style="list-style-type: none"> 3. Check that the roller on the brake arm stops in the middle of the notch in the cam disc. For information about how to adjust the brake, see the Maintenance Guide. 		

Error condition	Fault finding procedure
<p>The remote position indicator shows wrong position or there is no signal.</p>	<p>1. If there is a measuring amplifier: Adjust the output signal from the measuring amplifier with its two adjustment screws. If the failure does not disappear, proceed as follows:</p> <hr/> <p>WARNING</p> <p> Dangerous supply voltage!</p> <hr/> <p>Measure the output signal from the measuring amplifier in all positions. The signal shall raise linear up to the highest position. If no signal, check the feeding to the measuring amplifier and to the position transmitter. Check that the signal reaches the position indicator.</p> <p>2. Measure the resistance on the terminals of the position transmitter in all positions after both raise and lower operations.</p> <hr/> <p>WARNING</p> <p> Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off.</p> <p>N.B. The motor, contactors and heating element may be energized from separate sources.</p> <hr/> <p>BUE:</p> <p>3. Check that the contact plate and arm on the multi-position switch are free from dust and oxide. Check the contact function with the moving contact arm in all positions. Check the resilience of the moving contacts in the multi-position switch. For information about how to adjust the resilience, see the Maintenance Guide.</p> <p>BUL2:</p> <p>3. If the resistances are wrong replace the position transmitter. See section 3.5 in this guide.</p>

2.3.2 Power system

Error condition	Fault finding procedure
The three-phase motor runs back and forth without the tap-changer changes position.	Reverse two of the phases of the incoming supply. WARNING  Dangerous voltage!

2.3.3 Miscellaneous

Error condition	Fault finding procedure
Corrosion and/or condensation in the motor-drive mechanism cabinet.	<ol style="list-style-type: none">1. Check the function of the anti-condensation heater. Refer to the maintenance guide for motor-drive mechanisms, section "Heater".2. Check that the air vents not have been blocked.
Water in the motor-drive mechanism cabinet.	<ol style="list-style-type: none">1. Adjust the hinges on the cabinet door.2. Replace the door gasket on the cabinet.

3. Repairs and adjustments

3.1 Replacement of selector switch housing cover gaskets

This instruction guides you how to attend to an oil leakage due to damaged O-rings at the top cover.

3.1.1 Tools required

Normal set of combination wrenches (metric)

3.1.2 Material and spare parts required

- O-rings according to spare parts list
- Standard lithium complex or calcium complex grease with EP additive NLGI 2. Temperature range from -30°C to +100°C. Suggested products: Dow Corning Molykote Multilub, Gulf Crown EP 2 or similar.

3.1.3 Procedure



WARNING

Before any work is carried out on the tap-changer: Make sure that the transformer is disconnected and that earthing is properly carried out. Obtain a signed certificate from the engineer in charge.



WARNING

Be aware of the risk for slipping caused by oil spillage, for instance when working on the transformer cover.



CAUTION

Protect the tap-changer from water.

The following procedure is valid for all connections except the connection between the bevel gear and the top cover. All references are to the Maintenance guide, unless otherwise stated.

1. Retighten the nuts that clamp the part: If the oil leakage still remains, the O-ring has to be replaced.
2. Lower the oil level 100-150 mm. For information about oil draining, see section 3.4.
3. Dismantle the part. For top cover dismantling, see section 3.4.
4. Replace the O-ring with a new one.
5. Mount the part and tighten the nuts. For top cover mounting, see section 3.13.

Follow the following procedure for the connection between the bevel gear and the top cover:

1. Check if the leakage is between the bevel gear flange and the top cover. If the leakage is within the gear box (from the tap-changer into the gear box) contact ABB for further instructions.
2. Lower the oil level 100-150 mm. For information about oil draining, see section 3.4.
3. Loosen the hose clip on the bevel gear box and push the protection tube aside. Dismount the bevel gear box without twisting the horizontal drive shaft (square tube).
4. Replace the O-ring with a new one.
5. Check that the key in the vertical shaft of the bevel gear is facing the earthing symbol on the flange, see Fig. 8. If not, adjust by turning the external shaft of the bevel gear. This position must not be changed before the shaft system is completely assembled. Remount the bevel gear box on the top cover. Tighten the bolts.



CAUTION

Check that the tap-changer and motor-drive mechanism show the same position.

6. Push on the protection tube and reconnect the hose clip on the bevel gear box.

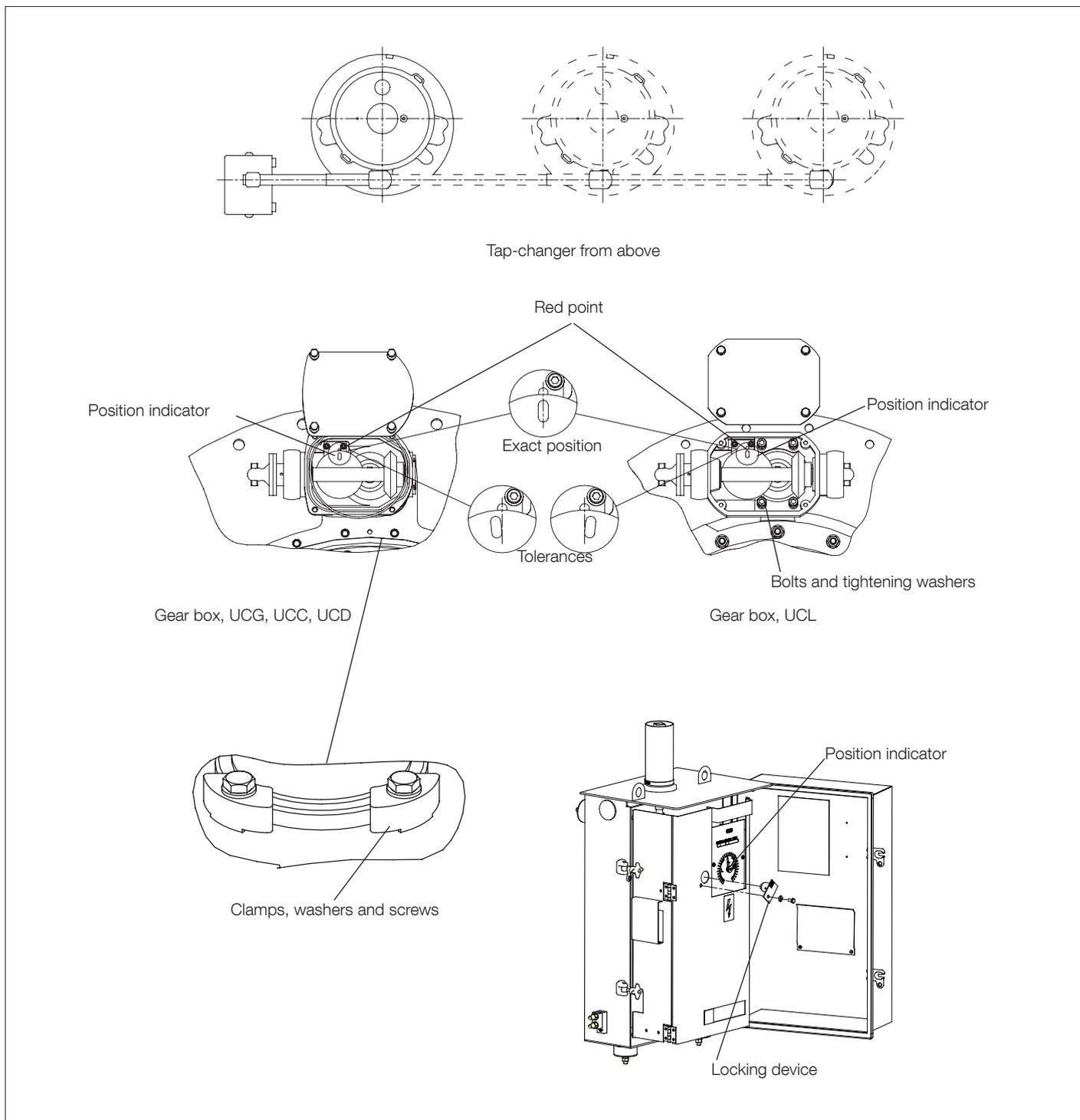


Fig. 8. Adjustment of bevel gear.

3.2 Replacement of supervisory equipment

3.2.1 Pressure relay

If the pressure relay fails to pass the insulation test and/or the function test (section 2.2), the pressure relay has to be replaced. See instruction 1ZSC000562-AAD.

3.2.2 Supervisory devices

Information about other supervisory devices is available in instruction 1ZSC000562-AAD.

3.3 Examination of the tap-changer after a pressure relay trip

The pressure relay has tripped during normal operation.

3.3.1 Tools and material required

- Maintenance guide
- Lifting and operating tool
- Lifting rig
- Lifting jack (40 kg, 2 m lifting height)
- Holding tool and screwing tool for mounting of fixed contacts
- Normal set of open end wrenches (metric up to 18 mm)
- Normal set of sockets (metric up to 18 mm)
- Allen socket 6 mm
- Ratchet wrench handle with extension
- Normal set of screwdrivers
- Pure transformer oil class II according to IEC 60156 (approximately 40 kg for cleaning)
- Clean and empty drums (for approximately 200 l)
- Bucket (10 l)
- Rags (lint-free)
- Brush with long shaft for cleaning of cylinder and selector switch shaft
- Ohmmeter (0.4-20 ohm)
- Protective gloves, oil proof

3.3.2 Procedure

WARNING



Before any work is carried out on the tap-changer: Make sure that the transformer is disconnected and that earthing is properly carried out. Obtain a signed certificate from the engineer in charge.

WARNING



Be aware of the risk for slipperiness caused by oil spillage for instance when working on the transformer cover.

CAUTION



Protect the tap-changer from water.

All references below are to the Maintenance guide, unless otherwise stated.

Close the valve to the oil conservator. Take off the cover of the selector switch housing. Follow the procedure in section 3.5. The oil level should be about 15 mm below the upper edge of the housing. If the housing is completely filled with oil, the reason for the pressure relay trip might be due to this absent gas cushion.

Even if the gas cushion is absent, the selector switch should be lifted out of the housing and carefully investigated in order to exclude other reasons for the pressure relay trip. Follow the procedure in section 3.5, when lifting the selector switch insert. Look for flash marks, loose parts etc on the selector switch insert and on the inside of the shaft. Also the inside of the cylinder should be cleaned and inspected.

Measure the transition resistors according to section 3.11.

Look for oil, penetrating from the transformer tank.

If no leakage or other faults are found, reassemble the tap-changer according to sections 3.13 and 3.17. Make sure the valve to the oil conservator is opened! After a pressure relay trip, we also recommend to carry out an insulation test and a ratio test of the transformer.

If both the tap-changer and the transformer are functioning properly, continue with section 2.2 in the Repair guide.

3.4 Replacement of a multi-position switch (BUL only)

3.4.1 Tools required

Small wrench (10 mm)

3.4.2 Procedure



WARNING

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off.

N.B. The motor, contactors and heating element may be energized from separate sources.

1. Disconnect the terminals.
2. Unscrew the fastening screws.
3. Replace the multi-position switch.
4. Note the position of the tap-changer. Operate the motor-drive mechanism in all positions both in raise and lower directions and check with a buzzer that all multi-position switches function properly.
5. Connect the terminals.
6. Reconnect all power supplies to the motor-drive.
7. Operate it back to the position noted in point 4.

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