# Electron beam gun ESQ 110

A product of BALZERS AG, Balzers

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**Warning — High voltage**

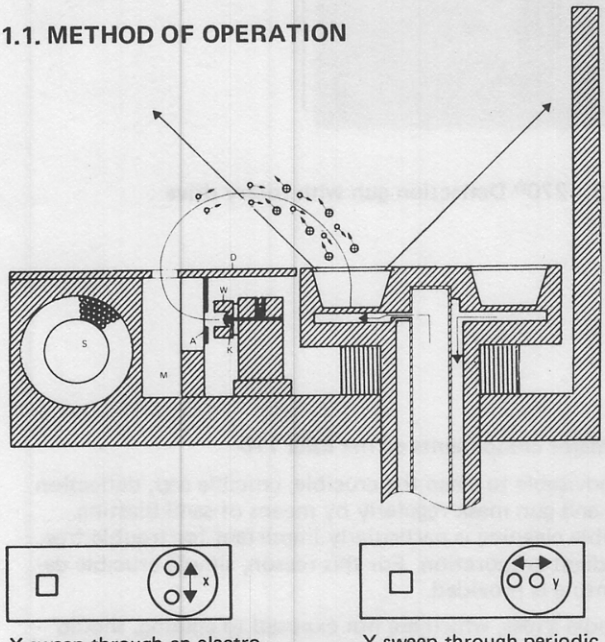
Service or repair work on components of the power supply or the high voltage lead-in may only be carried out by suitably qualified personnel. Contact with high voltage carrying components can be fatal.

Work on the high voltage lead-in for cleaning purposes, **after removing the power supply plug,** is the only exception to this rule.

## 1. APPLICATION

Constructed as an all-purpose evaporator, this system provides the best possible solution to any evaporation problem which can be overcome by the use of an electron beam evaporation source. At the same time, it is this quality of adaptability to the process which creates the necessity for accurate adjustment, in order to ensure that the optimum material evaporation characteristics are fully utilised. The electron beam evaporation system is a complete unit, with a power supply, controls and monitors.

### 1.1. METHOD OF OPERATION




X-sweep through an electromagnetic additional field (50 Hz)

Y-sweep through periodic variation (2 — 40 Hz) of the deflection field

Fig. 1

The electron beam evaporation source ESQ 110 consists of two main components (1) the electron beam gun, comprising the cathode K, Wehnelt shutter W and the anode A and (2) the water cooled evaporation crucible.

The electrons from the D.C. heated cathode (K), extracted through the electrical field, pass the anode (A), are deflected through approx. 270° by the magnetic field produced by the coil (S) and the pole shoes (M) and enter the crucible. The beam area is adjusted by the voltage connected to the Wehnelt shutter (W) (electrostatic focussing). There is another focussing effect in electrostatic focussing. The vapour atoms leaving the crucible are partially ionised by the electron beam. The electrons released by these vapour atoms travel at a much higher speed than the vapour ions, which have a speed distribution approximately corresponding to that of the neutral vapour atoms. Hence, high ion densities occur in the electron beam area, with a positive space charge capable of compensating for the negative space charge of the electrons. In fact, resulting from the vapour ions, a positive potential channel forms along the beam axis, which has a focussing effect on the beam electrons. Thus, with a 10 kV acceleration voltage, a density effect of the electron beam of approx. 40 kW/cm$^2$ is produced at the crucible surface.

Contrary to the evaporation of metal, a very much lower density effect of approx. 1 — 1.5 kW/cm$^2$ is desirable for the evaporation of dielectric materials. In this case the electron beam is de-focussed and "scanned" through an electro-magnetic A.C. field superimposed on the deflection field M. Another means of matching the evaporation source to the material to be evaporated and to the evaporation process is provided by a range of four interchangeable crucibles.



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## 2. TECHNICAL DATA

| | |
|---|---|
| Max. power input for evaporation of | |
| Al with a) pot crucible<br>b) other crucibles | 12 kW<br>5.5 kW |
| X-Y deflection | variables |
| Coil current | 0 – 2 A |
| Cooling water connection for evaporation source | 3/8" Serto screw coupling |
| min. water pressure<br>max. water pressure<br>Throughput | 3.5 bar<br>7 bar<br>approx. 14 l/min<br>at minimum 12 l/min |
| Intake temperature of the cooling water | 4 - 50 °C |
| Beam spot, variable from | 0.15 ÷ 10 $cm^2$ |
| Work pressure | $< 5 \times 10^{-4}$ mbar |
| Bake-out, max. | 100 °C |
| Weight | 16 kg |

### 2.1. Dimensions

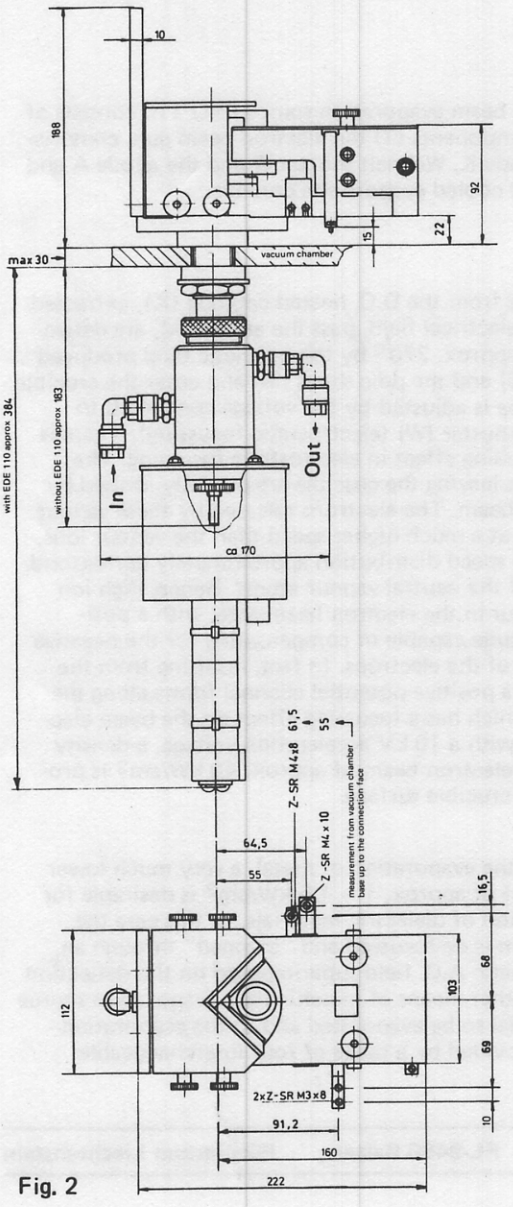



Fig. 2

## 3. DESCRIPTION

### 3.1. Evaporation source ESQ 110

The evaporation source is designed to ensure that apart from the material being evaporated, no hot surfaces of the gun can interfere with the evaporation process. The entire baseplate is thoroughly cooled by a special cooling line which is constructed as a bypass to the crucible cooling circuit. All masks, also the deflecting plate (secondary electrons) are made of solid copper and are in good thermal contact with the baseplate. The relevant screwed joints must therefore be firmly tightened.

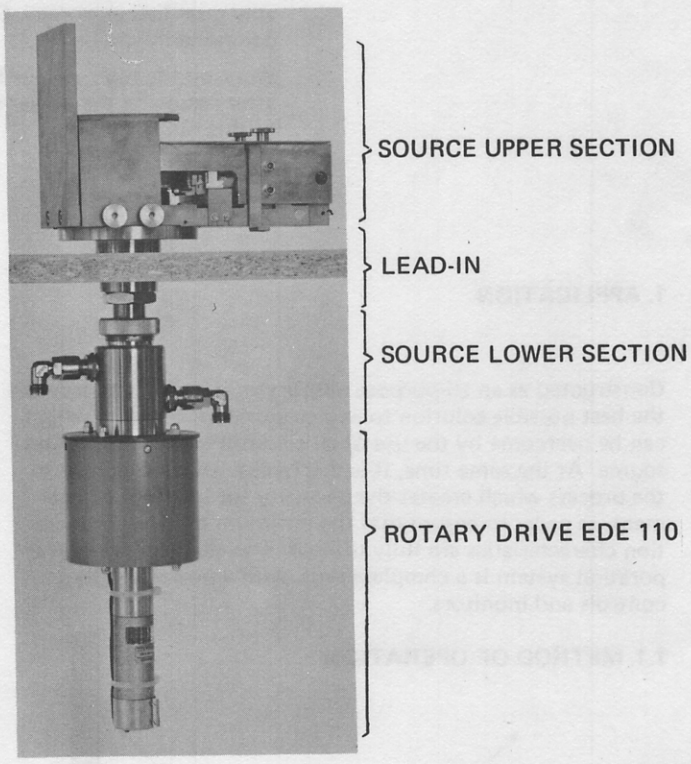



Fig. 3 270° Deflection gun with rotary drive

### 3.2. Major components of the ESQ 110

It is advisable to clean the crucible, crucible cap, deflection plate and gun mask regularly by means of sand-blasting. Crucible cleaning is particularly important for trouble-free, expedient evaporation. For this reason, simple crucible demounting is provided.

The pole shoes, which are not exposed to coating, should not be cleaned by sand-blasting, otherwise the nickle-plated surface (rust protection) will be worn away. Whilst sand-blasting the crucible and the baseplate, it is essential to make sure that all seal surfaces, also the mounting surfaces of the flat insulator and anode are masked. If these surfaces are damaged they must be restored, using a fine file or similar tool. A special plastic protection ring is supplied for crucible cleaning.

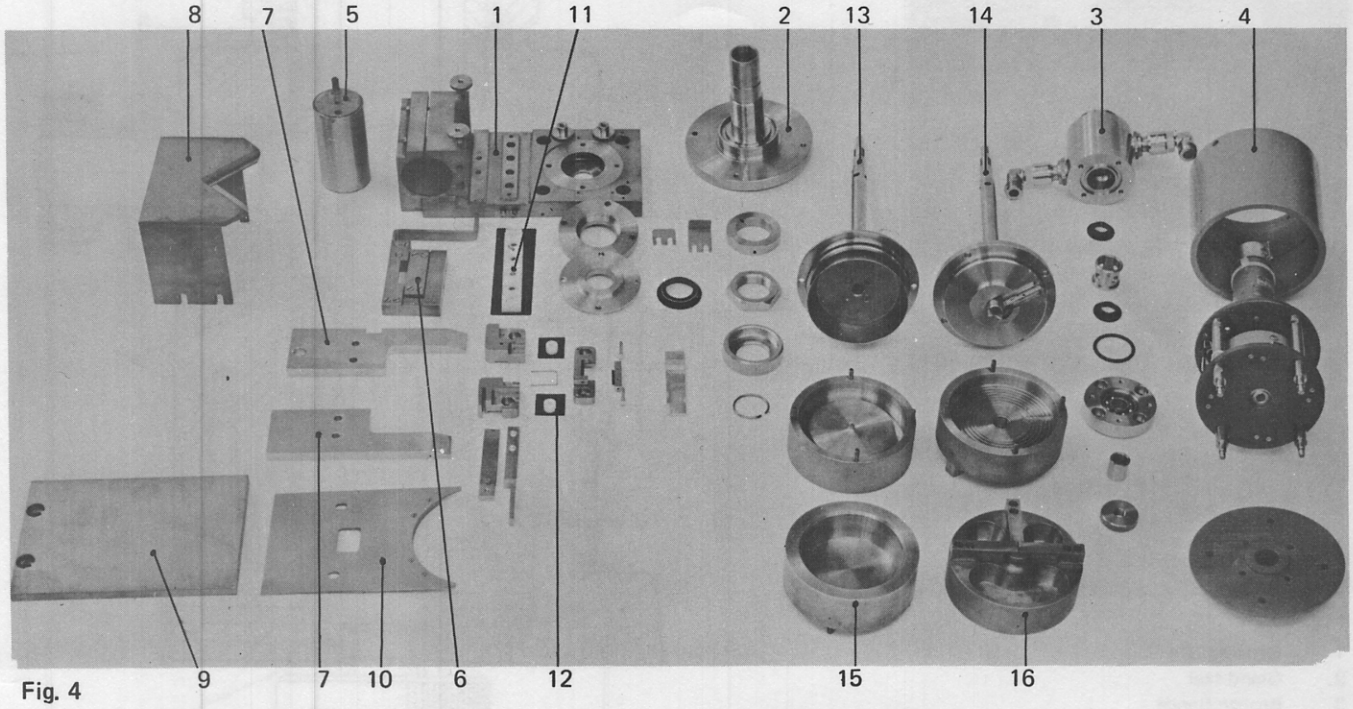



Fig. 4

1. Baseplate
2. Lead-in
3. Lower section (dismantled)
4. Rotary drive (dismantled)
5. Coil
6. Anode
7. Pole shoes
8. Crucible cap
9. Deflection plate
10. Copper mask
11. Flat insulator
12. Cathode system (dismantled)
13. Pot crucible (lower section)
14. Crucible lower section
15. Pot crucible
16. Oscillating crucible

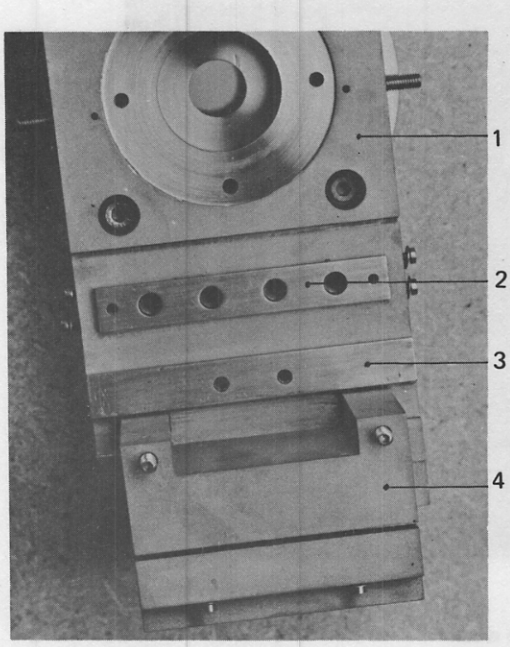



Fig. 5 Baseplate with coil holder

1. Baseplate
2. Mounting surface of the flat insulator
3. Mounting surface of the anode
4. Coil holder

## 4. INSTALLATION

### 4.1. Mounting the source ESQ 110

#### 4.1.1. Mounting the source upper section

a. The bypass plate (Fig. 6) with the semi-circular milled slot is screwed over the appropriate outlet hole below the clean baseplate.

b. On the upper side, the Cr/Ni flange with the O-ring seal and the bronze flange with the gland seal are screwed in position with the four M4 screws. Before fastening the 4 setscrews, ensure the gap between the Cr/ni flange and the bronze flange is at least 0.2 mm (draw-in of gland seal). Finally attach the pole shoe to the coil holder with the M5 x 30 steel setscrews.

c. Mount the anode (Mo-parts facing the crucible)

#### 4.1.2. Mounting the cathode holder

a Mount the two cathode holders on the flat insulator and screw in position with the two M3 cylindrical head screws.

b. Screw the Wehnelt section with the two round insulators to the cathode holder and tighten.

c. Tighten the cathode holder on the flat insulator.

d. Mount the cathode.

e. Adjust the lower Wehnelt plate (Ta) approx. 0.3 mm from the cathode

f. Screw the upper Wehnelt bar slacky in position with the two M2 vertical head screws (coat with Molykote).

g. Adjust the upper Ta plate approx. 0.3 mm from the cathode

h. Check the cathode, it should be located symmetrically in the gap b = 1.6 mm (Fig. 8).

i. Mount the two Cu-lead-ins on the cathode holder.

j. Tighten the Wehnelt wire firmly on the cathode holder (M2 cylindrical head screw).

k. Mount the cathode block on the baseplate.

l. Adjust the cathode: set back 2.7 ± 0.1 mm from the front face of the Wehnelt shutter.
(see section 5.2. and Fig. 20).

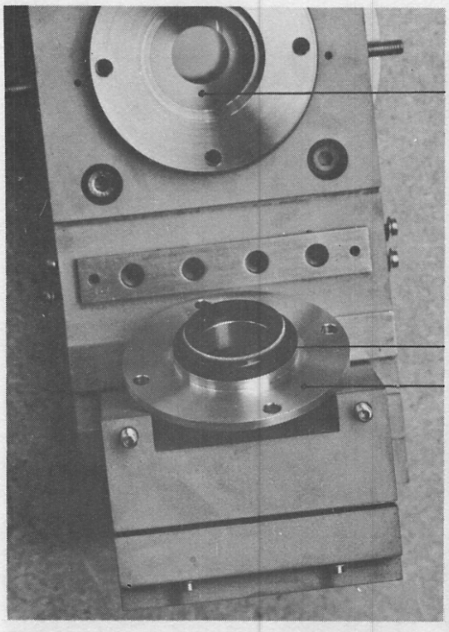



Fig. 6

1. Bypass plate
2. Gland seal
3. Bronze flange

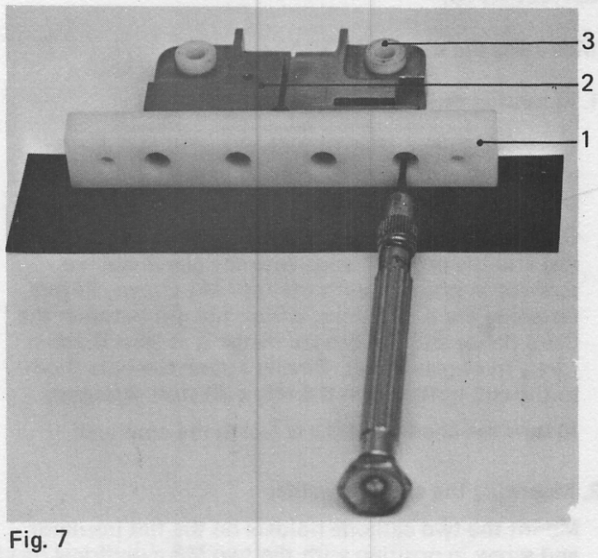



Fig. 7

1. Flat insulator
2. Cathode holder
3. Round insulator

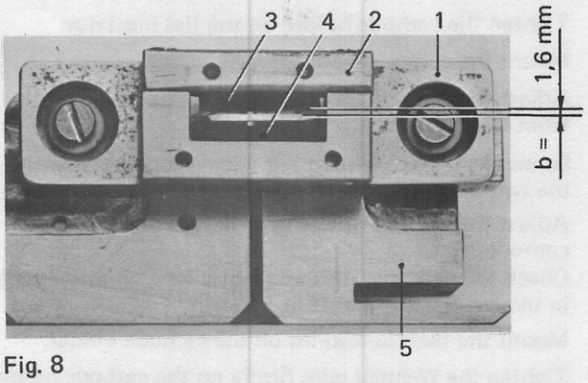



Fig. 8

1. Wehnelt section
2. Upper Wehnelt bar
3. Upper Wehnelt plate (Ta)
4. Lower Wehnelt plate (Ta)
5. Cathode holder

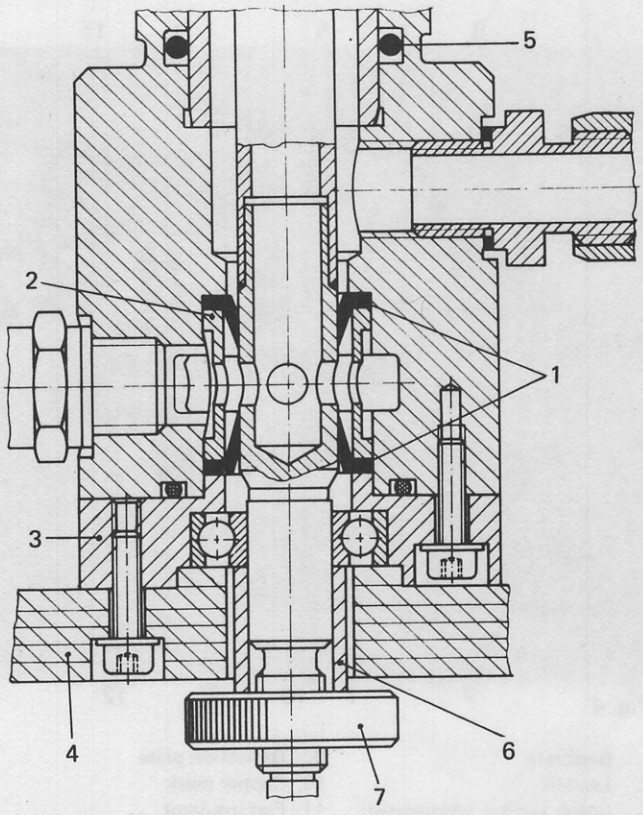



Fig. 9

1. Gland seal (14 x 27 x 7 mm)
2. Distance sleeve
3. Ballbearing flange
4. Ballbearing holder flange $\phi$ 60 mm (with rotary drive $\phi$ 115 mm)
5. O-Ring 27 x 4 mm
6. Intermediate piece
7. Milled nut with two M5 setscrews

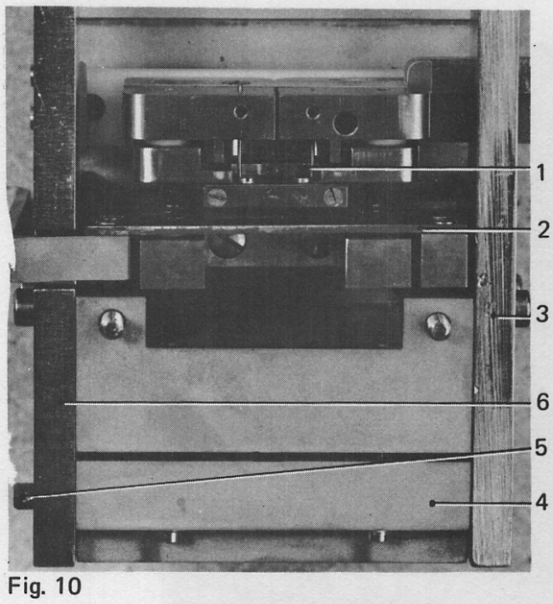



Fig. 10

1. Cathode system
2. Anode
3. Right hand pole shoe
4. Coil holder
5. Coil connection
6. Left hand pole shoe

m. Mount the deflection plate with two M5 setscrews.

o. Mount the complete cathode holder on the baseplate and adjust at a distance a = 3 mm from the anode, using a feeler gauge (two M3 screws) (see section 5.2.)

p. Insert the coil into the coil holder (note the connection side).

q. Mount the right hand pole shoe.

r. Clamp the coil firmly in position with the two M3 screws.

s. Mount the two coating protection plates for the flat insulator (small plate at the high voltage connection).

### 4.1.3. Mounting the source lower section

a. Attach the two water connections

b. Fit the gland seal (14/24 x 7 mm) with the seal lip facing downwards (Drawing!) Fig. 9, item 1)

c. Insert the distance sleeve

d. Fit the gland seal (14/24 x 7 mm) with the seal lip facing upwards (Fig. 9, item 1)

e. Mount the ballbearing flange with the ball bearing

f. Secure the cover flange and ballbearing flange in position with four M4 setscrews.

g. Lubricate and fit the 27 x 4 mm O-ring.

### 4.1.4. Mounting the source ESQ in the coating unit

a. Fit the lead-in with flange into the coating unit baseplate from above and fix in position with the washer (connect the earth line) and nut (M 30 x 1.5 mm). If the underside of the coating unit baseplate is coated with a protection film, then the gun and also the angle of the high current transformer (anode current) must be connected to the earth line (16 $mm^2$ Cu or Al strip 3 x 60 $mm^2$ which is provided with two 33 mm diameter holes and is firmly screwed to the gun and to the high current lead-in).

b. Fit the 80 x 4 mm O-Ring

c. Fix the completely assembled source upper section (without the crucible or the crucible lower section) in position with four M5 setscrews.

d. Mount the lock nut and the clamping ring on the lead-in from underneath.

e. Mount the source lower section on the lead-in and with the positioning screw (inner hexagon screw M4), slackly tighten in the key way.

f. Tighten the lock nut firmly.

g. Check the sealing surfaces of the gland seals (see spare parts list BB 800 041 E/1, 2, items 19 and 20) on the crucible lower section as to finish traces; if necessary, re-polish them.

h. Slide-in the crucible lower section with the crucible from above (twist slightly to avoid damaging the gland seals).

i. With the milled nut M10 fasten the crucible lower section with intermediate piece manually towards the ball bearing

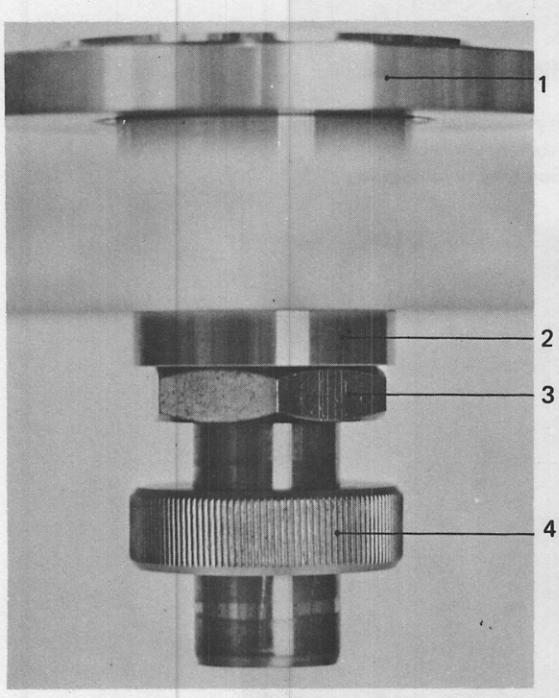



Fig. 11

1. Lead-in
2. Washer
3. Nut
4. Milled nut

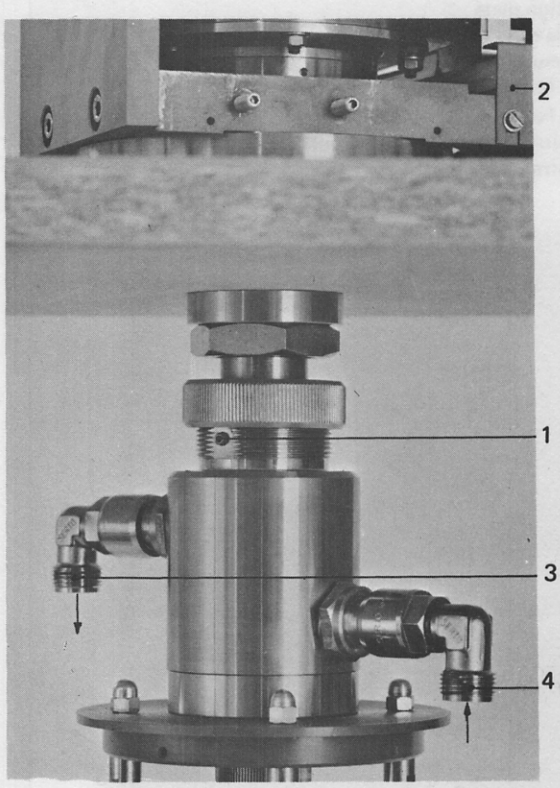



Fig. 12 Source lower section

1. Inner hexagon screw M4
2. Coating protection for the flat insulator
3. Water outlet
4. Water inlet

(until the crucible does not move). Then turn the milled nut half a turn back and clamp it with the two M5 set-screws. The axial clearance for the crucible lower section in the gun should be approx. 0.5 mm.

j. Mount the crucible cap (required only for 4-way or oscillating crucible).

k. Secure the Cu-mask with the two M5 milled nuts.

l. The high voltage leads from the high voltage feedthrough to the source must be screened optically tight. The necessary sheet (Fig. 13, item 4) is supplied with the source. After installation, cut the sheet to exact size to avoid arc-overs during evaporation.

m. If there is sufficient space, bend the deflection (Fig. 13, item 1) about 90 ° backwards to crucible level. This will prolong the time intervalls between the cleanings, particularly when larger amounts of material are evaporated (e.g. with pot crucible).

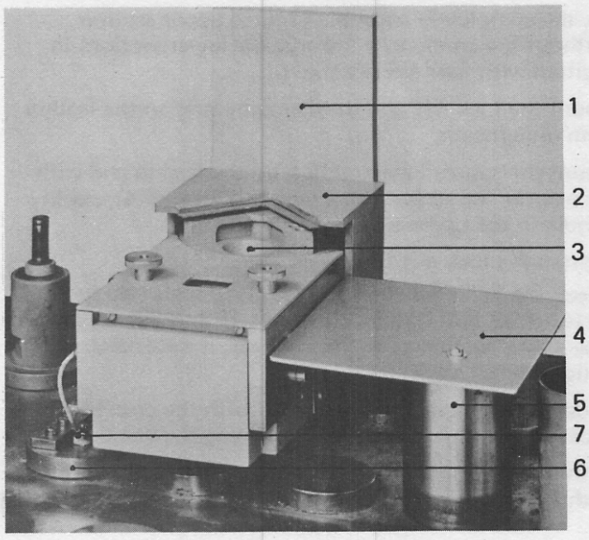



Fig. 13 Source complete with 4-way crucible

1. Deflection plate
2. Crucible cap
3. 4-way crucible
4. Screen for the cathode power supply
5. Screen for the high voltage lead-in
6. High current lead-in / Anode
7. Coil current lead-in

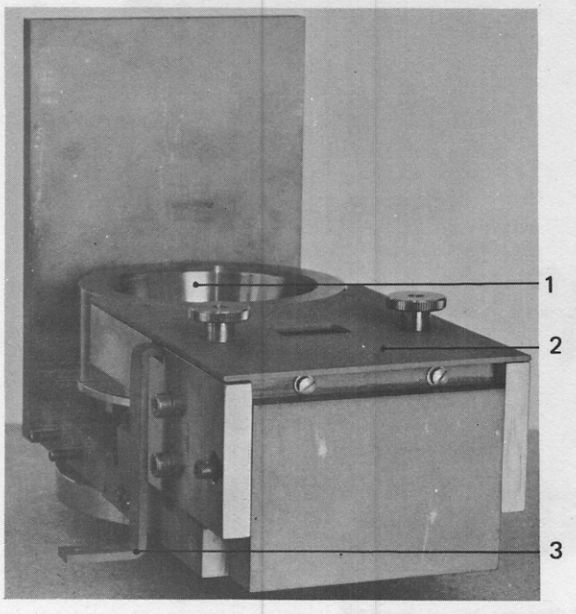



Fig. 14 Source with pot crucible

1. Pot crucible
2. Cu-mask
3. High current connection for the anode current

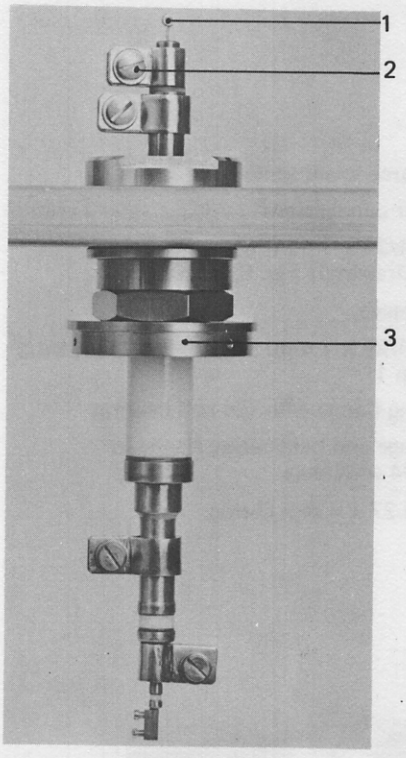



Fig. 15 High voltage lead-in

1. Wehnelt connection
2. Heater current connection
3. Protection tube holding plate

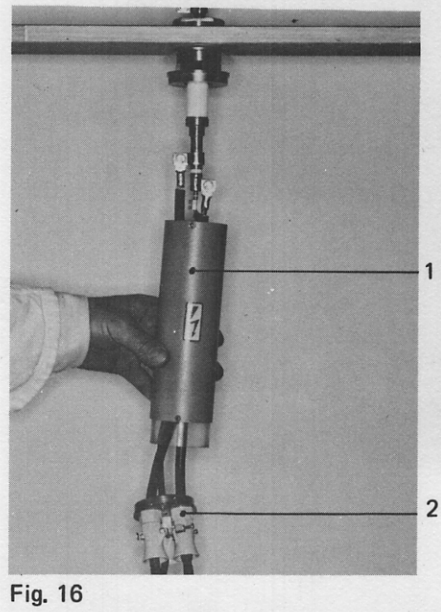



Fig. 16

1. Protection tube (with the insulation tube pushed into position)
2. Cable union plate

### 4.2. Mounting the high voltage lead-in

a. If the high voltage lead-in has not been completely dismantled, the following components must be removed: the protection tube, insulation tube, nut (M30 x 1.5) and connection plate to which the external cable is attached.

b. Thread the high current cable (white) and the Wehnelt cable (red) through the appropriate cable connectors.

c. Fit the lead-in from above, taking care not to damage the seal and fix in place with the nut and washer (M 30 x 1.5). Push the insulation tube up into position.

d. Screw the protection tube holding plate with thread M 30 x 1.5 on the lead-in.

e. Push the insulation tube and the protection tube over the high current Wehnelt cable.

f. Screw the cable shoes of the high current cable to the appropriate clips on the lead-in.

g. Connect the Wehnelt cable.

h. Push the insulation tube and the protection tube up to the protection tube holding plate and secure the protection tube with three M3 countersunk screws.

i. Push up the cable union plate and screw it to the protection tube with three M3 countersunk screws.

j. Tighten the cable union so that high current and Wehnelt cable are stress-free.

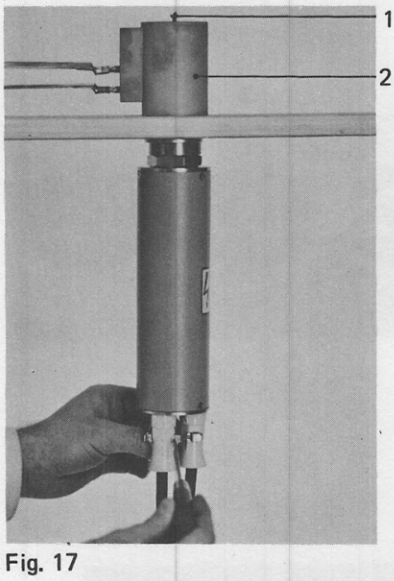



Fig. 17

1. Holder for the screen for the cathode power supply
2. Protection cover for the high voltage lead-in

### 4.3. Mounting the anode current lead-in and the anode current transformer

The high current lead-in (Fig. 13, item 6) acts as a current supply for the upper section of the anode (X-sweep). The lead-in must therefore be electrically insulated from the coating unit baseplate with 2 insulating plates, item 118 and 119 of the spare parts list BB 800 041 E / 6 and an insulating tube. If the underside of the coating unit baseplate is coated with an insulating protective film (anodised or brushed on), an earth line must be connected from the gun lead-in to the fixing angle 3 of the high current transformer. The connection from the lead-in to the anode is made with the installation material supplied, in accordance with the arrangement of the gun and high current lead-in. The coil current lead-in is mounted in the high current lead-in Fig. 13.

a. The anodised Al-high current lead-in is passed through the baseplate from above ($\phi$ 32.5 mm) and secured with the nut (M 30 x 1.5), simultaneously with the angle and insulation plate.

b. The nickel-plated copper angle is secured with the nut (M 20 x 1.5).

c. Attach the high current transformer to the angle item 142 of the spare parts list BB 800 041 E / 6, so that the high current contact can be made. The Cu-strip must be clamped between the Al-angle and the transformer.

d. Make the high current contact with the screw (M8) the nut and washer.

e. Make the coil connection with the nut M3.

f. Connect the primary connection to the 240 V inlet. If the sweep amplitude is too small, or if it becomes too small after a long operating period, the 220 V connection can be used. A changeover can also be made in the control unit EKS on the Variac from connection 240 V to the 220 V connection).

## 5. MAINTENANCE

### 5.1. Maintenance of the source ESQ 110

The ESQ 110 electron beam gun requires very little maintenance. None of its components is exposed to coating. The crucible cap and the deflection plate are the only parts to be cleaned, the frequency of cleaning depending on the quantity of material evaporated. It should be considered that it is not the source which requires periodic cleaning but the cleanness of evaporation. Thick layers deposited on the deflection plate can be re-evaporated because of the thermal radiation which is due to poor conductivity, although the cooling may be perfect. Therefore, to ensure perfect evaporation, we recommend regular cleaning of the crucible cap and the deflection plate. Do not use the crucible cap when working with the pot or the grooved crucible. In special cases it may be possible to work without the deflection plate (low beam power or use of a short, angle plate that does not protrude over the crucible) if the contamination of the evaporation source by the evaporant is very little. However, periodic cleaning is essential in any case (sand-blast).

It is advisable to change the gland seals every 400 hours of operation. If the crucible lower section is changed frequently, it may become necessary to replace the gland seals at shorter intervals.

Every 100 evaporation hours, dismantle the flat insulator and the two round insulators of the cathode holder and clean either mechanically (emery cloth) or chemically. The insulators are made of high purity $Al_2O_3$.

Service life of the cathode:

30 hours of evaporation or 200 evaporation cycles.

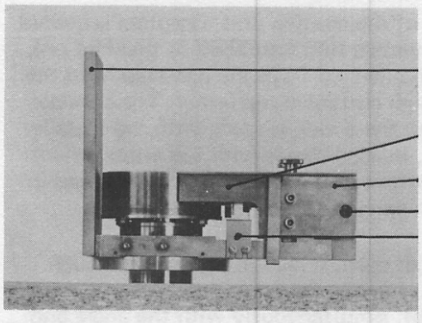



Fig. 18

1. Deflection plate
2. Cu-cap
3. Pole shoe
4. Coil connection
5. Coating shield for the flat insulator

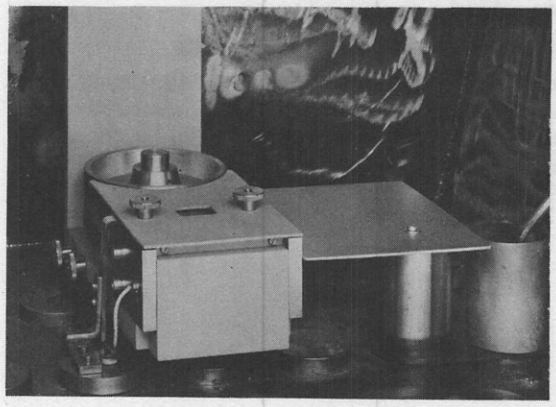


Fig. 19 Evaporation source complete with a grooved crucible

### 5.2. Changing the cathode

a. Remove the Cu-cap (two M5 milled nuts)

b. Remove the Wehnelt bar (two M2 countersunk screws)

c. Slacken the cathode holding screws (slotted screws M3)

d. Remove the old cathode

e. Insert the new cathode through the anode and into the hole in the holder

f. Insert the feeler gauge between the anode and Wehnelt

g. Press the cathode against the gauge and tighten the two cathode holder screws slackly

h. Mount the Wehnelt bar. Tighten the countersunk screws slackly. If new screws are being used it is advisable to give them a thin coating of Molykote beforehand.

i. Mount the Cu-mask.

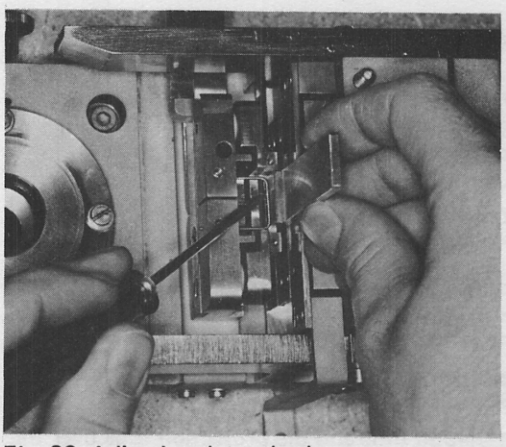


Fig. 20 Adjusting the cathode

### 5.3. Changing the crucible

In order to ensure that the evaporation source is ideal for the process, in addition to the electrical adjustments of the gun (beam power, acceleration voltage, focussing X-Y sweep) a range of interchangeable evaporation crucibles are provided. Three of these crucibles (4-way crucible No. 20-2751, oscillating crucible No. 20-2753 and the grooved crucible No. 20-2752) use the same crucible lower section 20-2673. Only the pot crucible 20-2737 has a special lower section. Therefore, it is only necessary to change the lower section if the pot crucible is to be changed for a different model or in reverse.

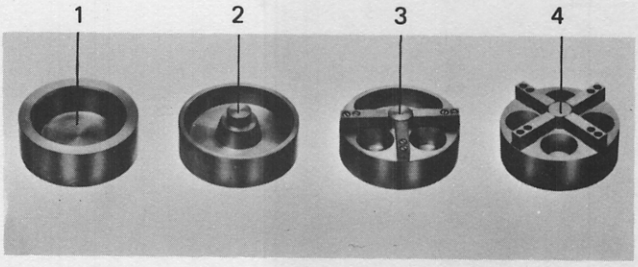



Fig. 21

1. Pot crucible
2. Grooved crucible
3. Oscillating crucible
4. 4 way crucible

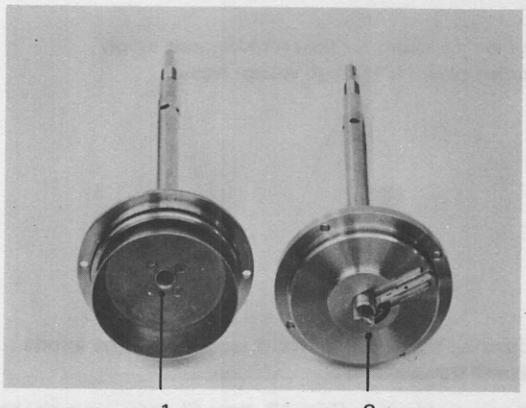



Fig. 22

1. Lower section for the pot crucible
2. Lower section for all the other crucibles

### 5.3.1. Changing the crucible without changing the lower section

The crucible is attached to the lower section by 4 steel bolts and nuts.

a. Switch off the gun water cooling. Connect the compressed air line to the water inlet and blow out the gun cooling system and the supply lines with compressed air.

b. Loosen the four M 3 nuts on the crucible lower section.

c. Using 2 screwdrivers as levers, lift the crucible off the lower section.

d. Mount a new crucible in the correct position (key-way) pressing it down with the hand. If necessary, apply a thin film of grease to the O-Ring beforehand.

e. Tighten the four M 3 nuts slackly.

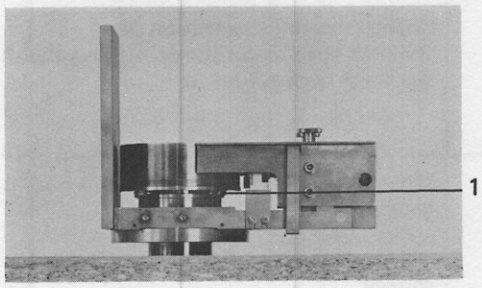



Fig. 23

1. Holding nuts (4 off on the periphery). When these nuts are loosened the crucible can be removed from the lower section.

### 9.3.2. Changing the crucible and the lower section

a. Switch off the gun water cooling. Connect the compressed air line to the water inlet and blow out the gun cooling water system and the supply lines with compressed air.

b. Remove the protection tube from the rotary drive EDE.

c. Remove the milled nut M 10 (rotary drive)

d. Lift the crucible with the lower section, upwards and out.

e. The new crucible lower section is pushed in from the top, downwards into the gun and rotated slightly (keyway) to bring it into position in the coupling. Fix in place with the milled nut M 10 and the distance sleeve (axial clearance 0.2 ÷ 0.5 mm).

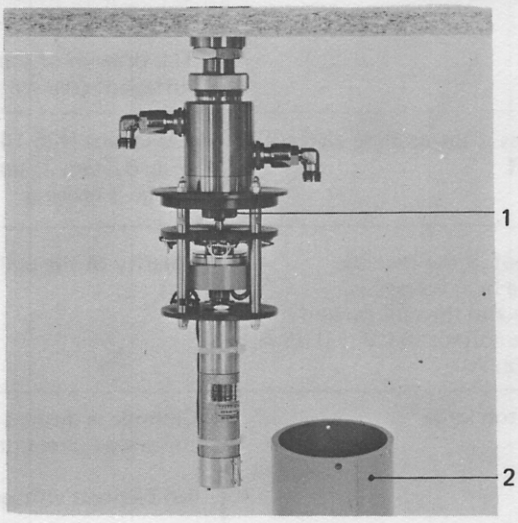



Fig. 24

1. Milled nut
2. Protection tube for the EDE

## 10. TROUBLESHOOTING

| Fault | Cause | Correction |
|---|---|---|
| The crucible is destroyed by the evaporant (alloying) | Beam spot is not in crucible centre. For pot crucibles: distance of beam-spot to crucible edge is too short | Correct the beam spot position |
| | Beam power is too high | Reduce the beam power |
| | Insufficient cooling | If Al is being evaporated in 4-way or grooved crucible, set "power limit" on EKS to 5.5 kW. |
| Arcing at high evaporation rates | Poor coverage of the high voltage installation | Carefully screen |
| Arcing at high pressure. Pressure peaks | The evaporant is outgassing too strongly | De-gas at reduced power |
| The evaporant is spitting too much | The electron beam power density is too high | Sweep or reduce the power |
| | Crucible is contaminated (e.g. from material previously evaporated) | Clean the crucible (e.g. sand-blast) |

| Fault | Cause | Correction |
|---|---|---|
| Crucible movement is jammed | Stains of evaporant on the crucible / Mask | Clean |
| | Milled nut on the crucible lower section (No. 7. Fig. 31) is too tight | Set clearance with the milled nut at approx. 0.3 – 0.5 mm and secure with the two M 5 screws |
| Pressure rises if the rotation is switched on or off | Gland seal H 25 – 14 25/38 x 6.5 (Fig. 6 item 2) under the bronze flange is leaking | Replace the gland seal |
| Pressure rises if the cooling water is switched on | O-Ring 80 x 4 (Item 18 of the spare parts list BB 800 041 E/1) is leaking | Replace the O-Ring |
| | The draw-in of the gland seal is insufficient (see sect. 4.1.) | Turn off 0.2 mm from Cr/Ni flange (machining) |
| Pressure rises if the cooling water is switched off | Gland seal H25-14 25/ 38 x 6.5 (Fig. 6, item 2) under the bronze flange is leaking | Replace the gland seal |
| No beam spot in the crucible although the high voltage is switched on and the coil current indication is correct (6 kV ~ 0.85 A, 10 kV ~ 1.55 A) | Polarity of the coil is incorrect | Change the coil connection on the plug strip under the coating unit with the earth connection |
| The spot is too large | Cathode is pushed too far in the anode direction | Move the cathode back (using a gauge) |
| | No Wehnelt voltage | Check the contact EHS 110 to Wehnelt shutter |

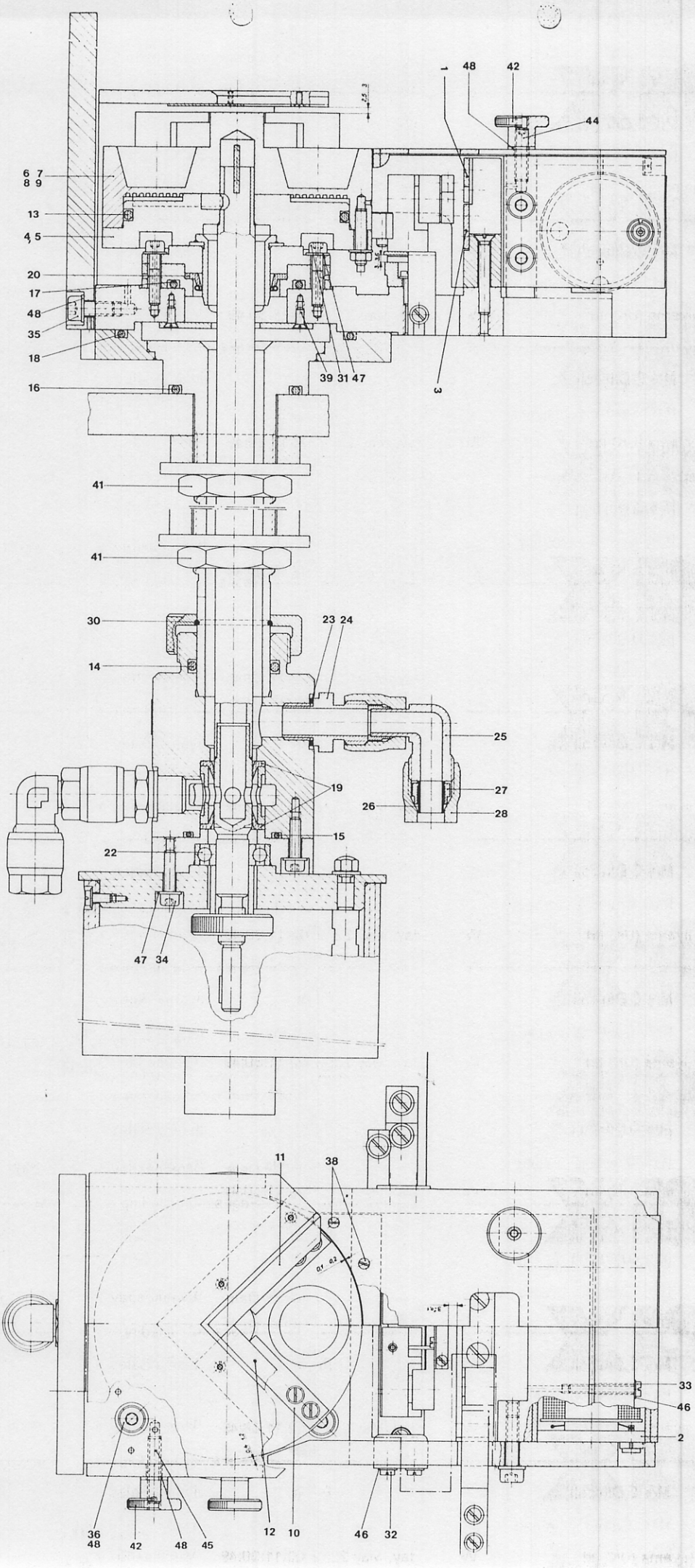
## 7. SPARE PARTS

Please order your spare parts according to the enclosed spare parts list.

Always state type and serial number as indicated on the name plate of the unit.

**Ordering Example**

1 O-ring, Viton, $\phi$ 40 x 4 mm, Code No. B 4070 644 PV, as to spare parts list BB 800 041 E / 1a, Item 16.




Electron beam evaporation source Elektronenstrahl-Verdampfungsquelle ESQ 110 20-2650 R1 BB 800 041 E/2a

| | Description<br>Teil | Item<br>Pos. | Code-No. Bestell-Nr. | | S | Remarks<br>Bemerkungen |
|---|---|---|---|---|---|---|
| 1 | Anode 1 | 1 | 20-2688 R1 | | | |
| 1 | Coil/Spule komplett | 2 | BK 204 031 X | | | |
| 1 | Anode 2 | 3 | 20-2689 R1 | | | |
| 1 | Holder/Halter | 4 | 20-2673 R1 | | | to/zu Pos.6,7,8 |
| 1 | Holder/Halter | 5 | 20-2734 R1 | | | to/zu Pos.9 |
| 1 | 4-way crucible/Vierlochtiegel | 6 | 20-2751 R1 | | | |
| 1 | Oscillating crucible/Pendeltiegel | 7 | 20-2753 R1 | | | |
| 1 | Grooved crucible/Rinnentiegel | 8 | 20-2752 R1 | | | |
| 1 | Pot crucible/Einlochtiegel | 9 | 20-2737 R1 | | | |
| 4 | Bar/Steg | 10 | BK 202 669 A | | | to/zu Pos.6,7 |
| 1 | Screening/Schirmblech | 11 | 20-2695 P1 | | | |
| 1 | Screening / Schirmblech | 12 | 20-2696 P1 | | | |
| 1 | O-Ring, Viton, $\phi$ 76 x 4 | 13 | B 4071 063 PV | | | |
| 1 | O-Ring Neoprene, $\phi$ 27 x 4 | 14 | B 4070 468 PN | | | |
| 1 | O-Ring, Neoprene, $\phi$ 29,2 x 3 | 15 | B 4070 501 PN | | | |
| 1 | O-Ring, Viton, $\phi$ 40 x 4 | 16 | B 4070 644 PV | | | |
| 1 | O-Ring, Viton, $\phi$ 42 x 4 | 17 | B 4070 675 PV | | | |
| 1 | O-Ring, Viton, $\phi$ 80 x 4 | 18 | B 4071 092 PV | | | |
| 2 | L-ring gasket/Hutmanschette H 14-4 14/24 x 7 | 19 | B 4079 155 P | | | |
| 1 | L-ring gasket/Hutmanschette H 25-14 25/38 x 6,5 | 20 | B 4079 309 VN | | | |
| | | 21 | | | | |
| 1 | Ball bearing/Rillenkugellager 6001 12/28 x 8 | 22 | N 4001 318 | | | |
| 2 | Seal ring/Dichtring SO 7-G 1/4, Cu | 23 | B 4119 532-K | | | |
| 2 | Nipple/Einschraubnuppel SO 1100-10-M 14 | 24 | B 4101 537 MN | | | |
| 2 | Angle/Einstellwinkel SO 2600-10 | 25 | B 4133 405 GN | | | |
| 2 | Sleeve/Stützhülse SO 18,3 - 10/8 | 26 | B 4119 418 X | | | |
| 4 | Clamping ring/Klemmring SO 18,1 - 10 | 27 | B 4119 367 X | | | |
| 4 | Socket joint /Anschlussmutter, SO 20-10-G3/8 | 28 | B 4117 569 GN | | | |
| | | 29 | | | | |
| 1 | Spring ring/Federring | 30 | 20-2666 P1 | | | |
| 4 | Screw/Schraube M4 x 20 | 31 | 20-2733 P1 | | | |
| 4 | Screw/Schraube M3 x 6 | 32 | N 3052 189 X | | | Inox |
| 2 | Screw/Schraube M3 x 25 | 33 | N 3052 203 X | | | Inox |
| 8 | Screw/Schraube M4 x 16 | 34 | N 3059 259 X | | | Inox |
| 2 | Screw/Schraube M5 x 12 | 35 | N 3059 292 X | | | Inox |
| 4 | Screw/Schraube M5 x 16 | 36 | N 3059 296 X | | | Inox |
| | | 37 | | | | |
| 8 | Screw/Schraube M2 x 6 | 38 | N 3111 114 X | | | |
| 2 | Screw/Schraube M3 x 8 | 39 | N 3111 191 X | | | Inox |
| | | 40 | | | | |
| 1 | Nut/Mutter M30 x 1,5 Ms | 41 | BN 790 249 | | | |
| 1 | Milled nut/Rändelmutter M5 | 42 | N 3477 120 X | | | Inox |
| 1 | Threaded pin/Gewindestift M4 x 8 | 43 | N 3211 251 X | | | * Inox |
| 2 | Threaded pin/Gewindestift M5 x 20 | 44 | N 3208 298 X | | | Inox |
| 4 | Threaded pin/Gewindestift M5 x 25 | 45 | N 3208 301 X | | | Inox |
| 6 | Washer/Scheibe 3,2/7 x 0,5 | 46 | N 3502 412 X | | | Inox |
| 12 | Washer/Scheibe 4,3/9 x 0,8 | 47 | N 3502 414 X | | | Inox |
| 12 | Washer/Scheibe 5,3/10 x 1 | 48 | N 3502 416 X | | | Inox |
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*not seen in the picture/nicht ersichtlich

**Spare Parts for / Ersatzteile zu** **20-2650 R1**

**Electron beam evaporation source/Elektronenstrahl-Verdampfungsquelle ESQ 110**

**BB 800 041 E / 1a**

| | Description<br>Teil | Item<br>Pos. | Code-No. Bestell-Nr. | S | Remarks<br>Bemerkungen |
|---|---|---|---|---|---|
| 1 | Beam/Balken | 75 | 20-2697 P1 | | |
| 1 | Pile bents/Joch | 76 | 20-2698 P1 | | |
| 1 | Wehnelt holder/Wehneltträger | 77 | 20-2699 P1 | | |
| 1 | Wehnelt plate/Wehneltblech | 78 | BK 202 702 | | |
| 1 | Wehnelt plate/Wehneltblech | 79 | BK 202 703 | | |
| | | 80 | | | |
| 1 | Cathode/Kathode | 81 | BK 202 704 A | | |
| 1 | Cathode holder/Kathodenhalter | 82 | 20-2718 P1 | | |
| 1 | Cathode holder/Kathodenhalter | 83 | 20-2719 P1 | | |
| | | 84 | | | |
| 1 | Insulator/Isolator | 85 | BK 202 700 | | |
| 2 | Insulator/Isolator | 86 | BK 202 701 | | |
| 2 | Ceramics part/Einzeltülle | 87 | B 4622 251 TN | | |
| | | 88 | | | |
| 1 | Wire/Draht, $\phi$ 1 x 500,Ni 99,8 | 89 | B 2220 140-W | | |
| 1 | Adjusting gauge/Einstellehre | 90 | 20-3014 P1 | | |
| | | 91 | | | |
| 1 | Screw/Schraube M3 x 4 | 92 | N 3052 186 X | | Inox |
| 4 | Screw/Schraube M3 x 6 | 93 | N 3052 189 X | | Inox |
| 2 | Screw/Schraube M3 x 10 | 94 | N 3052 193 X | | Inox |
| 2 | Screw/Schraube M3 x 16 | 95 | N 3052 198 X | | Inox |
| 2 | Screw/Schraube M2 x 6 | 96 | N 3111 114 X | | Inox |
| 2 | Screw/Schraube M2 x 8 | 97 | N 3111 116 X | | Inox |
| 2 | Screw/Schraube M3 x 8 | 98 | N 3111 191 X | | Inox |
| | | 99 | | | |
| 2 | Threaded pin/Gewindestift M3 x 5 | 100 | N 3204 188 X | | Inox |
| 1 | Threaded pin/Gewindestift M4 x 8 | 101 | N 3208 251 X | | Inox |
| | | 102 | | | |
| 2 | Screw/Schraube M4 x 8 | 103 | N 3052 251 X | | Inox |
| 1 | Screw/Schraube M4 x 10 | 104 | N 3052 253 X | | Inox |
| | | 105 | | | |
| 3 | Washer/Scheibe 3,2/7 x 0,5 | 106 | N 3502 412 X | | Inox |
| 3 | Washer/Scheibe 4,3/9 x 0,8 | 108 | N 3502 414 X | | Inox |

**Spare Parts for / Ersatzteile zu**

**Cathode to ESQ 110 / Kathode zu ESQ 110 20-2720 d R1**

**BB 800 041 E / 4a**

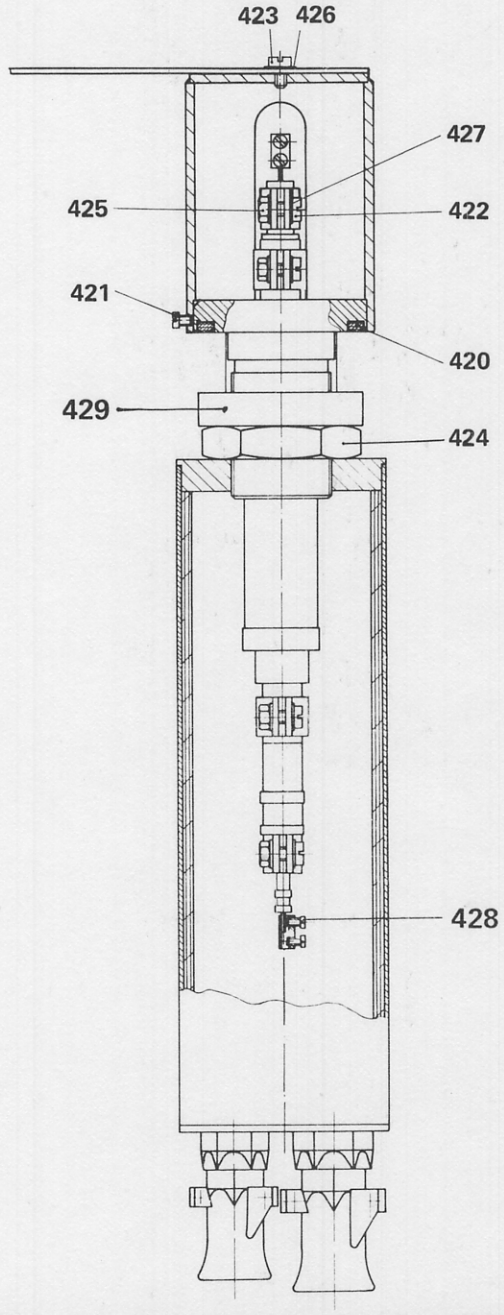
| | Description<br>Teil | Item<br>Pos. | Code-No. Bestell-Nr. | S | Remarks<br>Bemerkungen |
|---|---|---|---|---|---|
| 1 | Lead-in/Durchführung | 115 | 20-2901 P1 | | |
| 1 | Connection ring/Abschlussring | 116 | 20-2903 P1 | | |
| 2 | Sleeve/Hülse | 117 | 20-2906 P1 | | |
| 1 | Washer/Scheibe | 118 | 20-2907 P1 | | |
| 1 | Washer/Scheibe | 119 | 20-2908 P1 | | |
| 1 | Ring | 120 | 20-3301 P1 | | for/für BA510/ |
| 1 | Insulating ring/Isolierring | 121 | 20-3018 P1 | | 710 |
| | | 122 | | | |
| 1 | High current transformer/Hochstromtransformator | 123 | BG 202 995 | | |
| 1 | Ceramics part/Einzeltülle | 124 | BO 326 031 | | |
| 1 | Hose/Schlauch RNF 100 Sw | 125 | B 4616 718 AA | | |
| | | 126 | | | |
| 1 | O-Ring, Viton, $\phi$ 40 x 4 mm | 127 | B 4070 644 PV | | |
| 1 | O-Ring, Viton, $\phi$ 2,9 x 1,78 mm | 128 | B 4070 019 PV | | |
| | | 129 | | | |
| 4 | Screw/Schraube M4 x 12 | 130 | N 3052 255 X | | Inox |
| 1 | Screw/Schraube M10 x 20 | 131 | N 3015 471 X | | |
| 1 | Screw/Schraube M4 x 10 | 132 | 20-2905 P1 | | |
| 4 | Nut/Mutter M3 | 133 | N 3415 037 X | | Inox |
| 4 | Nut/Mutter M4 | 134 | N 3415 039 X | | " |
| 2 | Nut/Mutter M10 | 135 | N 3415 051 X | | " |
| 1 | Nut/Mutter M20 x 1,5 | 136 | N 3410 124 MN | | Ms |
| | | 137 | | | |
| 6 | Washer/Scheibe 3,2/7 x 0,5 | 138 | N 3502 412 X | | Inox |
| 18 | Washer/Scheibe 4,3/9 x 0,8 | 139 | N 3502 414 X | | " |
| 2 | Washer/Scheibe 10,5/21 x 2 | 140 | N 3502 424 X | | " |
| 1 | Washer/Scheibe 21/37 x 3 | 141 | N 3502 434 X | | |
| 1 | Angle/Winkel | 142 | 20-3016 P1 | | |

**Spare Parts for / Ersatzteile zu**

**High current lead-in/Hochstromdurchführung 20-2900 c R1**

**BB 800 041 E/6a**

| | Description<br>Teil | Item<br>Pos. | Code-No. Bestell-Nr. | | S | Remarks<br>Bemerkungen |
|---|---|---|---|---|---|---|
| 1 | O-Ring, Viton $\phi$ 40 x 4 | 420 | B 4070 644 PV | | | |
| 1 | Screw/Schraube M3 x 4 | 421 | N 3052 186 X | | | |
| 4 | Screw/Schraube M5 x 12 | 422 | N 3052 292 X | | | |
| 1 | Screw/Schraube M4 x 6 | 423 | N 3052 249 X | | | |
| 1 | Nut/Mutter M30 x 1.5 | 424 | BN 790 249 | | | |
| 4 | Nut/Mutter M5 | 425 | N 3415 041 X | | | |
| 1 | Washer/Scheibe 4,3/9 x 0,8 | 426 | N 3502 414 X | | | |
| 8 | Washer/Scheibe 5,3/10 x 1 | 427 | N 3502 416 X | | | |
| 1 | Terminal/Klemme | 428 | B 465510 701 | | | |
| 1 | Washer / Scheibe | 429 | BN 790 250 | | | |




Spare Parts for / Ersatzteile zu 20-2880 b R1

High voltage lead-in / Hochspannungsdurchführung

BB 800 041 E / 20a