

Cross-Beam Ion Source

A Product of BALZERS AG, Balzers

Operating Instructions No. BK 800 015 BE

BALZERS

Issued: February 1975 / DN 6291



1. APPLICATION

The Electron Impact Ion Source with twin cathodes is shown in Fig. 1. The electron path is kept perpendicular to the direction of ion extraction. This particular source is intended for the mass spectrometers QMG 101, QMG 311, and QMG 511. Besides being very useful for partial pressure measurements, this source is especially designed for the investigation of molecular beams.

The open design of the source allows the beam to be shot through the sensitive volume perpendicular to the electron beam and ion extraction direction without collision with the source electrodes. This makes the source especially suitable for measurements with high reactive substances, which can be condensed at a cryogenic surface behind the source. By this means dissociation by wall collision is greatly reduced. The source is made from sheet metal to keep the heat capacity of the various parts as small as possible, thus resulting in a rapid heatup and correspondingly low contamination of these parts. Furthermore, electron bombardment degassing is possible. The open construction permits rapid response to variations of partial pressure in vacuum systems, while still maintaining a high degree of accuracy.

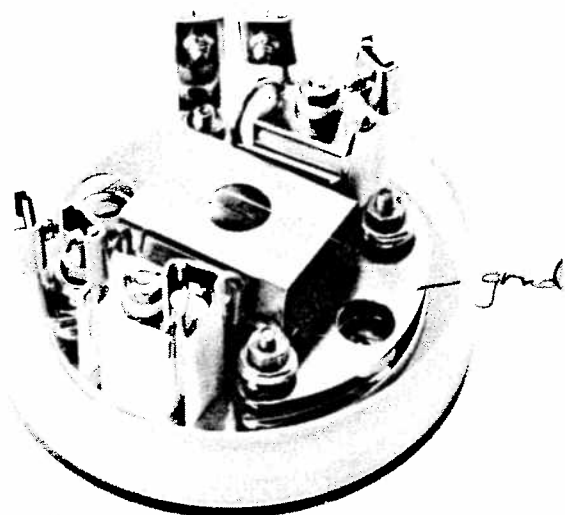


Fig. 1 Ion Source (with lower portion of transport and storage container)

2. GENERAL INFORMATION

2.1. Shipment

The ion source as shown in Fig. 1 is delivered in a plastic transport and storage container. Only two screws are required to fix it on the quadrupole mass filter. A centering pin is included in the shipment to facilitate the alignment. For each ion source, the corresponding wiring must be procured and installed (see accessories, section 9).

In a case where a complete analyzer head has been ordered, the ion source and associated wiring is already installed.

2.2. Electrode Configuration and Principle of Operation

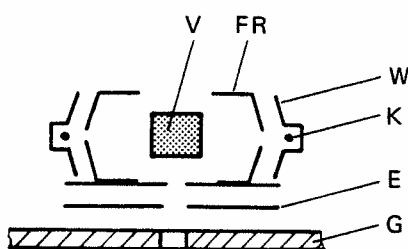


Fig. 2.1.

Electrons emitted by cathode (K) enter the sensitive volume via the entrance slit in (FR). Wehnelt electrode (W) is kept at cathode potential, and confines the electrons to a narrow and flat bundle. Ions generated by electron impact are extracted by electrode (E) and subsequently injected into the mass filter via a centrally located opening in the base plate (G) of the analyzer.

2.3. Cathode Assembly

2.3.1. Rhenium Cathode (Standard)

Filament and Wehnelt electrodes are mounted on a ceramic bloc and repositioned as shown in Fig. 2.2.

The filament is made of a rhenium wire of 0.2 mm diameter, Rhenium shows a remarkable resistance to the so-called "water cycle" that rapidly destroys tungsten filaments, it is not embrittled neither by recrystallisation nor in the presence of hydrocarbon vapors, because it does not form a carbide.

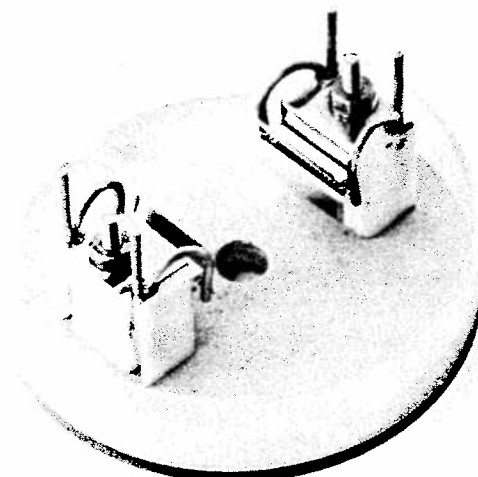


Fig. 2.2. Cathode assemblies with rhenium filaments in transport container

2.3.2. Tungsten Cathode

The cathode assembly is similar to the one shown in Fig. 2.2; however, the cathode filament is a straight tungsten wire. Tungsten cathodes are employed whenever the higher vapor pressure of the rhenium cannot be tolerated, or whenever a longer operational life is required as compared with the rhenium cathode.

3. TECHNICAL SPECIFICATIONS

3.1. Physical Dimensions and Other Data

Diameter	30 mm (~ 1.2 in.)
Height	20 mm (~ 0.8 in.)
Height to center of sensitive volume	8 mm (~ 0.32 in.)
Mounting screws	M 1.6 x 3 mm
Bolt circle	24 mm (~ 0.96 in.)
Electrical connections	Screw terminals

$$\text{Sensitivity} = \frac{\text{Ionization current}}{\text{Emission current} \times \text{pressure}} = 1 \text{ torr}^{-1}$$

Maximum operational pressure 1×10^{-4} torr

3.2. Cathodes

Number	2
Material	Rhenium (helix-wire) Tungsten (straight-wire)
Filament current (depending upon material)	2 to 4A
Filament voltage	2 to 5 V

3.3. Operational Parameters with QMG 101, 311, 511

Mode of operation	Constant emission
Emission current	Up to 2 mA
Acceleration potential: QMG 101	Fixed 100 V, or adjustable approx. 30 to 100 V
	QMG 311 (V5) Adjustable approx. 30 to 100 V
	QMG 511 (V1) Adjustable approx. 30 to 120 V (*)
Formation potential: QMG 101, 311 (V3)	0 to + 200 V to ground
	QMG 511 (V4) 0 to + 150 V to ground (*)
Extraction potential: QMG 101, 311 (V1)	0 to - 150 V to ground
	QMG 511 (V6) 0 to - 300 V to ground

(*) dependent to selected emission current.

3.4. Degassing of Ion Source

Cathode		grounded
Formation chamber	QMG 101, 311	+ 600 V
	QMG 511	+ 540 V
Extraction electrode:	QMG 101, 311	grounded
	QMG 511	V 4
Emission current:	QMG 101, 311	4 - 10 mA
	QMG 511	2 - 10 mA
Mode of operation		Constant emission

3.5. Material

Cathode	Rhenium, Tungsten
Insulators	Ceramic
Cathode support	Molybdenum
Others	Stainless steel

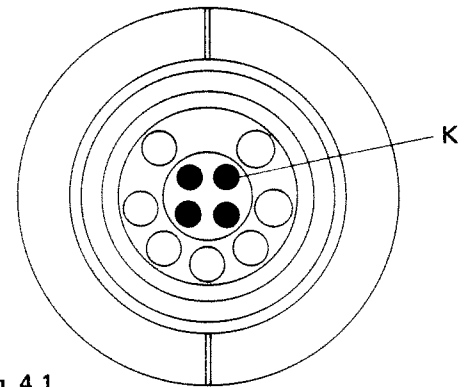


Fig. 4.1.

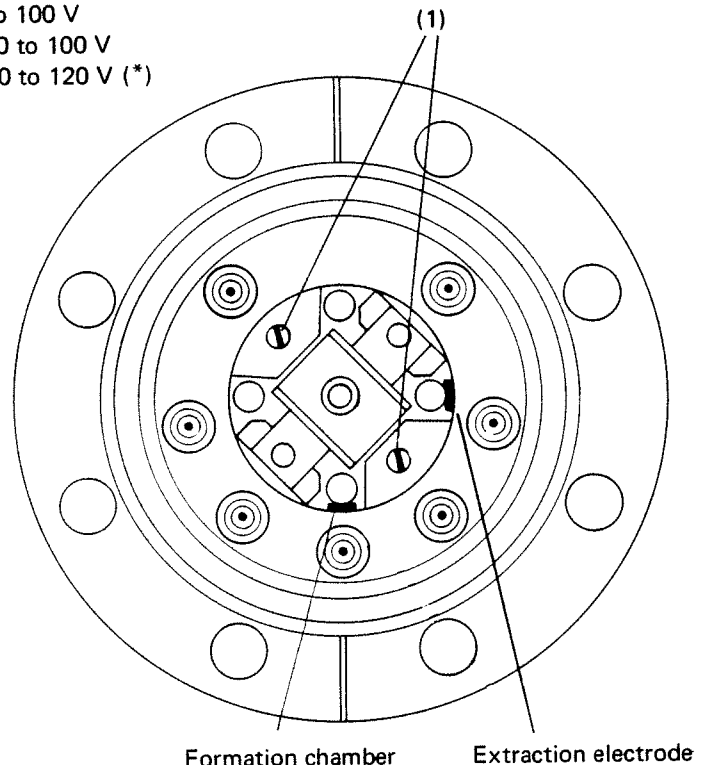


Fig. 4.2. Correct Position of Ion Source (two mounting screws (1), and electrical connections for formation chamber and extraction electrode are shown). With oder models the terminals may be reversed.

4. INSTALLATION OF ION SOURCE

- 4.1. Insert quadrupole mass filter vertically into opening of the wooden frame.
- 4.2. Remove existing ion source and/or cover plate. Four ceramic studs (K) will now be visible near the end plate of the QMA 140 (Fig. 4.1.)
3. Remove cover from transport and storage container and unfasten the ion source by removing two screws (1) as shown in Fig. 7.1.
4. Install the ion source with the above screws (1) at the front end of the mass filter as shown in Fig. 4.2.

5. ELECTRICAL CONNECTIONS

5.1. Electrical Connections between Feedthroughs and Ion Source

- 5.1.1. Connect the wiring as delivered to the corresponding feedthrough terminals as shown in Fig. 5.1.1.
2. Connect one wire each to machine screw terminals (3, 4, 5) of the ion source as shown in Fig. 5.1.2. While tightening the screws (3,4,5), U-washer (6) must be held securely by the jaws of suitable pliers.
3. Using an Ohmmeter that has a measuring range of about 10 MΩ, determine the insulation resistance of each conductor against ground as well as against other conductors which are not electrically connected to each other.
4. The cathodes assembly has to be installed exactly parallel to formation chamber electrode (FR); any misalignment should be corrected at once.
5. The mass filter is now ready for operation and may be installed in the vacuum chamber or bell jar.

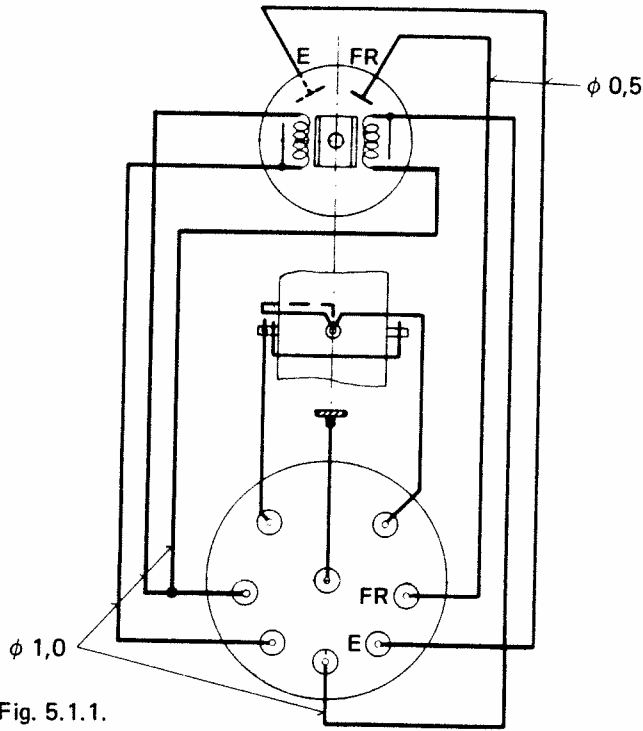


Fig. 5.1.1.

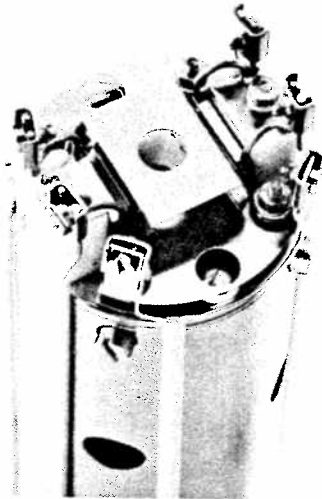


Fig. 5.1.2.

5.2. Electrical Connections between Analyser and Control Unit

5.2.1. Connections to QMG 311

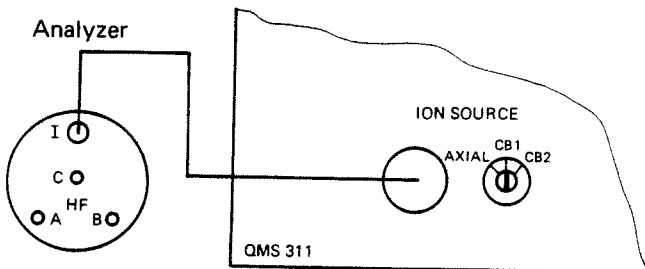


Fig. 5.2.

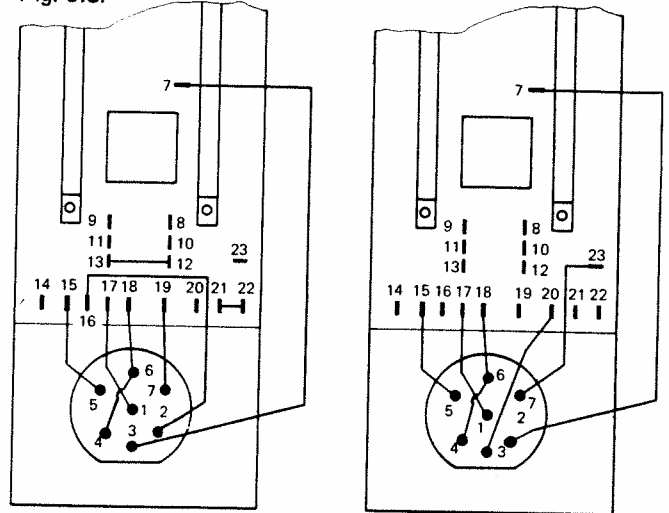
Turn selector switch "ION SOURCE" (located at the rear panel) to CB1 and connect multipole socket "ION SOURCE" of QMG 311 with the 5-connector socket of the analyser head signed "I" with the appropriate cable. By switching to CB2, the second cathode may be utilized.

5.2.2. Connections to QMG 511

Whenever an axial ion source was in use previously, the rear cover of the ion source supply must be removed and the electrical wiring changed according to Fig. 5.3.

Replace rear cover and connect 7-pole sockets of ion source supply and analyser with appropriate cable. The selector switch permits the operation of both cathodes in series or individually.

Fig. 5.3.

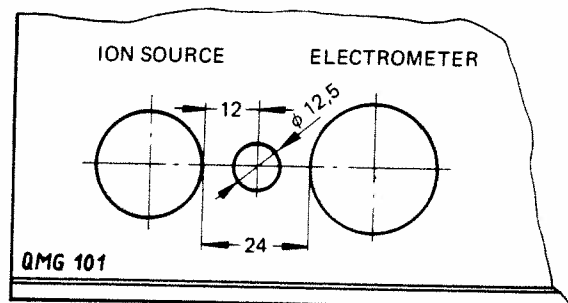


Axial			Cross Beam		
Plug	Board		Plug	Board	
2	16		2	7	
3	7		3	20	
7	19		7	23	
	21 - 22	Bridge		21, 22	Remove bridge
	12 - 13	"		12, 13	
1	17		1	17	
4 - 6	18		4 - 6	18	
5	15		5	15	

5.2.3. Connections to QMG 101

This requires some minor mechanical as well as electrical modification. First, a hole must be drilled into the rear panel as shown in Fig. 5.4. Second, a rotary switch (ELMA Company, Order No. 01-4x3) it is recommended to shorten the shaft of the switch and to cut a screwdriver slit into the stubby end. A modified switch may also be obtained from BALZERS AG, (Order No. BG 516 800 -T). Third, the

Fig. 5.4.



switch has to be wired as shown in Fig. 5.5. In position (a) the axial beam ion source may be used, whereas in position (b), cathode (1), and in position (c), cathode (2) of the Cross-Beam Ion Source will be energized.

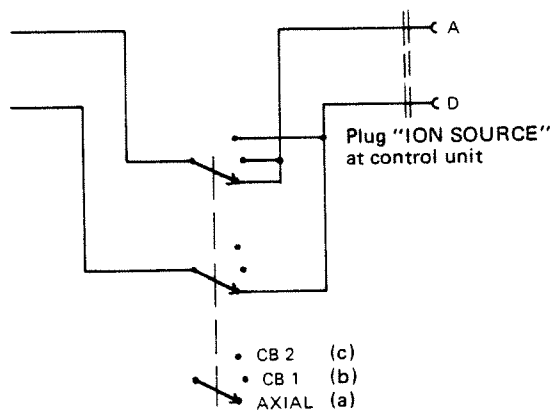


Fig. 5.5.

In cases where the above alterations are not desirable, the following changes in the electrical wiring between connector plate and feedthroughs may be made (Fig. 5.6.).

Remove feeder wire from terminal (G), bend away, and insulate, if necessary, with electrical tape. Cathode (K1) can now be operated.

When cathode (K1) becomes defective, and cathode (K2) should be energized, use the wire enclosed in the shipment to establish a connection between (f1) and (G) (dotted line).

Whenever (K2) should be used while (K1) is still operational, remove plug from feedthrough (f1).

In cases where (K1) and (K2) should be operated in parallel, connect (f1) and (G), and do not remove plug from (f1).

This particular operation is feasible; however, it may be necessary to readjust the filament protection (potentiometer E) by turning it clockwise.

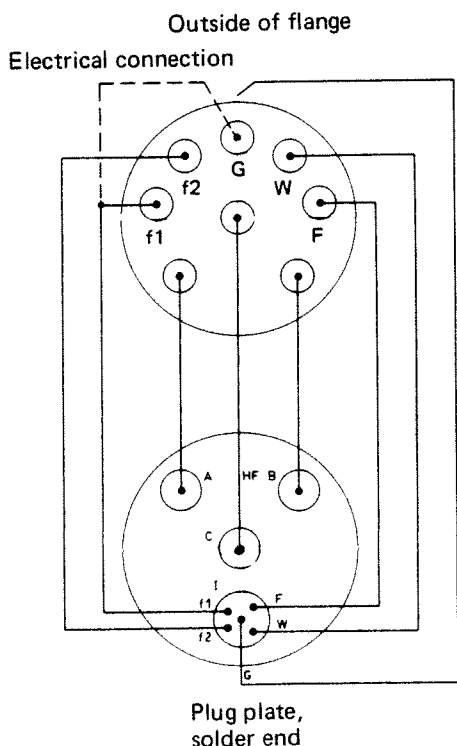


Fig. 5.6.

6. OPERATION OF ION SOURCE AND MASS FILTER WITH QMG 101, QMG 311, OR QMG 511

CAUTION

Do not operate ion source unless total pressure in work chamber or bell jar is less than 10^{-4} torr (10^{-2} N/m²).

6.1. Initial Operation of Ion Source

- 6.1.1. Connect analyzer and quadrupole control unit (see section 5 and operations manual ANALYZER). Turn control on and tune HF (see manual of QMG).
2. Set ionization potential at 100 V (QMG 101: fixed or adjustable at rear panel; QMG 311: V5; QMG 511: V1).
3. Adjust formation chamber potential with potentiometer to 40 V (QMG 101 and QMG 311: V3; QMG 511: V4)
4. Field axis potential should be about 15 V below the formation chamber potential (QMG 101 and 311: V4 \approx 25 V; QMG 511: V3 \approx 15 V)
5. Extraction voltage
QMG 101 and 311: V1 = -150V (measured against cathode)
QMG 511: V6 = -200 V (measured against ground)
6. Set EMISSION COARSE to 0.2 to 1 mA (QMG 101 and QMG 311); emission control FINE, or potentiometer (N) of the QMG 511 fully counterclockwise.
7. Turn emission on and regulate current to a value of 1 mA (see also 6.3.).

Note: Whenever the formation chamber potential is found to be smaller than the ionization potential, the cathode becomes negative in respect to ground, and electrons are lost to the environment. This could affect the accuracy of neighboring ionization gauges. Hence, to measure the total pressure correctly, the emission of the quadrupole mass analyzer must be either off or the formation chamber potential must be kept above the ionization potential.

- 6.1.8. For determination of the ion current or recording of mass spectrograms, refer to manual of the corresponding QMG.
9. The sensitivity of a mass analyzer using the Cross-Beam Ion Source depends upon the formation chamber potential for constant ion energy within the mass filter (in QMG 101 and QMG 311: proportional to V3 - V4, QMG 511: V3). Figure 6.1. depicts the qualitative relationship. The maximum sensitivity lies between 30 and 60 V.

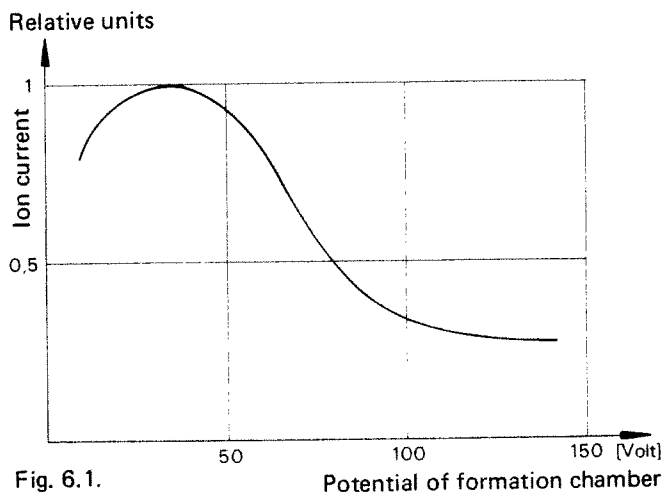


Fig. 6.1.

6.2. Optimization of Ion Source Potentials

Note: Gas should be admitted to the vacuum system to rise the pressure to twice the residual pressure, if possible.

- 6.2.1. Set ion energy "high", e.g.
QMG 101 and QMG 311: V4 = 0
QMG 511: V3 = 30 to 50 V.

Set QMG to the maximum of the integral spectrum signal (DC OFF) and tune formation chamber potential to obtain the largest ion current intensity.

2. Adjust extraction potential for the largest ion current reading (QMG 101 and QMG 311: V1; QMG 511: V6).
3. Reduce field-axis potential and corresponding ion energy to a point where the ion current starts rapidly to drop.
4. Run a test spectrum. If the peaks should still contain some spikes, exchange HF cables at one end and/or reduce ion energy further.

6.3. Operation with Small Ionization Potential

When the ionization potential is small (< 40 V), the emission current should not exceed 0.2 mA to prevent cathode burnout.

6.4. Operation at High Ambient Pressure

Above 10^{-5} torr, space charge effects become noticeable, especially with large emission currents. For maintaining adequate linearity in the higher pressure regions, the emission current should be kept below 0.2 mA.

7. MAINTENANCE

As long as the analyzer is correctly operating, no maintenance is required. However, depending upon operational conditions, the source and/or the mass filter may become coated with residues or contaminants while operating in hostile environments. This is especially true if hydrocarbons are present. Electron interaction with these vapors results in a variety of organic polymers, producing electric field distortions or other undesirable effects. Thus the sensitivity and resolution of the instrument is adversely affected.

Furthermore, these films result in leakage currents of otherwise insulating elements and source voltages may change uncontrollably. Whenever a positive or negative emission current is noted while the filament heating is off, the insulation between cathode and ground is defective.

Such effects are temperature as well as pressure sensitive and may or may not disappear when the system is brought back to atmospheric pressure. It is recommended to replace the insulating elements and perhaps the cathode(s) as well, to eliminate the reoccurrence of this effect.

7.1. Dismantling the Ion Source (Fig. 7.1.)

- 7.1.1. Remove analyzer from vacuum system and insert vertically into pre-cut opening of wooden frame.
2. Remove wires of ion source by holding U-clamp (6) with flat nose pliers while unfastening terminal screws. To free now the whole ion source from the mass filter if necessary, remove screws (1).
3. Remove nuts (2), cathode assembly (8), and insulating bushings (7).

4. Remove four nuts (13), formation chamber (11), extraction plate (12), and shield washers (14, 15). Finally, remove screws (1) and take off base plate (10).

7.2. Cleaning of Ion Source

Experience has shown that a fiberglass brush is very helpful in mechanically cleaning the various electrodes of the ion source. Inside the formation chamber, a fine polishing cloth (No. 400 – 600), rolled into a cylinder of about 4 mm in diameter is recommended for the removal of unwanted films.

CAUTION

Do not use excessive force in cleaning the formation chamber. Permanent deformation may result because of the thin sheet metal employed.

Following the above cleaning operation, the parts should be washed in Freon TF with a few percent methanol added, followed by a final alcohol rinse. The cleaned parts may then be dried with warm air and subsequently re-assembled using lint-free gloves.

Figure 7.1. shows the complete assembly with all of the parts in their corresponding position. Please note that the centrally located shield washers (15) have larger holes. In case of substantial contamination of the ion source, the insulating elements should all be replaced and the ion entrance hole of the mass filter cleaned with the rolled-up polishing cloth described above.

Should the base stay in place during the cleaning procedure, the mass filter must be held upside down to avoid debris falling into the filter.

It might be advisable to clean the rods of the mass filter whenever a strong contamination is noticeable near or around the entrance hole. (See manual of the respective analyzer.)

7.3. Degassing of the Ion Source

The degassing step is only useful in pressure regions below 10^{-8} torr. The largest tolerable emission current is about 10 mA, and the degassing time should not exceed 5 min.

Because of the sheet metal construction, the electrodes do not really need a separate degassing cycle; they become hot enough while operating under normal conditions.

7.4. Cathode Replacement

Replacement cathodes and Wehnelt electrodes, as delivered, are mounted upon ceramic insulators as shown in Fig. 2.2.

- 7.4.1. Remove analyzer and insert vertically into hole of wooden frame.
2. Remove machine screws (3) and U-washers (6) (Fig. 7.1.).
3. Unscrew nut (2) and remove cathode assembly and insulating bushing.
4. Unscrew nut (2) from new cathode assembly, remove from container, and slip over bolt (9).
5. Make sure that insulating bushing (7) is properly seated, then tighten nut (2). The Wehnelt electrode must be parallel to the formation chamber (see also 5.1.4.).
6. Reconnect wires with U-washers (6) and machine screws (3) according to Fig. 7.1. Great care should be exercised in tightening the screw connections to avoid any damage to the delicate ceramic holding of the cathode filament.

7. Check electrical insulation against formation chamber, extraction electrode and ground. Cathode should be positioned exactly in center of channel of the Wehnelt electrode, and at the same height as the slit in the formation chamber. This completes the cathode replacement, and the ion source is ready for installation into the mass filter.

Ansicht A - A

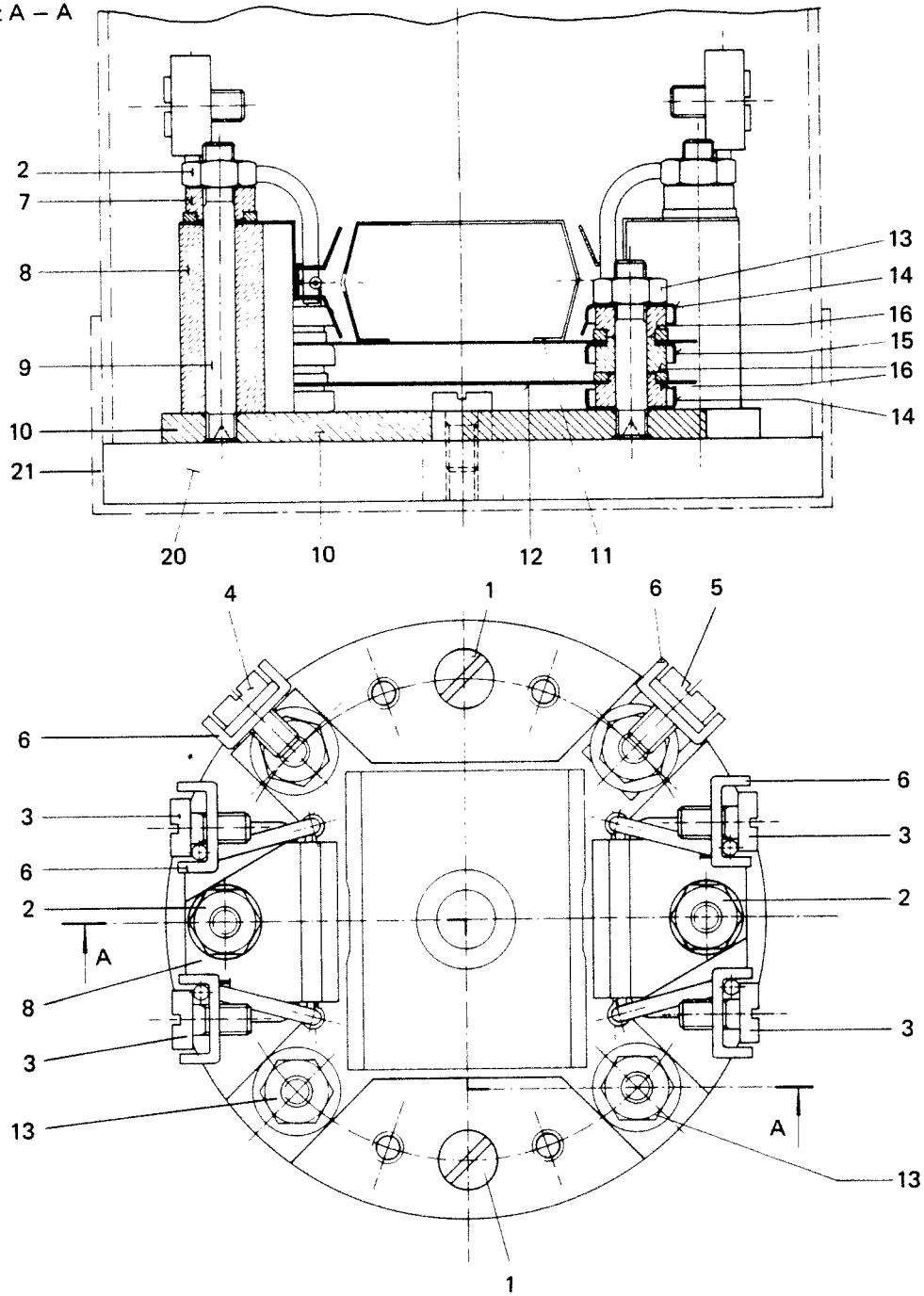


Fig. 7.1.

8. TROUBLESHOOTING

Remarks concerning the QMG 311 are also valid for the QMG 101. Voltage V5 of the QMG 311 corresponds to the ionizing voltage of the QMG 101.

Symptom	Probable Cause	Remedy
8.1. Emission cannot be turned on, cathode will not glow, indicator will not light	a) Short circuit in heater board b) Short circuit in ion source cable	Locate short circuit and fix it Check cable, repair or replace
8.2. Emission indicator will not light No emission	a) Ion source not connected b) Break in cable c) Cathode burned out	Turn FIL OFF, then connect cable Repair or replace cable Check resistance of cathode at connection
8.3. Cathode heating can only be switched on at low emission current; shuts down below 1 mA	a) Ion source potentials are properly selected, protective circuit set too low b) Ionization potential too small (20 – 30 V) c) Cathode or Wehnelt electrode bent out of shape	Change cutoff settings for protective circuit, check heating current (see manual of QMG). Operate with lower emission current Replace cathode or correct position
8.4. Cathode will glow bright, protection circuit will shut down immediately after turn on. (QMG 101 and QMG 311)	Ionization potential (V5) missing fuse blown in circuit board (P7), V2 = V3, V1 = V5 = 0	Replace fuse, check cathode
8.5. No ion current, emission normal	a) Ion source potentials not correct b) QMG 311: V3 = V4 = 0, V2 ~ 0, V1 and V5 correct. Fuse blown in circuit board (P6)	Set potentials according to section 6.2. Replace fuse, check insulation of ion source
8.6. Voltage variations when connecting cable of ion source to analyzer	Insulation faulty, either ion source or wiring	Measure insulation resistance under vacuum , using an Ohm meter with either one or ten MΩ range. Note: Leakage current might be absent at atmospheric pressure
8.7. Emission current displayed while cathode heating is off a) QMG 311: current dependent on V3, V5 QMG 511: on V4 and V1 b) Ionization potential small, may not be raised to 100 V	Leakage current between cathode and ground QMG is preset or wired for an axial-ion source	Replace cathode insulators and/or cathode Convert QMG to Cross Beam Ion Source (see section 5.2.)
8.8. Poor resolution, good sensitivity	QMG 311: V4 too low QMG 511: V3 too high RESOLUTION set too small	Adjust axial field voltage V4 (or V3) to correct value (see section 6.2.) Set to larger values until a good compromise is reached between intensity and resolution
8.9. Poor resolution, poor sensitivity	a) Leakage current corresponding to 8.6 or 8.7 b) Ion source contaminated	Replace insulators Clean ion source and eventually the mass filter according to section 7. (See also OP's manual of analyzer)
8.10. Very good resolution, poor sensitivity	a) QMG 311: V4 too high QMG 511: V3 too low b) RESOLUTION set too large	Make V4 smaller, V3 larger (see section 6.2.) Set to smaller values until resolution is just sufficient
8.11. Resolution normal, poor sensitivity	Chosen emission current is small Cathode misaligned in regard to formation chamber Dirty ion source	Correct emission current or take into account small values. Re-align filament. Clean ion source according to section 7.2.

9. ACCESSORIES

Electrical wiring between ion source and flange feed-throughs

- A Cathode No. 1
- B Cathode No. 2
- C Formation chamber and extraction electrode

9.1. Mass filter with Faraday cup, mounted on flange NW 52 U or NW 63 CF

	Order No.
A + B	BG 520 272 -T
C	BG 520 194 -T

9.2. With axial SEM, mounted on flange NW 76 U (with reducer for NW 52 U)

A + B	BG 520 268 -T
C	BG 520 275 -T

9.3. With axial SEM, mounted on flange NW 100 CF (with reducer for NW 63 CF or NW 35 CF)

A + B	BG 520 276 -T
C	BG 520 193 -T

9.4. With 90° off axis SEM, mounted on flange NW 63 CF

Connecting flange NW 63 CF

A	BG 520 269 -T
B	BG 520 270 -T
C	BG 520 192 -T

Connecting flange NW 35 CF

A	BG 520 281 -T
B	BG 520 282 -T
C	BG 520 283 -T

Switch for QMG 101 for conversion to Cross Beam Ion Source, ELMA Co.
(see section 5.2.3.)

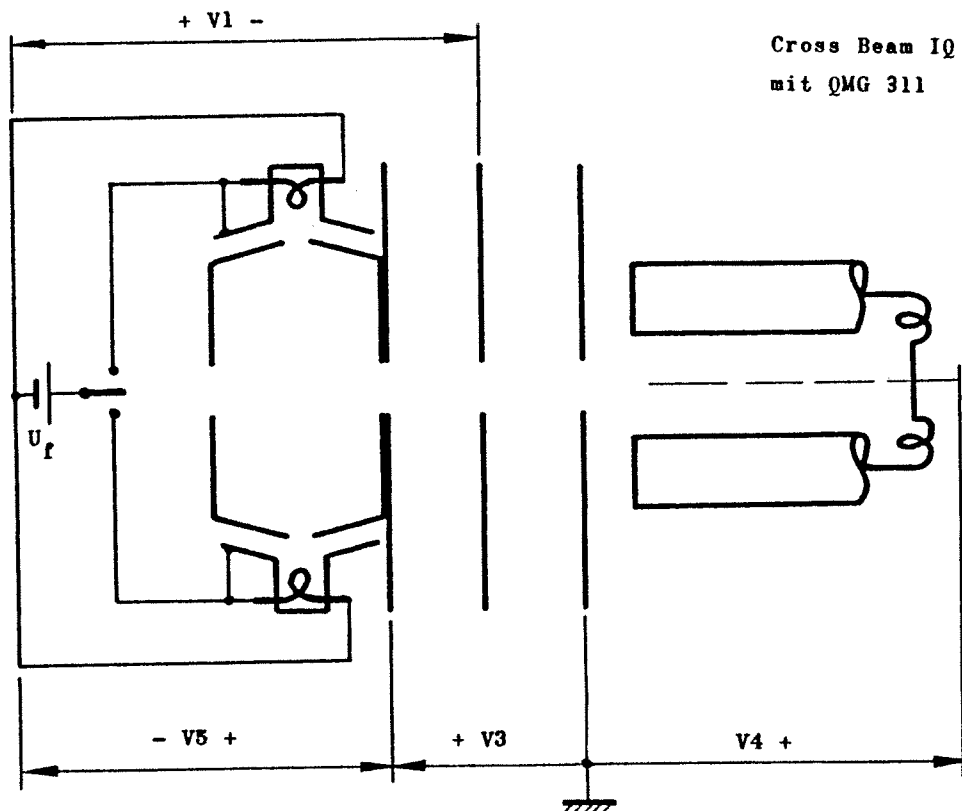
BG 516 800 -T

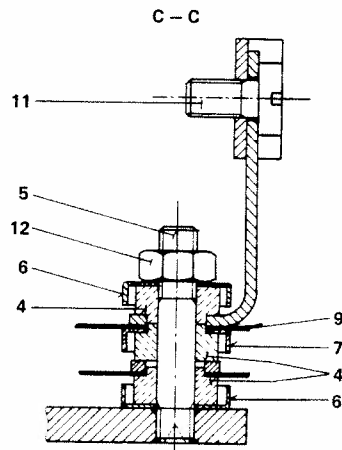
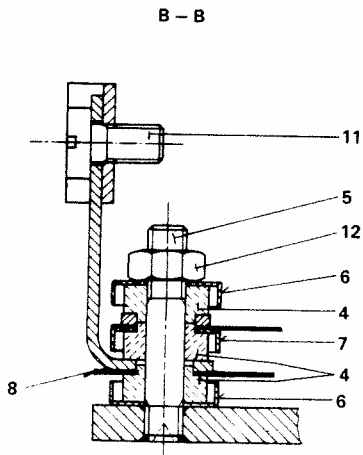
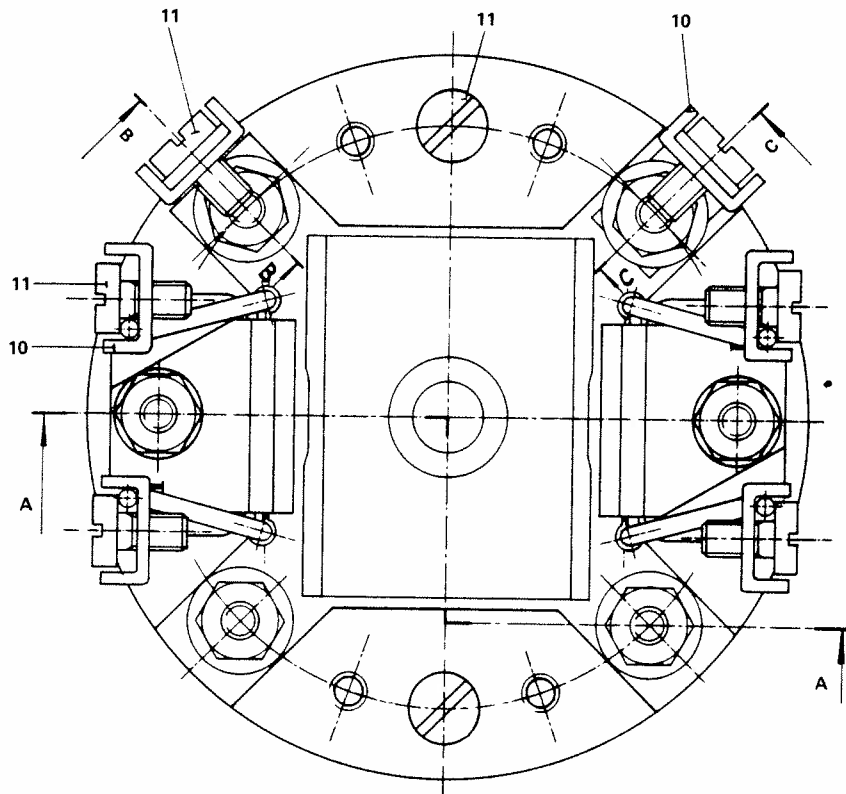
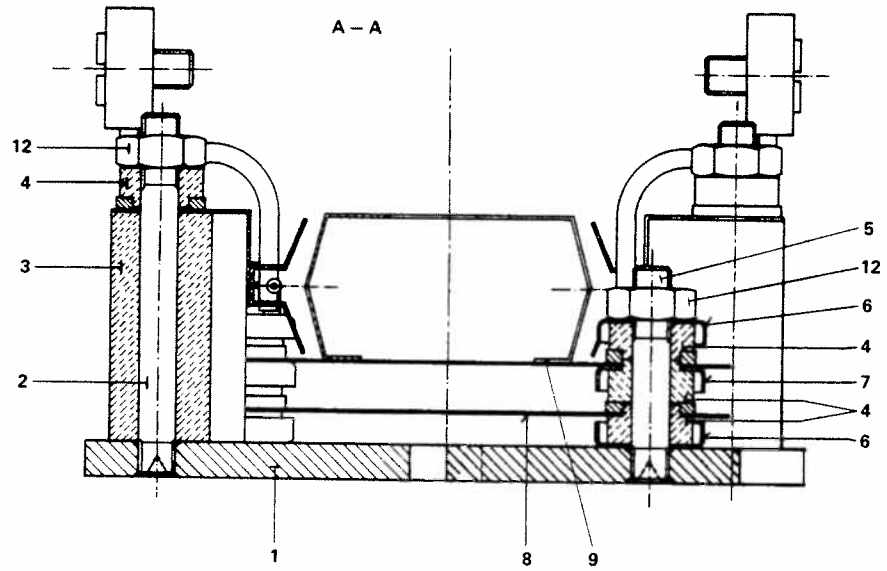
10. REPLACEMENTS AND SPARE PARTS

All parts listed under accessories are stock items.

Ordering example:

"20 ceramic insulators, order no. 80-9801 P1/BN 809 801 B, according to spare parts list BK 800 015 E / 2, pos. 4".





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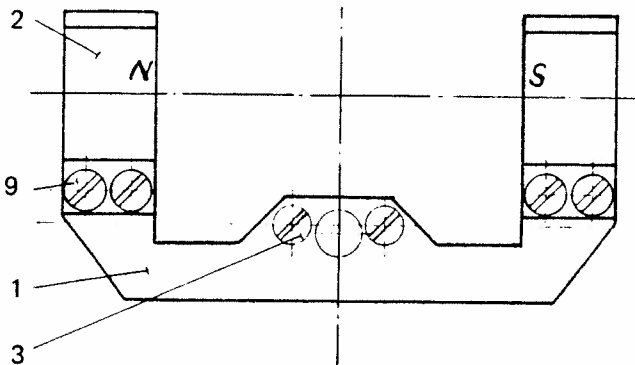


Fig. 9.1. Magneteinheit Magnet Unit

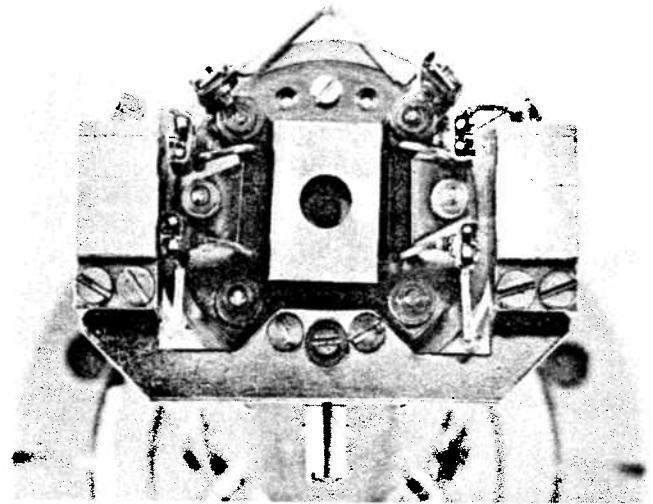


Fig. 9.2.

9.5. Elektronenführungsmagnet (Fig. 9.1.)

Zur Cross Beam Ionenquelle gibt es eine Magneteinheit bestehend aus zwei Recoma-Magneten, eingeschweisst in ein Gehäuse aus Edelstahl, und einer Montageplatte. Die Einheit wird montiert ausgeliefert und kann mit zwei Schrauben an der Ionenquelle befestigt werden. Die Magnete sind bis 250 °C ausheizbar.

Durch das Magnetfeld werden die Elektronen auf das empfindliche Volumen konzentriert, man erhält grössere Ionenausbeute und zugleich wird die Verschmutzung stark reduziert.

9.5.1. Montage der Magneteinheit

Ab April 1975 wurde die Verdrahtung zur Cross Beam Ionenquelle so geformt, dass die Magneteinheit montiert werden kann, ohne die Verdrahtung lösen zu müssen. Bei älteren Ausführungen muss die Verdrahtung durch eine neue ersetzt werden. Weiters müssen, wie Fig; 9.2. zeigt, die Extraktionsblende und der Formationsraum entsprechende Ausnehmungen und die Grundplatte neben den Befestigungsschrauben zwei Gewindelöcher aufweisen. Die Ausführung wie Fig. 5.1.2. ist nicht für die Magneteinheit geeignet.

- 9.5.1.1. Analysator mit Anschlusskopf auf dem Holzrahmen abstellen.
2. Bei älteren Ausführungen Verdrahtung für die Heizung durch neue ersetzen.
3. Die beiden Befestigungsschrauben (3) in der Magnetplatte entfernen und Magneteinheit aus der Verpackung nehmen.

ACHTUNG! DIE MAGNETE SIND AUF DER MONTAGEPLATTE MIT EINER LEHRE MONTIERT UND SOLLEN NICHT ABGENOMMEN WERDEN.

4. Magneteinheit wie Fig. 9.2. auf der Ionenquelle mit den beiden Senkkopfschrauben so befestigen, dass die Magnete parallel zu den Kathodenblöcken sind.
5. Isolation aller Elektroden der Ionenquelle und richtige Lage der Kathoden prüfen (siehe 7.4.7.). Analysator ist bereit zur Montage.

9.5. Electron guiding magnet (fig. 9.1.)

For the cross beam ion source, a magnet unit consisting of two Recoma magnets, welded in a housing of stainless steel, and a mounting plate can be furnished. This unit is furnished as an assembly and can be attached to the ion source by means of two screws. The magnets are bakeable at 250 °C.

By the magnetic field, the electrons are concentrated on the sensitive volume, a higher ion yield is obtained and, at the same time, contamination is considerably reduced.

9.5.1. Mounting the magnet unit

In April 1975 the wiring of the cross beam ion source was reshaped. Now it is possible to mount the magnet unit without removing the wiring. With older models, the wiring must be replaced by a new type. Extraction electrode and formation chamber must be provided with suitable recesses, and the base plate must be furnished with 2 threaded holes beside the fastening screws (see fig. 9.2.). The model shown in Fig. 5.1.2. is not suitable for the magnet unit.

- 9.5.1.1. Place analyzer with connection head on wooden frame.
2. Replace wiring on older models by new one.
3. Remove the fastening screws (3) plate and take the magnet unit out of the packing.

CAUTION! THE MAGNETS HAVE BEEN INSTALLED ON THE MOUNTING PLATE USING A FIXTURE. THEY MUST NOT BE REMOVED!

4. Using the two screws, fasten the magnet unit on the ion source as shown in fig. 9.2. The magnets must be parallel to the cathode blocks.
5. Check insulation of all electrodes of the ion source and position of the cathodes. The analyzer is now ready for mounting.

9.5.2. Einstellen der Ionenquellenpotentiale

Wenn die Ionenquelle mit Magnet auf einem Analysator montiert ausgeliefert wurde, kann die günstigste Einstellung der Ionenquellen-Potentiale und der Emission dem Prüfprotokoll entnommen werden. Wird der Magnet nachträglich eingebaut, sind die günstigsten Werte zu ermitteln:

- 9.5.2.1. Verbindung zwischen Steuergerät und Analysator herstellen (siehe Abschnitt 5 und Betriebsanleitung Analysator). Steuergerät einschalten und HF abgleichen (siehe Betriebsanleitung QMG). Bei Analysatoren mit off-axis SEV soll zunächst der Elektrometer an den Auffänger (bzw. Ablenk-Kondensator) zur Messung des Ionenstroms angeschlossen werden. Erst wenn die Ionenquelle eingestellt ist, wird der SEV in Betrieb genommen und die Ablenkspannung optimiert (9.5.1.11.)
2. Ionisierungsspannung auf 70 V einstellen (QMG 101 fest (100 V), oder an der Rückwand einstellbar, QMG 311: V5, QMG 511: V1)
Für kleinere Werte Punkt 6.3. beachten
3. Bildungspotential (Formationsraumpot.) der Ionen einstellen.
(QMG 101 und 311: V3; QMG 511 V4).
Wenn maximale Empfindlichkeit im unteren Massenbereich gewünscht wird (Masse 1 bis 100), soll ein kleiner Wert zwischen 20 und 40 V eingestellt werden, bei Messungen mit Ionen grösserer Masse sind 120 Volt einzustellen, wodurch die Massendiskriminierung klein gehalten wird.
4. Feldachsenpotential ca. 15 Volt unter Formationsraumpotential einstellen.
(QMG 101 und 311: $V4 \approx V3 - 15$,
QMG 511: $V3 \approx 15$ V)
5. Extraktionsspannung einstellen
QMG 101 und 311: $V1 = -50$ V (ist gegen die Kathode festgelegt)
QMG 511 $V6 = -50$ V (ist gegen Masse festgelegt)
6. Emission COARSE auf 0,2 – 1 mA (bei QMG 101 und 311), Emissionsregler FINE bzw. Pot. N beim QMG 511 auf etwa Mittelstellung drehen.
7. Emission einschalten und auf 0,6 mA einstellen bzw. Punkt 6.3. beachten.

Wenn das Formationsraumpotential kleiner als die Ionisierungsspannung ist, ist die Kathode negativ gegen Masse und gibt Elektronen an die Umgebung ab. Dadurch kann die Anzeige benachbarter Messröhren gestört werden. Um den Totaldruck korrekt zu bestimmen, muss die Emission des Quadrupols abgeschaltet oder eine Einstellung mit Formationsraumpotential grösser als die Ionisierungsspannung gewählt werden.
8. Nachweis des Ionenstroms bzw. Registrieren von Massenspektren gemäss Betriebsanleitung zum QMG
Möglichst ein Gas einlassen auf mindestens doppelten Restgasdruck. Auf einen Peak dieses Gases oder das Maximum des integralen Spektrums (QMG 101 und 311 DC OFF, QMG 511 INTEGRAL) einstellen.
9. Extraktionsspannung (9.5.2.5.) und falls erwünscht abwechselnd Formationsraumpotential (9.5.2.3.), auf maximales Signal einstellen.
10. Emissionsstrom verändern und feststellen, bis zu welchem Wert noch ein entsprechender Empfindlichkeitsgewinn erreicht wird. Extraktionsspannung nachjustieren.
11. Bei Analysatoren mit off-axis SEV jetzt auf Betrieb mit SEV umstellen (Betriebsanleitung zum Analysator) und die Ionen-Ablenkspannung optimieren.
12. Spektrum registrieren und RESOLUTION und Ionenenergie auf erforderliche Auflösung und Peakform einstellen. (siehe 6.2.1.)

9.5.2. Adjusting the potentials of the ion source

When the ion source with magnet has been delivered mounted on an analyser, the best values of the ion source voltages and emission current can be taken from the test certificate. For a source subsequently fitted with a magnet, these adjustments have to be performed as follows:

- 9.5.2.1. Connect analyzer and quadrupole control unit (see section 5 and operations manual ANALYZER)
Turn control on and tune RF (see manual of QMG)
At an analyzer with off-axis SEM connect the electrometer amplifier to the faraday cup (or deflection plates) for direct measurement of the ion current
The SEM is switched on only after having adjusted the ion source potentials, and now the deflection voltage will be optimised (9.5.2.11.)
2. Set ionization voltage at 70 V (QMG 101 fixed at 100 V or adjustable at rear panel. QMG 311 V5; QMG 511 V1)
3. Adjust formation chamber potential with potentiometer (QMG 101 and QMG 311 V3, QMG 511 V4) For maximum sensitivity in the lower mass range (1 to 100) set at 20 to 40 V, for measurement in the higher mass range set at 120 V to keep mass discrimination small
4. Field axis potential should be about 15 V below the formation chamber potential (QMG 101 and 311: $V4 \approx V3 - 15$; QMG 511: $V3 \approx 15$ V).
5. Extraction voltage
QMG 101 and 311 $V1 = -50$ V (relative to cathode)
QMG 511 $V6 = -50$ V (relative to ground)
6. Set EMISSION COARSE at 0.2 to 1 mA (QMG 101 and QMG 311); emission control FINE, or potentiometer (N) of the QMG 511 fully counterclockwise.
7. Turn emission on and regulate current to a value of 0,6 mA (see also 6.3.).

Note: Whenever the formation chamber potential is found to be smaller than the ionization voltage, the cathode becomes negative relative to ground, and electrons are lost to the environment. This could affect the accuracy of neighboring ionization gauges. Hence, to measure the total pressure correctly, the emission of the quadrupole mass analyzer must be either off or the formation chamber potential must be kept above the ionization voltage.
8. For detection of the ion current or recording of mass spectra, refer to manual of the corresponding QMG. If possible, admit a gas to the system to raise the pressure to about twice the residual pressure. Adjust scan to a peak of this gas or to the maximum of the integral spectrum (QMG 101 and 311: DC OFF, QMG 511: INTEGRAL).
9. Adjust extraction voltage (9.5.2.5.) and if necessary formation chamber potential (9.5.2.3.) for maximum signal.
10. Change emission current and adjust for a value up to which an adequate increase of sensitivity is observed. Readjust extraction voltage.
11. Analyzer with off-axis SEM now change to operation with SEM (refer to analyzer manual) and adjust ion deflection voltage for maximum signal.
12. Record spectrum and adjust RESOLUTION and ion energy (field axis potential) for required resolution and peak shape (ref. to 6.2.1.).

Ersatzteile

Ersatzteile	Replacement parts
Führungsmagnet kompl.	Magnet unit BN 845 121 -T
Montageplatte	Mounting plate BG 521 406
Magnet, eingeschweisst	Magnet, welded in SS-housing BG 521 407 -X
Senkschraube M 1.6 x 2.8	Countersunk screw BG 521 412 -R