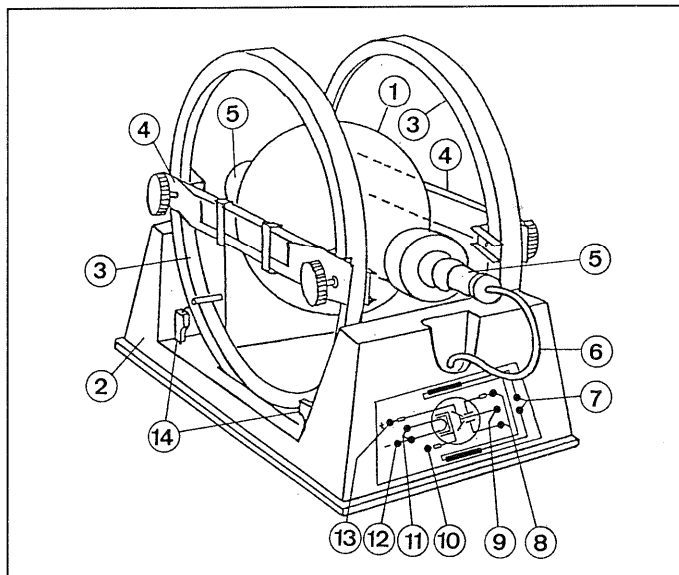


2/95-Sf-



Die Geräte dienen zur quantitativen Untersuchung von Elektronenstrahlen in elektrischen und magnetischen Feldern sowie zur Bestimmung der spezifischen Elektronenladung e/m und der Elektronengeschwindigkeit v .

Literatur: Versuchsbeschreibungen zum Hauptkatalog Physikversuche "Elektrizitätslehre" (599 831)

1 Sicherheitshinweise

- Vakuum-Röhre! Implosionsgefahr bei Stoß, Fall u.ä.
- Fadenstrahlrohr (555 57) ausschließlich im Ständer, (555 58) verwenden.
- Vorsicht beim Experimentieren von berührungsgefährlicher Spannung!
- Verwendung von Sicherheits-Experimentierkabeln (500 600 ff) empfehlenswert (optimaler Berührungsschutz).
- Geräte ohne Sicherheitsbuchsen (z.B. Netzgeräte früherer Baureihen) mit Sicherheits-Adapterbuchsen (500 95/96/98) nachrüsten.
- Versorgungsgeräte erst einschalten, wenn die Schaltung fertiggestellt ist.
- Maximal zulässige Heizspannung: 6,3 V

Gebrauchsanweisung Instruction Sheet

555 57/58/59

Fadenstrahlrohr Helmholtzspulen mit Ständer und Meßvorrichtung Fine Beam Tube Helmholtz Coils with Holder and Measuring Device

Fig. 1

These apparatus are used for quantitative investigations of electron beams in electrical and magnetic fields, and for determining the specific electron charge e/m and the electron velocity v .

Literature: Physics Experiments, Volume 2 (599 932); New Physics Leaflets 1 (471 773)

1 Safety notes

- Vacuum tube: danger of implosion for shocks, falls, etc.
- Use the fine beam tube (555 57) only with the stand (555 58).
- This apparatus uses hazardous contact voltage. Exercise caution at all times!
- Use safety connection leads (500 600 ff) for maximum contact protection.
- Equip all devices without safety sockets (e.g. power supplies from older series) with safety adapter sockets (500 95/96/98).
- Do not switch on the supply voltage until you have finished setting up the circuit!
- Do not exceed the maximum heating voltage of 6.3 V!

2 **Lieferumfang, Beschreibung, technische Daten**

2.1 **Fadenstrahlrohr (557 57)**

① Fadenstrahlrohr

Gasfüllung: Wasserstoff; etwa 1 Pa
Elektronenstrahlssystem: indirekt geheizte Oxid-Katode, Wehnelt-Zylinder, kegelförmige Anode mit Abschirm-Halb-zylinder
Heizspannung und -strom: 6 V, ca. 1 A
Anodenspannung U_A : 150 V- bis 300 V-
Wehneltspannung U_W : max. 10 V
Plattenpaar zur elektrostatischen Strahlablenkung (unmittelbar hinter Anode angeordnet)
Plattenspannung U_p : 50 V- bis 100 V-

2.2 **Helmholtzspulen mit Ständer und Meßvorrichtung (555 58)**

- ② 1 Ständer zur Halterung des Fadenstrahlrohres und der Spulen in definierter Lage;
Anschluß der Betriebsspannungen an Sicherheitsbuchsen ⑦ bis ⑬, die intern mit den Buchsen ⑭ (Spulenanschlüsse) bzw. über fest installiertes Kabel ⑥ mit 6-poligem Stecker mit der Röhre verbunden sind.

Buchse	verbunden mit
⑦	Helmholtzspulen
⑧	Ablenkplatten
⑨	Anode
⑩	Wehnelt-Zylinder
⑪	Heizung
⑫	Katode
⑬	Anode

③ Paar Helmholtzspulen

Windungszahl n: 130 je Spule
maximal zulässiger
Spulenstrom I_S : 2 A (kurzzeitig 3 A)
Widerstand R : ca. 2 Ω je Spule
Spulenradius r : 150 mm
Spulenabstand a : 150 mm

- ④ Meßvorrichtung*), bestehend aus Steg mit 2 Schiebern und Steg mit Spiegel, zur Bestimmung des Durchmessers bei kreisförmig verlaufendem Elektronenstrahl.

⑤ 2 Schellen, 4 Schrauben, 4 Unterlegscheiben

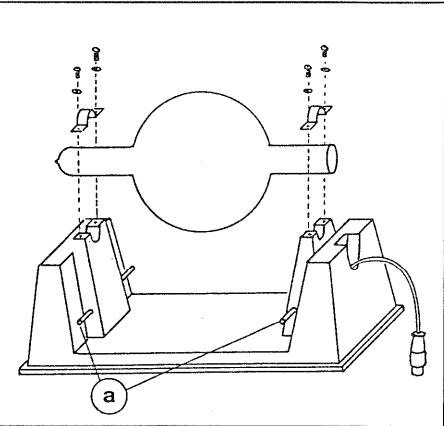


Fig. 2.1

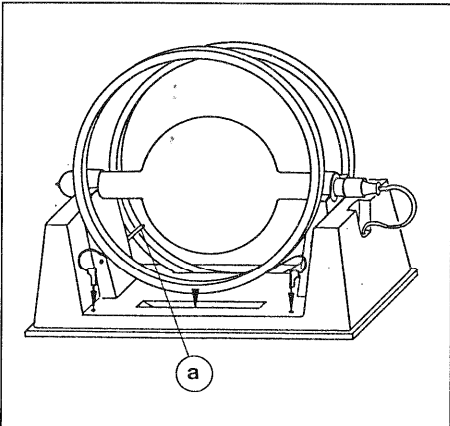


Fig. 2.2

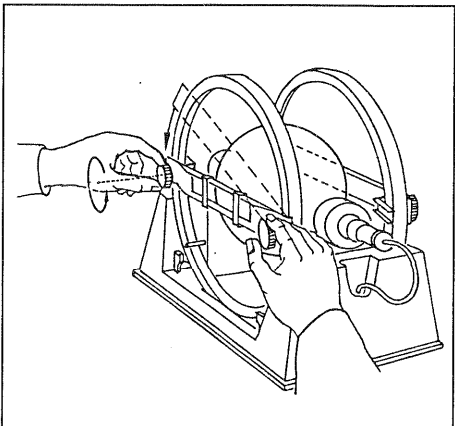


Fig. 2.3

2 **Scope of supply, description, technical data**

2.1 **Fine beam tube (557 57)**

① Fine beam tube

Gas filling: hydrogen, approx. 1 Pa
Electron beam system: indirectly heated oxide cathode, Wehnelt cylinder, conical anode with semi-cylindrical screens
Heating voltage and current: 6 V, approx. 1 A
Anode voltage U_A : 150 V DC to 300 V DC
Wehnelt voltage U_W : max. 10 V
Pair of plates for electrostatic deflection (directly behind anode)
Plate voltage U_p : 50 V DC to 100 V DC

2.2 **Helmholtz coils with holder and measuring device (555 58)**

- ② 1 holder for supporting the fine beam tube and the coils in a defined position
Operating voltages connected to safety sockets ⑦ to ⑬, which are connected internally to sockets ⑭ (coil connections) and to the tube via a permanently attached lead ⑥ with 6-pin plug.

Socket	connected with
⑦	Helmholtz coils
⑧	Deflection plates
⑨	Anode
⑩	Wehnelt cylinder
⑪	Heating
⑫	Cathode
⑬	Anode

③ Pair of Helmholtz coils

Number of turns n: 130 per coil
maximum permissible
coil current I_S : 2 A (briefly 3 A)
Resistance R : approx. 2 Ω per coil
Coil radius r : 150 mm
Coil spacing a : 150 mm

- ④ Measuring device*), consisting of support with two slides and support with mirror, for determining the diameter of the circular electron beam.

⑤ 2 clamps, 4 screws, 4 washers

*) Unter der Kat.-Nr. 555 59 auch einzeln lieferbar, zum Nachrüsten von früher bezogenen Helmholtzspulen mit Ständer (555 58)

*) Also available individually under Cat. No. 555 59, for re-equipping older-type Helmholtz coils with holder (555 58)

3 Bedienung

3.1 Montage

Vor Erstinbetriebnahme Anordnung gemäß Fig. 2 montieren.

Bitte beachten: Rohr so auf den Ständer legen, daß die Achse des Elektrodensystems lotrecht verläuft (s. Fig. 2.1).

Beide Spulen mit den verschiebbaren Stiften @ fixieren (Fig. 2.1/ 2/3).

Meßvorrichtung im horizontalen Spulendurchmesser montieren (Fig. 2.3)

3.2 Hinweise zum Experimentieren

Zusätzlich erforderliche Geräte:

Spannungsversorgung für Elektronenstrahlsystem, elektrisches Feld und magnetisches z.B.

Stabilisiertes Netzgerät, 0-300 V	522 35
Kreuzschalter	504 49
Drehpotentiometer, 100 k Ω	537 85
Geregeltes Netzgerät, 20 V, 3 A	522 397

Strom- und Spannungsmesser, z.B.

AV-Meßgerät	531 94
Demo-Multimeter	531 911

Vorrichtung zur Messung der magnetischen Feldstärke, z.B.

Tangentiale B-Sonde (516 60) mit Teslameter (516 62)

Versuche im dunklen Raum durchführen;

bei allen Versuchen ohne elektrische Strahlablenkung Ablenkplatten auf Anodenpotential legen.

Beginn der Glühelktronen-Emission nach einer Heizdauer von wenigen Minuten;

Anodenspannung zwischen 150 V und 300 V unter Beobachtung des Elektronenstrahls variieren, bis die engste Strahlenbündelung erreicht ist, die möglicherweise über die Spannung am Wehnelt-Zylinder noch verbessert werden kann;

zur Bestimmung des Krümmungsradius bei magnetischer Strahlablenkung Schieber @ der Meßvorrichtung gemäß Fig. 4 so einstellen, daß dieser mit seinem Spiegelbild und dem Fadenstrahl auf einer Linie liegt (Visierlinie).

3 Operation

3.1 Assembly

Set up the apparatus as shown in Fig. 2 before putting it into operation the first time.

Important: the tube must be placed in the holder so that the axis of the electrode system is completely vertical (see Fig. 2.1).

Fix the two coils in position using the sliding pins @ (Fig. 2.1/2/3).

Attach the measuring device so that it lies along the horizontal diameter of the coils (Fig. 2.3)

3.2 Experiment notes

Additionally required:

Voltage supply for electron beam system, electrical field and magnetic field, e.g.:

Regulated power supply, 0-300 V	522 35
Commutator switch	504 49
Rotary potentiometer, 100 k Ω	537 85
Electronic controlled power supply, 20 V, 3 A	522 397

Current and voltage meters, e.g.

AV-meter	531 94
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Apparatus for measuring magnetic field strength, e.g.

Tangential B-probe (516 60) with Teslameter (516 62)

Carry out the experiments in a darkened room.

Connect the deflection plates to the anode potential for all experiments without electrical beam deflection.

The emission of electrons starts after heating for just a few minutes.

Vary the anode voltage between 150 V and 300 V while observing the electron beam, until the tightest beam is attained; it is sometimes possible to improve this even further by means of the voltage at the Wehnelt cylinder.

To determine the bending radius for magnetic deflection, adjust the slide @ of the measuring device as shown in Fig. 4 so that it is in line with the mirror image and the fine beam (line of sight).

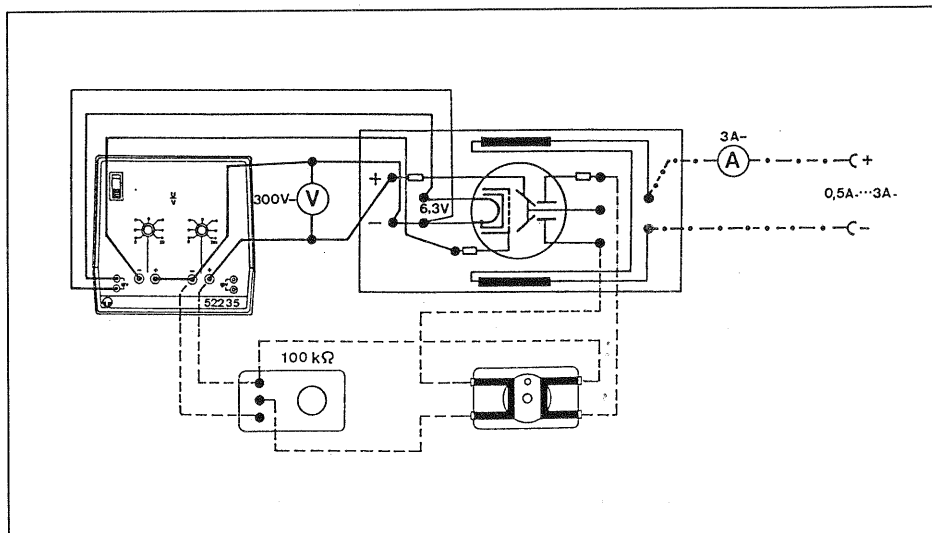


Fig. 3

- Schaltung für Elektronenstrahlsystem
- Schaltung zur Ablenkung des Elektronenstrahls im homogenen Magnetfeld
- Schaltung zur Ablenkung des Elektronenstrahls im elektrischen Feld
- Circuit for electron beam system
- Circuit for deflection of the electron beam in a homogeneous magnetic field
- Circuit for deflection of the electron beam in an electrical field

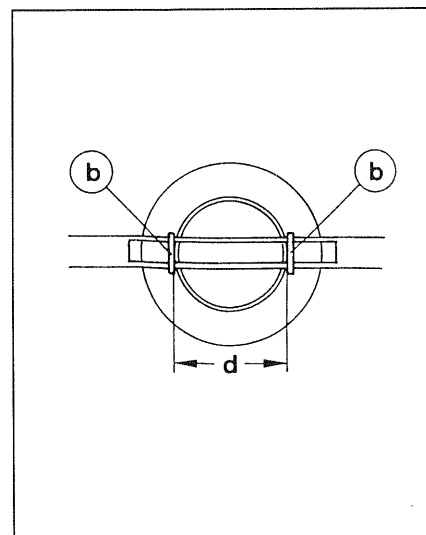


Fig. 4

1/90 - Sf-

Instruction Sheet

555 57/58/59

E - 3707

FYSIKKLABORATORIUM 1 OG 2
INSTITUTT FOR FYSIKK
NTH

Fine Beam Tube

Helmholtz Coils with Holder and Measuring Device

This apparatus is used for qualitative and quantitative investigations on electron beams in electric and magnetic fields as well as for the determination of the charge-to-mass ratio e/m of the electron and also on the electron velocity v .

Literature: Physics Experiments, Volume 3 (599 942)
New Physics Leaflets for Colleges and Universities,
Volume 1 (599 952)

1 Safety Notes

- Vacuum tube! Danger of implosion when subjected to shock.
- Use the fine beam tube (555 57) only in connection with the holder (555 58).
- Lethal voltages! It is advisable to use the safety leads (500 65 and following numbers) which provide optimum safety.

2 Scale of Delivery, Description, Technical Data

2.1 Fine beam tube (555 57)

① Fine beam tube

Gas filling: 1.33×10^{-5} bar

Electrode system: indirectly heated oxide cathode,
Wehnelt cylinder, conically shaped anode with semi-cylindrical screen

Filament voltage and current: 6.3 V, 1 A approx.

Anode voltage U_A : 150 V d. c. to 300 V d. c.

Wehnelt voltage U_W : 10 V max.

Pair of deflection plates for electrostatic deflection of the beam (immediately placed after the anode)

Deflection voltage U_D : 50 V d. c. to 100 V d. c.

2.2 Helmholtz coils with holder and measuring device (555 58)

② 1 Holder for holding the fine beam tube and placing the Helmholtz coils in a well defined position.

Supply voltage connections are made via safety sockets ⑦ to ⑬ which are internally connected via sockets ⑭ (coil connections) or the permanently mounted cable ⑥ to the 6-pin plug with the fine beam tube.

Sockets ⑦ are connected to the Helmholtz coils

Sockets ⑧ are connected to the deflection plates

Socket ⑨ is connected to the anode

Socket ⑩ is connected to the Wehnelt cylinder

Sockets ⑪ are connected to the heating filament

Socket ⑫ is connected to the cathode

Sockets ⑬ are connected to the anode

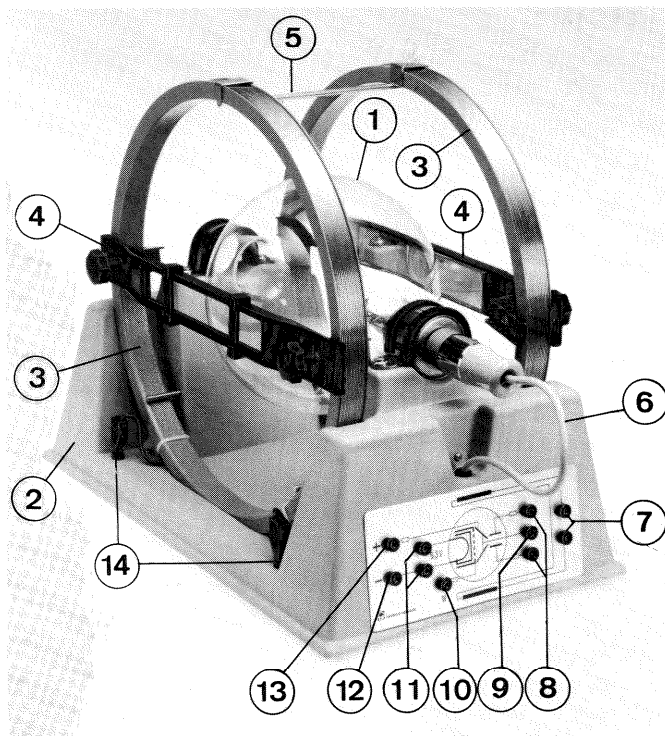


Fig. 1

③ Pair of Helmholtz coils

Number of turns: 130 on each coil

Coil radius r : 150 mm

Distance between the coils a : 150 mm

Maximum current I_S through the coils: 2 A

④ Measuring device*), consisting of two parts, one with a mirror and the other with two riders, for measuring the diameter of the electron beam when it is made to follow a circular path.

⑤ Spacer

2 clips, 4 screws, 4 washers

*) Also available separately under Cat. No. 555 59 so that the older type of Helmholtz coils with holder (555 58) can be converted.

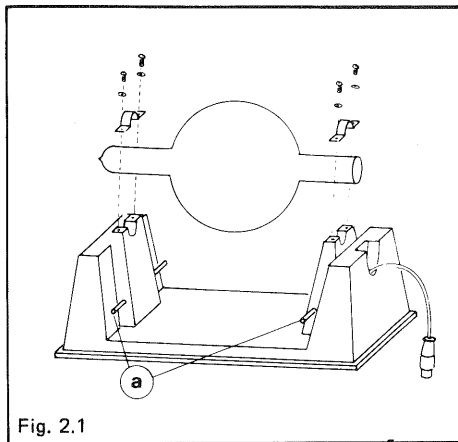


Fig. 2.1

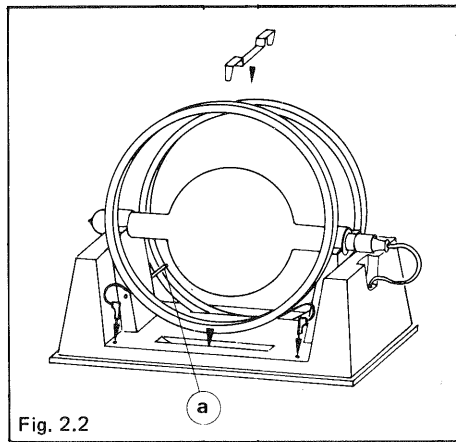


Fig. 2.2

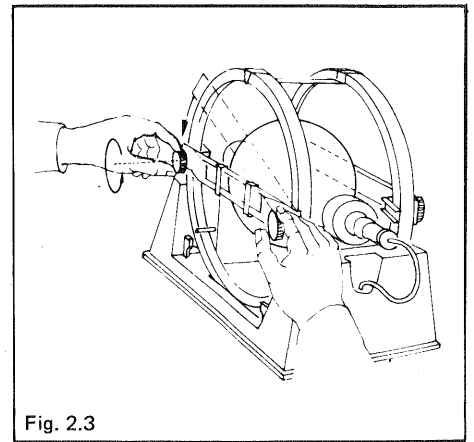


Fig. 2.3

3 Operation

When making the unit operative for the first time, assemble it according to Figs. 2.1 to 2.3.

Note: Mount the fine beam tube to the holder so that the axis of the electrode system is placed vertically (refer to Fig. 2.1).

Fix both coils with pins (a) (Figs. 2.1, 2.2).

Mount the measuring device horizontally between each of the coils (Fig. 2.3).

Additionally required equipment:

Power supply for the electron beam system, electric and magnetic field, e. g.

Regulated power supply unit, 0 to 300 V	522 35
Commutator switch	504 49
Rotary potentiometer, 100 k Ω	537 85
Ni-Cd accumulator, 6 V, 22 Ah	522 71
with rheostat, 11 Ω	537 26
or	
regulated power supply unit, 0 to ± 15 V d.c.	522 30

Voltmeters and ammeters, e. g.

AV Meter	531 94
Demo-Multimeter	531 91

Equipment for measuring the magnetic field:

Hall probe (516 50) with power supply unit for Hall probe (516 52) and Microvoltmeter (532 13)
or
Hall probe, tangential (516 501) with demonstration meter (530 50) and Tesla scale module (530 65)

Important:

Only switch on the power supply units after having completed the circuit.

It is advisable to use safety leads (500 60 and following numbers) when making connections to the safety sockets. Equipment without safety sockets (some of the older types of power supply unit) should be re-equipped with safety socket adapters (500 95/96/98).

The experiments should be carried out in a darkened room.

The deflection plates should be connected to the anode potential in all those experiments which do not require any form of electric beam deflection.

Never increase the filament voltage above 6.3 V!

Glow emission of electrons will begin several minutes after switching on.

Vary the anode voltage between 150 V and 300 V closely observing the beam until the beam has been focused as best as possible. Focusing can in some cases be further improved by changing the voltage applied to the Wehnelt cylinder.

Adjust rider ① of the measuring device according to Fig. 4 so that its mirror image will be in line with the electron beam for determination of the radius when magnetically deflecting the beam.

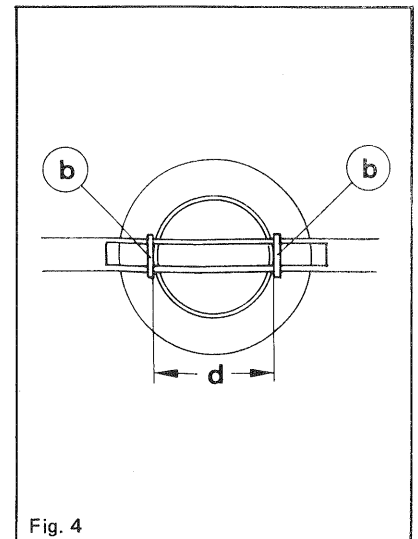
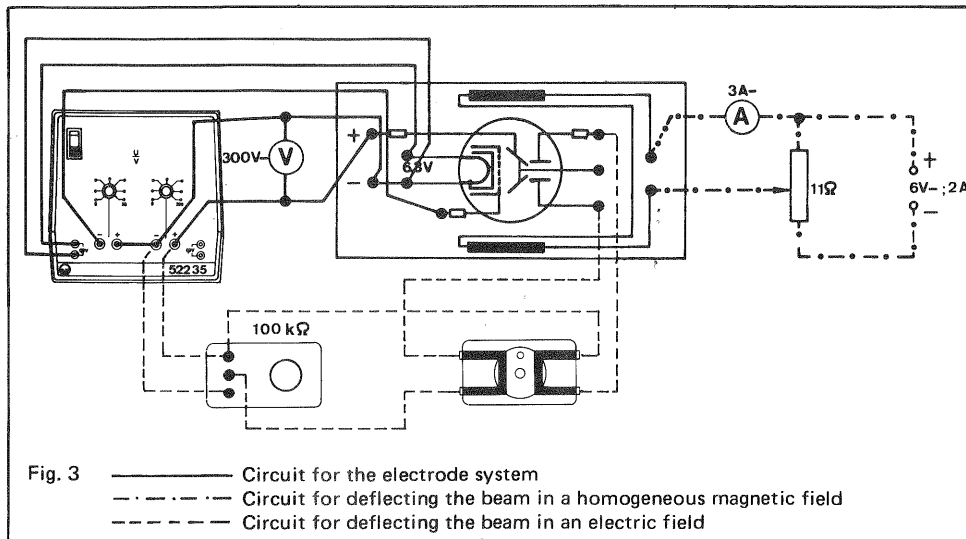


Fig. 4