CIT ALCATEL
Division vide et mécanique
33, rue Emeriau
75725 PARIS CEDEX 15

Tel : 16.1.45.71.10.10
Telex : ALCANUC 270 431 F

IMPORTANT

THIS INSTRUMENT BECOMES OPERATIONAL IN LESS THAN 10 MINUTES.

THE LIFE EXPECTANCY OF THE TURBO INCREASES, BY NOT ALLOWING THE PUMP TO RUN UNNECESSARILY.

HELIUM LEAK DETECTOR : ASM 110 TURBO
with 5100 TMP

Preliminary technical manual

SEPTEMBRE 1985

Ref. 67894

CHAPTER 1

GENERAL

CONTENTS

CONTENTS

GENERAL SPECIFICATION

ALCATEL ASM 110 T is a complete, portable leak station : it includes a gas analyser and a roughing system.

It comes in two separated units (figure 2) :

GAS ANALYSER		ELECTRONIC CABINET
Width	380 mm	230 mm (1/2 Rack)
Length	530 mm	250 mm (3 U)
Height	470 mm	150 mm
Weight	53 Kg	5 Kg

. Power supply : 220 V. - 50 Hz. single phase)
115 V. - 60 Hz. single phase (option))
100 V - 60 Hz single phase (option)) 800 VA
240 V - 50 Hz d° (option))

Oil capacity forepump : 500 cc

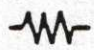
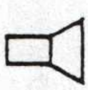
SYMBOLS

GAS ANALYSER (figure 2)

Roughing valve :	-∇-	Open
	-∇-	Closed
By-pass valve :	position 1 :	Roughing
	position 2 :	Detection
	medium :	Closed

TMP information :	- yellow light	: $\leq$ 27000 tr/mn
	- green light	: $\geq$ 27000 tr/mn
	- red light	: default

ELECTRONIC CABINET (figure 5)

Green light $< 10^{-2}$	Analysis cell pressure is $< 10^{-2}$ mbar
Green light 	Filament on
Green light -∇-	Throttle valve is open
	Sensibility adjustment
	Audio signal volume control
	Audio signal threshold
" 0 "	Zero adjustment knob
50 mV	Recording output 50 mV
He	Helium signal adjustment

OPERATION SPECIFICATION OF THE ASM 110T LEAK DETECTOR

. Maximum operating pressure of the analysis cell	10^{-4} mbar
. Pumping speed for air	
. In front of the analysis cell	50 l/s
. At the inlet valve	6,5 l/s
. Intrinsic sensitivity of the analysis cell	$3{,}5.10^{-4}$ A/mbar
. Variation of sensitivity as a function of pressure between 10^{-6} and 10^{-4} mbar	$\pm$ 20 % max.
. Smallest signal detectable at an air pumping speed of 3.5 l/s	2.10^{-11} atm.cm3/s He
. Direct reading range	2.10^{-11} to 1.10^{-5} atm.cm3/s He
. Response time	
. Scale 10.10^{-10}	1.5 s
. Scale 3.10^{-9}	1 s
. Scale 10.10^{-9} 10.10^{-6}	0.5 s
. Filament protection (triode)	off at 2.10^{-4} mbar
. Turbomolecular pump protection (Pirani gauge)	Closing of the safety inlet valve at 5.10^{-2} mbar
. Audio signal	Adjustable on the whole range
. Air roughing pumping speed at the inlet port	1 l/s

NOTE : 1 mbar = 0.75 Torr
1 mbar = 100 Pascals
1 Torr = 1 mm Hg

LAYOUT OF TECHNICAL MANUAL

ASM 110 T detector is made of two parts :

- A "analyser block" which contains the main part of the equipment : the analysis cell with its high vacuum pumping station, the general electric circuits, the roughing station and the converter.

- An "electronic cabinet" with the control and the signal-lights

In this document, we shall study :

- The "analyser block"	chapter 2
- The general electric circuits	chapter 3
- The "electronic cabinet"	chapter 4

Moreover, we shall find :

- The operating instructions	chapter 5
- The options	chapter 6
- The figures and drawings	chapter 7

THE USER SHOULD READ AT LEAST CHAPTER 5 (RED INDEX)

CHAPTER 2

ANALYSER BLOCK

CONTENTS

2 - 1

ANALYSIS CELL

CONTENTS

2.11 - OPERATING PRINCIPLE (figure 7)

Detection of helium is made by means of a mass spectrometer analysis cell tuned for the mass of helium (m/e = 4), or another light mass (m/e = 2 or 3).

m/e : atomic weight of the particle / number of electrons lost in ionization.

The principle of magnetic deflection spectrometers is a follows.

The neutral molecules of the gas to be analysed pass into an ionization chamber (or ion source) where they are bonbarded by an electron beam emitted by a heated tungsten filament. A considerable part of the molecules are converted into ions. These ionized particles are then accelerated by an electric field.

The analysis tube is subjected to a magnetic field which bends the ion paths along different radii, according to the mass of ions (or more precisely, according to the m/e ratio). Thus, the ion beam which contained ions of different mass is separated into several beams, each containing only ions of the same m/e ratio. The helium ions (m/e = 4) are separated from the lighter ions (H_2^{+} and H_1^{+} of lesser radius) and heavier ions (N_2^{+} and O_2^{+} of greater radius).

With a constant magnetic field (permanent magnet), the accelerating field is adjusted so that the helium ions (m/e = 4) follow a specific path (passage through diaphragms) and strike the target placed at the entrance of a direct current amplifier.

The helium ion current is proportional to the partial helium pressure in the installation and its measurement makes it possible to determine the value of the flow of the leak detected.

The total pressure in the analysis must be less than 2×10^{-4} mbar so that the electron and ions paths are note disturbed by residual molecules. But the risk of damage to the heated filament only begins at about 10^{-3} mbar.

Note 1 : The obtain proper separation of the helium ions from the "noise" due to scattered ions, an electrode placed in front of the target eleminates the secondary ions of low energy. This electrode is called "repeller".

Note 2 : an auxiliary electrode in front of a plate is located at the top of the tube. This electrode collects ions having a greater mass than the helium ions. This electrode thus permits measurement of the total pressure in the analyser without using a Penning-gauge. (Indeed, it is not suitable to measure signals of very low value (1×10^{-11} atm.cm3/s) by retaining a Penning gauge which is a helium noise source). This electrode acts as the plate of a triode gauge, hence the name "triode electrode".
When measuring signals of very low value, it is not advisable to use a Penning-gauge which is a source of helium noise.

2.12 - CONSTRUCTION (Figures 6 and 8)

The analysis cell has been carefully constructed in order to obtain a high degree of reproducibility of characteristics and good stability :

- Metal parts of stainless steel
- Filament holder of machined alumina
- Built-in pre-amplifier.

The analysis cell assembly (see figures 6 and 8) mainly consists of :

a) A vacuum or deflection chamber
b) A lens holder flange
c) A permanent magnet
d) A pre-amplifier

a) The vacuum chamber of the analysis cell is made of a light alloy. It has a rectangular opening into which fits the entire set of electrodes attached to the "lens holder flange".

b) The lens holder flange serves as a support for all the electrodes and electric feedthroughs of the cell. It includes :

- A power feedthrough socket mounted with a metal seal,

- A pre-amplifier mounted with a metal seal,

- A massive block for the target mounting and shielding,

- An ion source which consists of two parts :

  . a filament holder
  . a ionization chamber with a stainless steel sheet electron collector and a massive ion emitter.

The filament holder mechanically positions the tungsten filament with respect to the ionization chamber.

The electron collector and the filament are constructed and arranged in such a way that the temperature of the electron collector stabilizes at 400° C by electron bombardment and filament radiation. The cell is therefore made impervious to contamination due to impurities of the articles tested, without having to use a special heating system.

c) The permanent magnet which creates the deflective magnetic field. It consists of :

- The permanent magnet itself
- 2 Machined pole parts which are attached to the magnet by araldite. These parts should never be detached from the magnet.

One pole is marked N.

NOTE : following disassembly of the unit, care must be taken to proper' reposition the magnet (N must be facing to the left, when one looks at the analyzer cell from the rear. This means N will be located on the same side as mechanical pump).

d) The pre-amplifier (figure 10), is mounted on a 12-pin feedthrougr socket and consists of :

- 2 Electrometer tubes
- 1 Resistor 8.10^{11} Ohms.
- 1 Target.

These parts form a rigid assembly which cannot be disassembled and should not be touched with the fingers.

2.13 - MAINTENANCE

There are three normal maintenance operations to be carried out on the analysis cell :

- Replacement of the filament
- Cleaning of the ion source cell
- Cleaning of the entire analysis cell.

2.131 - Replacement of the filament

Replacement of the filament requires only very partial disassembly of the analysis cell. Replacement is carried out in the following manner :

- Turn leak detector off.

- Disconnect the two Jaeger plugs of the analysis cell.
- Unscrew the six screws (socket wrench).
- Remove the lens holder flange (the gasket cannot be re-used) and place it on a very clean sheet of white paper.
- Loosen the 2 set screws of the U-links of the filament clamps and the connections.
- Unscrew the filament holder screw and remove the filament.

To install a new filament, the above operations are carried out in the reverse order.

When these operations are being carried out, care should be taken not to touch the internal parts of the analysis cell with fingers.

REMARKS :

1 - Visually check to make sure the filament is correctly placed in front of the slot of the ion source. If necessary, change the position of the collector by slightly loosening its two fixing screws.

2 - The tungsten filament, which is hardened by a special heat treatment, is fragile. It should never be touched. Handle the filament holder with pliers.

3 - To replace the metal gasket, use lead wire 0,8 mm in diameter and clean it with alcohol. Form a rectangular loop with the wire by overlapping the two ends at one of the corners :
   - carefully place the gasket horizontally on the vacuum chamber.
   - carefully lower the lens holder flange vertically into place.
   - gradually tighten the screw, a little at a time, do not completel crush the spring washers.

NOTE : The use of pure lead is not recommended. Use commercially available fuse wire, a shiny lead/Antimony, which makes it easier to obtain airtightness.

Tools :

- A socket wrench for size 5 mm allen screws
- A 2.5 mm screwdriver
- A pair of Precelle pliers

2.132 - Cleaning of the ion source supply only

Cleaning is only carried out when there is a loss of sensitivity.
The lens holder flange is removed as indicated in § 2.131.
After having removed the filament, the electron collector is removed.
The collector is cleaned as indicated in § 2.133 below. In particular, the inlet slot and the electron impact surface should be cleaned.
Preferably, this collector should be replaced by our standard replacement part available at a low price.

Tools :

The same as in § 2.131.

2.133 - Cleaning of the entire analysis cell

Cleaning of the entire analysis cell is only required under exceptional conditions (flash, generalized contamination resulting in insulating deposition film). This operation should be carried out with the greatest care (cleanliness, cleaning, degassing, etc...).

The user must :

- Carry out the operation in a very clean room (clean room or laboratory or office) in which there is a working surface covered with white paper.

- Not touch the electrodes with his fingers during the disassembly.

Disassembly :

1° Begin this operation as was indicated for replacement of the filament, then :

2° Disconnect the triode electrode
" repeller electrode

3° Disconnect the other parts.

Cleaning :

All the parts are cleaned in a bath consisting of :

- 50 % ethyl alcohol
- 50 % ethyl acetate, then rubbed and dried with paper.

If necessary, use abrasive cloth to remove the insulating the metal pieces of the analysis cell and the vacuum chamber.

Reassembly :

Reassembly is carried out by performing the above operations in the reverse order, without touching the parts with the fingers. Reinstall the alumina spacers and proper center them.

Tools for disassembly of the analysis cell

- 1 pair of Precelle pliers
- 1 x 5 mm allen key
- 1 x 4 mm screwdriver
- 1 x 2.5 mm screwdriver
- 2 aluminium gaskets
- 0.8 mm diameter lead wire

NOTE 1 : We have already seen that the electrodes can normally be cleaned and the filament replaced without removing the vacuum chamber. Should this however prove to be necessary, the operation will be carried out in the following manner :

- Disconnect two electrical connectors from the analyzer cell.
- remove the screws holding the analyzer in its housing.
- remove the analyzer from its housing.

Reassembly :

- Install NW 25 viton centering ring.
- Reinstall the analyzer in its housing.

NOTE 2 : After having opened the analysis cell, make sure the gaskets are airtight by using the detector itself.

2.134 - Troubles

2.1341 - Filament breaking

This trouble is easy to detect. By means of a calibrated leak, it can be found that the detector no longer generates a signal and that the "filament" light is out.

By checking the Jaeger plug with an ohmmeter, an open circuit will be measured (broken filament) between contacts 1 and 5.

Causes

In general, filaments burn out due to abnormal wear resulting from successive air inrushes. It will then be noted that there is a deposit of blue or yellow powder on the electron collector due to evaporation of the tungsten.

Corrective measures

The filament must be replaced (see § 2.131). If the filament has produced a flash, the ion source must be cleaned before a new filament is installed.

2.1342 - Contamination of the analysis cell

There are two indications of contamination :

1) Due to outgassing, the filament goes off automatically, when being switched on.

2) A loss of sensitivity (ratio 2 or 3)

Corrective measures

The analysis cell is cleaned according to the procedure described in § 2.132 or 2.133.

NOTE : Loss of sensitivity can also be caused by deformation of the filament. It is possible to recenter the filament in front of the electron collector, thus avoiding having to replace the filament.

2 - 2

HIGH VACUUM PUMPING UNIT

CONTENTS

The high vacuum unit consists of :

1) One air cooled turbomolecular pump (TMP)

-

2) One mechanical forepump used :

- As backing pump for the turbomolecular pump.

- As roughing system, through the by-pass valve, to evacuate small articles on test.

3) One Pirani gauge head.

2.21 TURBOMOLECULAR PUMP

High vacuum is obtained ($<10^{-4}$ mbar) by means of an air cooled turbo-molecular pump (ref. TMP instruction manual) , and is controlled by a frequency convertor. located on the bottom of the analyzer, near the roughing pump (see picture 3).

2.22 FOREPUMP AND FORELINE

2.221 - Operating principle and construction

The TMP exhaust is connected to the mechanical pump inlet by a three-way ball valve and a plastic hosen through the three-way ball valve, we can also connectthe same mechanical pump directly to the inlet port to rough down small parts.

2.222 - Maintenance

Dismantling :

- Remove the leak detector cover.
- Remove the plastic tube of the TMP
- Remove the plastic tube of the foreline.
- Remove the by-pass valve
- Disconnect the motor.
- Unscrew and remove the four pump fixing screws (under the frame).

Regular maintenance :

The mechanical pump oil level should be checked once a month.

The pump oil should be changed after every 2 000 hours of operation.

For specific maintenance of the mechanical pump model 2004 A, see maintenance and operating instruction manual.

The lines should be cleaned after every 4 000 hours of operations.

2.23 - PIRANI GAUGE

2.231 - Operating principle

The Pirani gauge is a thermic manometer : the temperature of a wire heated by an electric current depends on the pressure.
The pressure measurement is carried out by measuring the resistance of the metallic wire (hence its temperature and the pressure).

The Pirani gauge has 3 functions :

1 - It shows that the pressure in the analyser is lower than 5.10^{-2} mbar, by means of a green light " $<10^{-2}$ " located on the electronic cabinet.

2 - It protects the analyser against a sudden pressure rise by closing the inlet valve (above 5.10^{-2} mbar).

3 - It prevents the filament from being energized if the pressure exceeds 5.10^{-2} mbar.

NOTE : The leak detector filament has its own protection device controlled by the triode electrode current.

2.232 - Construction

The Pirani filament is located in a glass tube mounted on a stainless steel flange.

2.233 - Maintenance

The Pirani gauge is cleaned with an alcohol / acetone solution after every 4 000 hours of operation.

Disassembly and cleaning of the gauge head :

This operation must be carried out when the equipment is not operating.
The gauge head is connected to the trap by a quick disconnect clamp with Buna o-ring :

- Disconnect the gauge power cord.

- Remove the gauge.

- Rinse the gauge head with an alcohol / acetone solution.
  The filament is replaceable (part number A 433 731).

2 - 3

ROUGHING

CONTENTS

2.31 - DESCRIPTION

This unit is used to rough the inlet valve and the inlet line at a pressure of 10^{-3} mbar.

The roughing unit consists of two major parts :

- One vane pump model 2004 A (4 m3/h) and its connection to the inlet valve.
- An electromagnetic safety valve.

2.32 - MECHANICAL PUMP AND CONNECTION TO THE INLET VALVE

The mechanical pump model 2004 A is described in § 2.22.

This pump is connected to the inlet valve, by means of a ball valve, when the control knob is on position 1.

This pump is used to evacuate the inlet valve or pieces whose volumes do not exceed a few liters. For more important volumes, it is better to use an auxiliary roughing pump.

2.33 - INLET VALVE

2.331 - Introduction

This bellows-type valve protects the analyser from accidental air inrush. It also allows to work by throttling.

2.332 - Description

This valve is represented in figure 10

2.333 - Operation of the safety device.

This is not a conventional electromagnetic valve. It opens manually and closes automatically. Its driving shaft is divided in two parts. The first one carries the electromagnetic coil. The other, a disk which closes the magnetic circuit.

The power to the coil is controlled by the Pirani gauge. The pressure must be $< 5.10^{-2}$ mbar for the coil to be energized. To open the valve, the operator must first turn the valve control knob clockwise (which will bring the 2 disks into contact ; then he must turn the knob counter-clockwise).

2.334 - Maintenance

There is no special maintenance operation to be perfomed. The valve is disassembled and cleaned whenever general maintenance is carried out on the equipment.

In particular, maintenance will be required if the pressure in the analyser is higher than 5.10^{-5} mbar (with the detector inlet blanked off). Such maintenance will only be needed after 4000 or even 10 000 hours of operation, if the detector operates on clean articles.

CHAPTER 3

ELECTRICAL WIRING

CONTENTS

3.1 - ANALYSER (figure 13 : electrical diagram 8081-004)

The power supply controls are located in the electronic cabinet.

The on-off switch, with circuit breakers, is located on the front panel. It controls and protects the whole equipment (6/8 A for 220 V or 8/10 A for 115 V).

There is also a time counter.

A blower cools the turbomolecular pump. It will be cleaned every 2 000 hours and replaced after 20 000 hours.

3.2 - SAFETY INLET VALVE (figure 10)

- Rating : 7 volts - DC
- Voltage between P08. 1 and P08. 2 = 1.2 V.

A micro-switch in the valve monitors the valve opening.

CHAPTER 4

ELECTRONIC CABINET

CONTENTS

The ASM 110 T electronic circuits are located in a portable cabinet connected to the vacuum unit by means of a cable.

This arrangement has several advantage :

- Easy to carry.
- The solid state electronic cabinet temperature is not affected by the vacuum pomps heat.
- The portable control cabinet allows the operator to read both the total pressure and the helium partial pressure.

4.1 - DESCRIPTION OF ANALYZER ELECTRONIC

On the cabinet front panel are located :

- The leak meter (left hand side).
- The total pressure gauge meter (right hand side)
- The range selector and the sensitivity adjustment potentiometer (in the middle).
- 3 pilot lights (green) with the following engravings :

  . $< 10^{-2}$ indicates that the pressure in the analyser is below 10^{-2} mbar.

  . indicates the filament is on.

  . - ▽ - indicates the inlet valve is open.

- The helium peak adjustment potentiometer (bottom right).
- The two controls of the audio signal (bottom right).

  . Volume.
  . Alarm threshold adjustment potentiometer.

- The zero adjustment potentiometer knob and the two recorder output sockets (bottom left). Green socket is ground.

At the rear of the cabinet are located :

- The cabinet to vacuum unit connection cable socket.
- The protection fuse.
- A socket for connection to a fast test station (DGC) or to a remote meter.

4.2 - DESCRIPTION OF FREQUENCY CONVERTER

See instruction manual about TMP.

4.3 - OPERATION AND ADJUSTMENT

The electric diagram of the electronic cabinet is shown in figure 12 (drawing 6668-3).

Three different functions are to be distinguished :

- Pirani circuit :
  . Board E02 FM 67 516 — rear of the cabinet

- Filament and triode power supply :
  . Board E02 FM 67 516 — rear of the cabinet
  . Heat sink for the power transistor — rear of the cabinet

- Amplifier circuits :
  . Board E01 FM 67 517 — front of the cabinet

4.31 - Pirani circuits

They protect the analyser against pressure-rise. When the pressure, read by the Pirani gauge exceeds 5.10^{-2} mbar, the safety valve power supply is switched off, and cell filament cannot be heated.

4.311 - Pirani gauge operating principle

The temperature of a heated filament varies as a function of its exchanges with the ambiant medium. The Pirani filament temperature is measured by its electric resistance.

4.312- Construction

The filament is connected to the cabinet terminals J01-20 and J01-21. It is inserted in a measuring bridge R57 - R 58 - R 59 (15 V. DC).

The diagonal signal is amplified by a Q18 and Q 12.

The relay K02 is open at atmospheric pressure and closes when the pressure reaches 5.10^{-2} mbar. K02 relay allows :

- TMP starting.

- The filament to be switched on (contact 5.7)

- The safety valve coil to be energized (contact 8.10)

4.313- Adjustment

There is no adjustment required. The safety relay works when the pressure is lower than or equal to 10^{-1} mbar at the detector inlet

4.32- Triode power supply

The power supply delivers the different voltages needed for the two functions .

- Analysing function : measurement of the helium partial pressure.

- Vacuum measurement function : measurement of the total pressure, based on the principle of a triode vacuum gauge.

4.321 - Construction

a - Analysis cell power supply

The filament is connected to terminals J01.19 and J01.22 in the electronic cabinet.

The heating power is delivered by the two 10 V. windings of tranformer T01 through ballast transistor Q15 wired in series with the filament. When pressure conditions are satisfactory, the relay K01 turns on (contact 8.10). Filament is energized and pilot light DS 103 (mounted in parallel on Q15) lights up.

The heating power is controlled so as to maintain a constant electronic emission in the filament. For this, only a part of the diode filament - electron collector electronic current passes through the base emitter junction of Q03.

Potentiometer R 109 controls the electronic current adjustment. The electronic current can be measured at the resistor R81 terminals linked to red and green sockets on the printed board (1 K Ω).

Transistors Q03 - Q14 and Q13 amplify the control current and drive the ballast transistor.

The analyser power supply delivers also the polarization voltage to the different electrodes. Diodes CR 32 - CR 33 and CR 34 constitute a reference voltage chain :

- 120 V. fixed voltage between R 68 + R 69 terminals : polarization of the "filament electron-collector" diode.

- 200 V. adjustable acceleration voltage (adjustable through potentiometer R 108). To be measured between ground and CR32 - R72. Auxiliary terminals 38 and 41 on the printed board allow different adjustments of the acceleration voltage for masses 2, 3 and 4.

- Polarization voltage of the repeller electrode. The repeller electrode voltage is about 150 V. to the ground (terminal 37 on the printed board). This repeller prevents the scattered ions from penetrating into the ion collector.

b - Total pressure measurement :

The ionic current collected by the triode electrode is amplified by Q17 and measured by galvanometer M02. In addition, this output signal is applied to Q10 -Q11 amplifier which controls the filament on-off relay K01. Relay K01 is set on when the operator actuates lever (S02). It goes off :

. If pressure rises above 5.10^{-4} mbar.

. If the user pushes on the lever S02.

4.322 - Adjustments

At the factory :
Triode Q17 amplifier zero is adjusted through R 106 on printed board E02.

In the field :
Acceleration voltage adjustment through R 108 (Helium) and electronic current adjustment through R 109 (see 5.12, 6 and 7).

There is no adjustment of the triode vacuum gauge : the filament safety threshold is set at a pressure of 5.10^{-4} to 10^{-3} mbar at the detector inlet port.

4.33 - Amplifier circuits

These circuits provide amplification, ionic current measurement, "leak" signal indication.

4.331 - Construction

We are going to study :

- The power supply circuits
- The current amplifier
- The audio signal device

a - Power supply

Transformer T01 can be connected either on 220 VAC or on 115 VAC. It delivers 4 diffent output voltages :

- A stabilized voltage of - 100 V. for the output stage of the amplifier.

- A regulated voltage of + 15 V. (integrated circuit Q19) for :

  . The electrometer tubes of the amplifier Q16
  . The triode vacuum gauge
  . The Pirani vacuum gauge

- A regulated voltage of - 15 V. (integrated circuit Q20)for :

  . The amplifier Q16
  . The triode vacuum gauge
  . The Pirani vacuum gauge

- Stabilized voltages of + 8 V., + 5.6 V., - 5.6 V. for the audio signal device.

b - Amplifier

The first amplification stage consists of two electrometer tubes under vacuum located in the analyser cell. This location is necessary as the measured currents are very low ($2 \cdot 10^{-16}$ A) and the impedances are very high ('8 10^{11} Ω). One of the electrometer tubes is used as reference and provides the highest zero stability. The grid of the other one is connected to the target.

Polarization is determined by the voltage created in R 346 by the ionic current.

The whole can be balanced by adjusting R 101 and R 102 potentiometers.

The electrometer tube plates are connected to the two terminal inputs of the amplifier Q 16.

The output signal of Q16 amplifier is amplified in Q01 and Q04 and then delivered to galvanometer M01 through a resistor chain attenuator R41 to R46.

The output signal is injected by means of a feedblack loop into resistor R 346 so as to stabilize the amplifier.

The zero of the amplifier can be modified from the front panel by turning "0" potentiometer (R 103) in order to cancel any parasite helium signal.

A remote leak meter, on option, can be connected in parallel with Q04 output through R31. <u>In this case, the range selector S01 must be set on 3.10^{-7} scale</u>.

A recorder can be plugged in J02 and J03. The recorder must be grounded. It is connected in parrallel with resistor R 17 (499 Ω), its internal resistance must therefore exceed 50 000 Ω and its sensitivity must be 50 mV. for full scale deviation.

c -<u>Audio signal</u>

Q04 output drives the threshold amplifier Q05 - S06. The signal transmission threshold is adjusted by R 104. The amplified signal is sent to an oscillator whose frenquency is related to the amplitude of the signal which controls it. In this way, the frequency of the audio signal varies with the intensity of the leak signal. An amplifier Q02,Q09 amplifies the oscillator signal. R 105 is used to adjust the volume.

4.332- Adjustments

a -<u>Amplifier</u>

L 101 anode voltage is adjusted at 8 V. by R 102 (E01 printed board left).

Set zero of the amplifier with R 101, "0" potentiometer being palced two turns from full rotation.

b -<u>Audio signal</u>

Threshold adjustment by R 103 (see 5.13).

4.34

At the back of the ASM electronic unit the following information is available about the 12 pin socket,

1 - TRIODE PRESSURE

2 - FILAMENT

3 - FILAMENT

4 - THROTTLE VALVE

5 - THROTTLE VALVE

6 - AUDIO SIGNAL

7 - SIGNAL AMPLIFIER
REMOTE METER

8 - MASS

9 - THRESHOLD 10^{-2}

10 - THRESHOLD 10^{-2}

11 - COIL POWER-SUPPLY OF THE SAMPLING-VALVE

CHAPTER 5

OPERATING INSTRUCTIONS

CONTENTS
5.1 - DETECTOR OPERATION
5.2 - MAINTENANCE OPERATION ADJUSTMENTS
5.3 - FREQUENCY OF MAINTENANCE OPERATIONS
5.4 - TROUBLE CHECKING
5.5 - SPARE PARTS LIST
5.6 - ACCESSORIES

OPERATING INSTRUCTIONS

5.1 - DECTECTOR OPERATION

OPERATION	LOCATION
5.11-START - UP	
1 - Check the voltage before plugging in (220 V. 50 Hz. or 115 V. 60 Hz.)	Electronic cabinet (rear) Analyser (rear)
2 - Connect various cables to the appropriate outlets and sockets.	Analyser
3 - Set the range selector knob on scale 10.10^{-6} atm.cc/sec.	Electronic cabinet
4 - Push on the green button As the fore-pump starts up, the needles on the galvanometer Sweef across the dials. This is normal	Analyser
5 - Turn the pilot valve knob on position 2 (the mechanical pump roughs down the turbomolecular pump).	Analyser 
6 - After a few minutes, " 10^{-2}" pilot indicator will light and TMP is activated, indicated by a yellow pilot indicator. When the green pilot indicator is activated, the pump will be at operational speed and filament switched on by triggering the switch marked "-∿∿∿-". Green pilot indicator market "-∿∿∿-" lights ; pressure indicated on triode galvanometer will be about 10^{-4} mbar and will gradually drop to 10^{-5} mbar. If filament light flashes, wait a few more minutes and try to activate filament again.	Electronic cabinet
7 - Unit is ready for operation.	

5.12 - LEAK RATE CALIBRATION

It is not worth while controlling calibration before each test, but it is advisable to test periodically the instruments good working, for sensitivity may have been changed by accidental air inlet or errors from the operator. Calibration is made with a standard leak.
Proceed as follows :

1 - Connect the standard leak to the inlet valve (leak rate must be about 1.10^{-7}).	Analyser
2 - Set the range selector knob on 10.10^{-9} scale. Use the "0" adjusting knob to get a reading on the leak galvanometer. It is not useful to use the 10.10^{-10} position for a more accurate reading.	Electronic cabinet
3 - Set the range selector knob on 3.10^{-7} scale.	Electronic cabinet
4 - Turn the pilot valve knob on position 1. Mechanical pump gurgles.	Analyser 
If necessary, open the valve of the calibrated leak, when it has one.	
After 10 seconds, slowly open the inlet valve checking that the vacuum gauge needle stays in the green zone.	Analyser 
	Electronic cabinet -▽-
Green light - ▽ - will come on when the valve is open.	Electronic cabinet
5 - Turn the pilot valve knob on position 2.	Analyser 

6 - Read the leak value on the galvanometer. The measured signal slighty decreases suring a few minutes on account of a helium memory effect.

Figures 10.10^{-10} 3.10^{-10} read on the range selector correspond to the full scale deviation of the leak galvanometer.

For 10.10^{-10} 10.10^{-9} positions, the reading will be taken on 0.10 scale.

For 3.10^{-9} 3.10^{-8} : the reading will be taken on 0.3.

A 30 % error can be allowed between the reading and the value on the leak.

7 - To modify the deflection of the galvanometer, use the potentiometer which regulates the filament electronic current.

Electronic cabinet

8 - If the calibrated leak is equipped with a valve, it is possible to check that the leak meter zero is correct by closing the valve.

Electronci cabinet

9 - After the calibration has been done, shut the inlet valve and vent by removing the calibrated leak.

Analyser

5.13 - AUDIO SIGNAL

An audio signal can be used to complete the signal of the galvanometer in order to warn the user.

Threshold adjustment :

- Set the range selector knob on 10.10^{-9} scale.

Electronic cabinet

- Make an equivalent helium signal with the "0" potentiometer.

- With a screwdriver turn the threshold potentiometer.	Electronic cabinet
- Volume adjustment : turn the volume control knob.	Electronic cabinet

5.14 - TESTING A SMALL VOLUME ARTICLE UNDER VACUUM

1 - Shut inlet valve.	Analyser -▽-
2 - Connect the article to the inlet valve by a metallic tube (better than a plastic one but not compulsory).	Analyser
3 - Set the range selector knob on 10.10^{-9} scale, which is a good range to work on To use a remote meter, set the selector on 3.10^{-7} position.	Electronic cabinet
4 - Set the by-pass valve knob on position 1. Mechanical pump gurgles.	Analyser
5 - Wait a few seconds to a few minutes before opening the inlet valve. A 10 liter volume needs 3 minutes to be evacuated.	
6 - Slowly open the inlet valve while checking the vacuum gauge meter. The needle must stay in the green zone.	Analyser -▽- Electronic cabinet
If the inlet valve cannot be opened, put the by-pass valve on position 2, stopping meanwhile on medium position. Then try to open the inlet valve.	

NOTE

If the filament goes off, close the inlet valve and wait 10 seconds before re-opening.	Analyser
7 - Set the pilot valve control knob on position 2.	
Perform test.	

NOTE

If testsare performed on series of small volume pieces, it is recommanded to use an auxiliary roughing pump in order to prevent contamination of the turbomolecular pump see § 5.15).

5.15 - TESTING A LARGE VOLUME PIECE UNDER VACUUM

Evacuate inlet port to the lowest possible pressure (ultimate pressure of mechanical pump : 1.10^{-2} mbar).
If it is not possible to completely open the inlet valve, then switch the filament off and open the inlet valve.
After a few minutes, switch on the filament by triggering the switch marked "-vvv-". Green pilot indicator marked "-vvv-" lights : pressure indicated on triode galvanometer will be about 10^{-4} mbar and will gradually drop to 10^{-5} mbar.
If filament light flashes, wait a few more minutes and try to activate filament again.

5.16 - SNIFFING

The sniffing method is used for pieces under internal helium pressure.

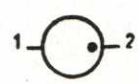
- Connect the sniffer probe to the inlet valve and rough it as indicated in 5.14. — Analyser

- Open the sniffer probe so as to get 1.10^{-4} mbar on the leak detector vacuum gauge. It may be necessary to wait about 10 minutes before opening it, in order to allow the outgassing of the sniffer hose.

5.17 - SHUT-OFF

Set the selector range on 10.10^{-6} scale — Electronic cabinet

Shut the inlet valve. — Analyser

Set the pilot valve knob on position 2. — Analyser 

Press the red button that will switch off the main supply.

5.18 - INLET SAFETY VALVE OPERATION

The safety valve principle has been described in § 2.333.

While operating the leak detector,sudden air inrush may result in automatic valve shutting.

To re-open the valve, turn the knob clockwise all the way down. Switch the filament on and turn the valve knob counter-clockwise to open.

5.19 - REMARKS ABOUT THE "HIGH SENSITIVITY" TESTS

The ASM 110 T leak detector enables to measure, at full speed, 2.10^{-11} atm.cm3/s leaks. However such a high sensitivity is not always necessary .

Generally, when the acceptance threshold will be 10^{-8} atm.cm3/s, the user will work on the 10.10^{-9} or 3.10^{-8} range.

Remember that the calibration must be achieved with a leak greater than 10^{-8} atm.cm3/s.

5.2

MAINTENANCE

5.21 - QUICK CHECKING

To make sure of normal operating conditions, it is only necessary to check the following points :

- The internal pressure of the detector, the inlet valve being open and blanked-off, must be lower than 1.10^{-5} mbar.

- Zero stability rapid variations must not exceed $\pm$ 3 small sivisions on 10.10^{-10} sensitivity range.

- When comparing the value indicated on a calibrated leak with the leak meter reading, this latter should not be more than 30 % lower (after adjustment of the helium peak)

If one of the above conditions is not fulfilled, see § 5.4 - trouble checking.

5.22 - COMPLETE OVERHAUL

After dismantling and cleaning all the parts of the analyser unit, a complete test will be made with the following operations :

- Electrometer tubes balancing § 4.232

- Electrometer current adjustment § 4.222

- Filament protection § 4.222

- Inlet valve test § 4.222

- Amplifier zero stability test

- Helium signal stability test.

PERIODICAL MAINTENANCE OPERATIONS

Periodicity (hours)	MAINTENANCE OPERATION
200	Check the oil level of forepump
1 000	Check the analysis cell background noise at 1.10^{-4} mbar (less than 10^{-8} atm.cm3/s.)
2 000	Drain the mechanical forepump oil.
4 000	Complete cleaning of : - vacuum system - analysis cell Remove dust from fan and electronic cabinet
10000	Mechanical forepump complete overhauling.
20000	Replace the Turbomolecular pump fan. Replace the seals and gaskets.

NOTE : Reference TMP manual for maintenance instructions for the TMP.

TROUBLE CHECKING

If several detectors are used, it will be easier to locate any defect by substituition of interchangeable parts such as amplifier, pre-amplifier or connection cable.

5.41 - MECHANICAL PUMP MOTOR	
Difficult on start-up.	- Normal if the temperature is lower than 10° C - Use a heater if necessary.
5.42 - INLET SAFETY VALVE	
The valve does not open.	- Check if coil is energized : 5.5 V.D.C. between P08.1 and P08.2 (plug disconnected, if necessary see § 2.33.)
The pilot light ▽ does not light up.	- Check if pilot light is energized : 5.5 V.D.C. - Check coil terminals P08.3/P08.2 - Check bulb.
5.43 - PUMPING SYSTEM	
Pressure stays over 1.10^{-5} mbar few minutes after the starting.	- Could be a leak in the vacuum circuitry : - Close the inlet valve - Leak check the vacuum circuitry with helium. - Check to see if TMP has reached operational speed (green light switched on (analyser).
5.44 - AMPLIFIER ZERO SETTING	
No possible adjustment	- Perform the adjustment described in § 4.232. - If possible, use another pre-amplifier or another electronic cabinet.

The leak rate meter needle swings suddenly to the left and sticks there for several minutes before returning to its normal position.	- Electrical parasite due to : - Mains power - A wire broken in a cable or a plug.
Zero is unstable on scale 10.10^{-10} (more than $\pm$ 3 small divisions).	- Try to substitute a spare pre-amplifier, adjust polarities as indicated in § 4.232.

5.45 - ANALYSIS CELL

The filament light does not light up.	- Check the bulb and voltage at bulb contacts. - Check the filament continuity circuits between J06.1 and J06.5 - Check filament power supply (see electrical diagram).
On filament switch on, pressure rises and filament goes off.	- Clean the analysis cell (§ 2.1342).
No helium signal with calibrated leak on.	- Make sure the inlet valve is open and the filament has been switched on. - Adjust "helium peak" potentiometer (electronic cabinet front panel). - Check electronic current is 1 mA (1 V.) on R8 1 terminals. - Make sure acceleration voltage between P06.4 and P06.6 is about 200 V. - Make sure the magnet is properly instaled with "N" stamped pole facing the rear of the cabinet.

	- Dismantle the analysis cell, check it is clean. Make sure the filament alignement is correct. - Check the electrodes of the analysis cell are not shorted with ground. - There is probably a short-circuit between ground and ionization chamber if the filament light brightness varies when acceleration voltage is varied.
Lack of sensitivity	- Dismantle the analysis cell. Check the filament cleanliness and its alignement. - Change the electron collector. - Clean the analysis cell and its chamber. - It could be necessary to use fine abrasive cloth to remove insulating material which are not visible (§ 2.1342).
Large helium signal without calibrated leak at ultimate pressure (lower than 10^{-5} mbar).	- Has TMP reached operational speed ? - Is mechanical pump rotating ? - Is there any helium in the room ? - Check level and cleanliness of mechanical pump oil - Shut the inlet valve. If signal goes off, clean the inlet valve. - If signal does not go off, clean the analysis cell.
More than 50 % less on helium signal between 10^{-6} and 10^{-4} mbar.	- Clean the analysis cell and change the electron collector.
Helium signal instabilities : peaks with periods of a few minutes.	- Clean the inlet valve. - Do not use grease.

5.5 SPARE PARTS KIT

DESCRIPTION	PART NUMBER
5.5.1 Maintenance kit for ASM 10	67542
1 Mechanical pump oil charge	10990
2 complete filament assembly	53146
5 screws CM 2 L 4	83489
5 Washers Trepp diam. 6	84486
5 Electron collector	83485
1 Preamplifier	86393
1 Solenoid coil	67505
3 Pirani filament	57972
2 Alumina spacers	83467
1 PC board E01 A 313836	67522
1 PC board E02 A 313835	67521
1 Potentiometer R 103	37519
1 Potentiometer R 104	87554
1 Potentiometer R 105	87552
1 Potentiometer R 108	37512
1 Potentiometer R 109	37511
2 Diodes CR 13 - CR 14	87380
1 Transistor Q 15	87406
2 Fuses F01 0,5 A	60519
1 Galvanometer M01	55497
1 Switch S02	60300
1 Transformer T01	55499
3 bulbs for lights DS 01, DS 02, DS 03	60041
1 Galvanometer M 02	55498
1 seals kit	67541
2 Fuses 1 A	83473
5.5.2 ASM 110 T specific parts	
1 Spare part kit for TMP 5100	63082
1 Seal packet for TMP 5100	63075
1 Adjusted printed board for CFF 100	
1 Light BD 601 R	
1 Light BD 603 G	
1 Light BD 609 Y	
1 Self transformer (100-115 V)(Option 100 V 60 Hz)	67806
1 Fuse 0,3 A TD (220 V)	60529
1 Fuse 0,6 A TD (100 - 115 V)	

5.6 - ACCESSORIES DELIVERED WITH EACH DETECTOR (P/N 67886)

Qtity	Description	Warchouse Number
1	Filament	53 146
	–	
1	ø 5 mm allen key	81 141
1	Tube containing :	
	- 2 fuses : D1 TD 1 A	83473
	- 1 midget bulb 24 V. 50 mA	
	- 1 bi-pin bulb 24 V.	
	- 2 fuses D1 TD. 0.05. A	60 524
	- 1 Pirani filament	57 972
1	Tube containing :	
	- 1 electron collector	83 485
	- 5 CM2 L4 screws	83 489
1	Tube containing :	
	- metal gasket	53 147
	- metal gasket	83 476
	- lead gasket	83 478
1	Tube containing :	
	- 3 micro midget bulbs 5.	60 041
1	Tube containing :	
	- 3 micro midget bulbs 24 V.	
1	Screw driver	
1	Can of oil for vane pumps	10 990
1	Syringe of grease	56 993

CHAPTER 6

OPTIONS

CONTENTS

GROSS LEAK OPTION

There are nine ranges in the standard ASM110T It is possible to achieve measurements between 10^{-9} and 10^{-5} full scale.

Some users prefer a 10^{-8} 10^{-4} range.

ASM 110 T detector can supplied with such a range. The pre-amplifier inlet resistor whose normal value is 8.10^{11} Ω , is 6.10^{10} Ω in this case.

Any other range can be supplied on request.

6 - 2 OTHER VOLTAGES

6.2.1 OPTION 60 HZ. - 115 V.

ASM 110T detector can be supplied for 60 Hz. - 115 V. mains supply.

Differences between 115 - 60 Hz. model and 50 Hz - 220 V. model are as follows.

- Vane pump motor
- Timer
- Circuit breaker
- Fans

- T01 special connection
- Electronic cabinet fuse.

6.2.2 OPTION 60 HZ -100 V

ASM 110 T DETECTOR CAN BE SUPPLIED FOR 60 Hz - 100 V mains supply . It is necessary to add an 100/115 V auto-transformer.

6.2.3.OPTION 50 Hz - 240 V

ASM 110 T Detector can be supplied for 50 Hz, 240 V mains supply. It is ncessary to add an 220/240 V auto-transformer.

LONG DISTANCE SNIFFER OR L.D SNIFFER (ref. 85801)

This devise is intended to enable a sniffing operation to be carried out by means of a helium mass spectrometer on an objet situated more than a few meters away from the detector.

I- PRINCIPE

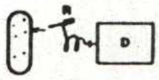


FIGURE 1

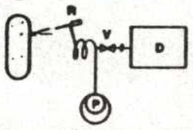


FIGURE 2

The helium leak testing of any vessel by the sniffing method consiste in:
- pressurizing helium into the object to be tested.
- sniffing any helium leak by means of a probe R
- sending the flow of gas on to an analyser D which detects any tracer helium.

For distances under 2 meters the probe is connected directly to the detector D(fig I).
For distances over a few meters, an auxiliary pump must be used, which enables the tracer gas to be carried in viscous flow, in order to obtain the right transfert speed. The detector is then connected in parallel to the sniffing circuit by a valve or a diaphragm V (fig 2).

This method is inconvenient because the user has to add a pumping device (membrane or vane pump) too bulky to be included in the housing of a portable detector, and necessitating a connection to a mains supply.
The Alcatel system, called L.D.(long distance), allows the tracer gas to be transferred in viscous state without adding an extra pumping apparatus to the mass spectrometer.

2- DESCRIPTION

Fig 3 gives a conventional diagram of the spectrometer detecter:

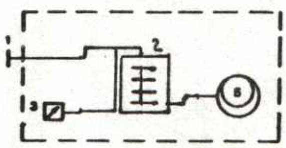


FIGURE 3

I Inlet port

2. Turbomolecular pump

3. Analyser cel.

5. Vane pump.

One could imagine connecting the sniffing probe to the inlet port of pump n°5. This unfortunately is impossible : to obtain an acceptable transfer speed, the pressure in the pump would have to reach too high a degree, incompatible with the working of the turbomolecular pump.

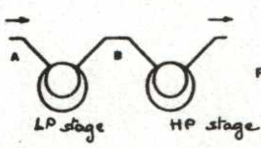


FIGURE 4

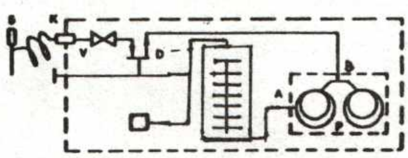


FIGURE 5

However, if the design of pump 5 is examined more closely, it will be noted that this device generally comprises 2 pumping stages in series (fig.4)
So the idea was hit upon of installing a derivation between the 2 stages at point B where pressure can build up without perturbing the diffusion pump coupled at A.

This leads to diagram 5. The sniffer probe, made of a stainless steel capillary tube, is connected to the detector housing by means of a thin plastic tube and a pneumatic couplingK. This enables the probe to be easily connected or disconnected when the sniffing method is needed.

The gas flow through the probe across a sampling device D(porous membrane) and is then evacuated by the high pressure stage of the vane pump P.
An electromagnetic valve closes automatically in the event of a mains supply failure, in order to avoid an air inrush on the TMP when the valve pump comes to a stop.

3- PERFORMANCE

Detection of leaks ranging about I.IO^{6} std. CM3/S.
Transfer speed of helium : I M/S
Pressure in analysis cell : 2.IO^{5} mbar.

4- OUTSTANDING FEATURES

-Ease of Operation: The probe is a metallic type pencil Ø 3 mm, connected by a plastic tube Ø 4 mm, to a pneumatic coupling fixed on the an analyser's front plate. The probe can be rapidly connected or disconnected without perturbing the operation of the analyser.
There is no need for a mains supply.

- Easily Fitted : The L.D sniffer can be fitted to any detector Alcatel ASM IO, ASM5, DGC5, DGCIC Bulk is negligible. The extra weight being about IOOgr.

-Reliability : There are no mobile components (needle valves) therefore no readjusting needed. The probe is fitted with a filter easily replaced when the pressure drops below 2.IO^{5} mbar.The device has been adjusted to maintain a pressure ranging about 2.IO^{5} mbar in the analysis cell, this reduces the wear of the filament.

-5 DIRECTIONS FOR USE

All that is necessary is to connect the quick mneumatic coupling and check that this operation increases the triode pressure to 2.IO^{5} mbar
In some cases it may pay to work with a remote leakmeter.

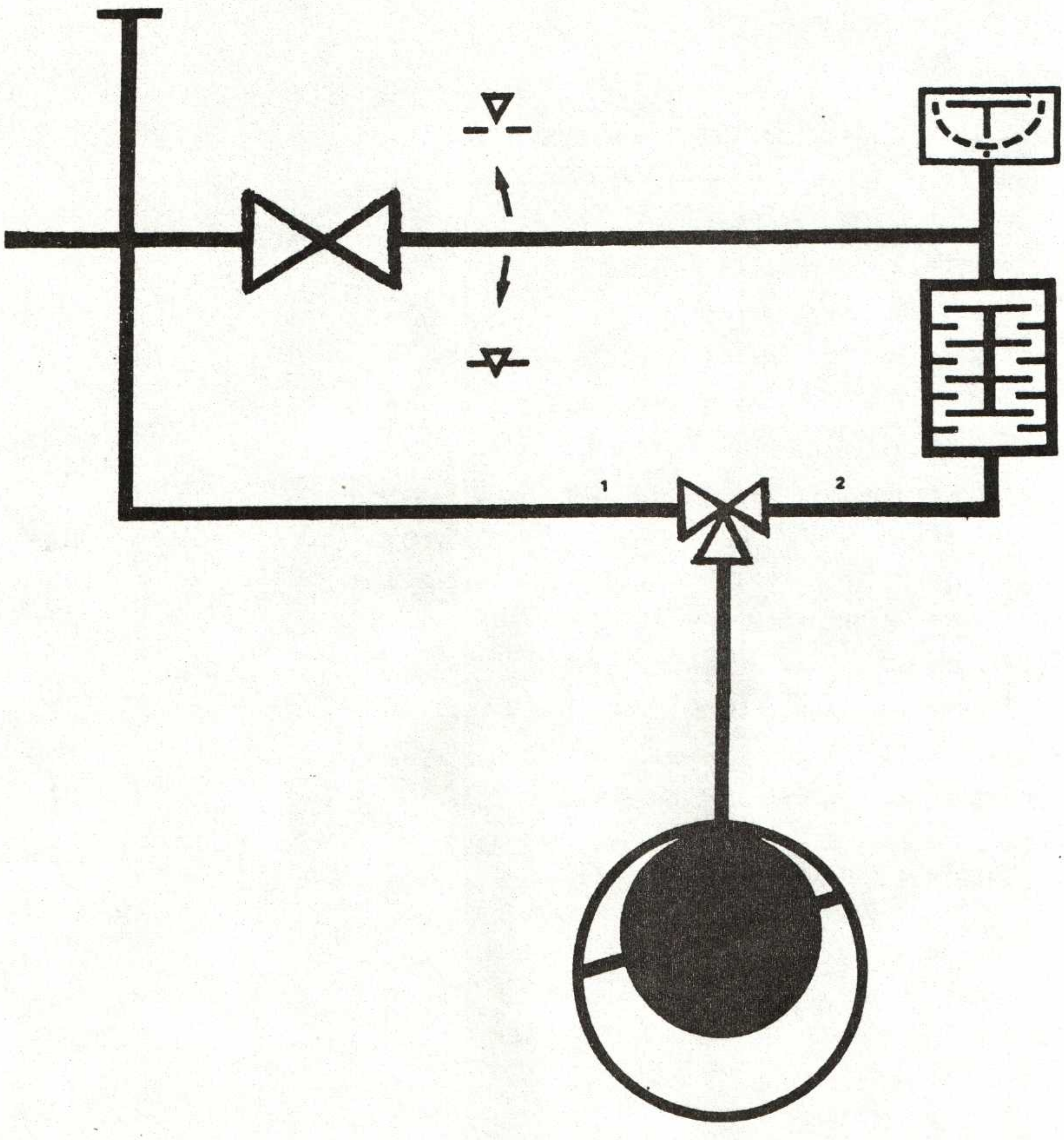
CHAPTER 7

FIGURES AND DRAWINGS

FIGURES AND DRAWINGS

FIGURES AND DRAWINGS

ASM 110 T



Schematic diagram

FIGURE 1

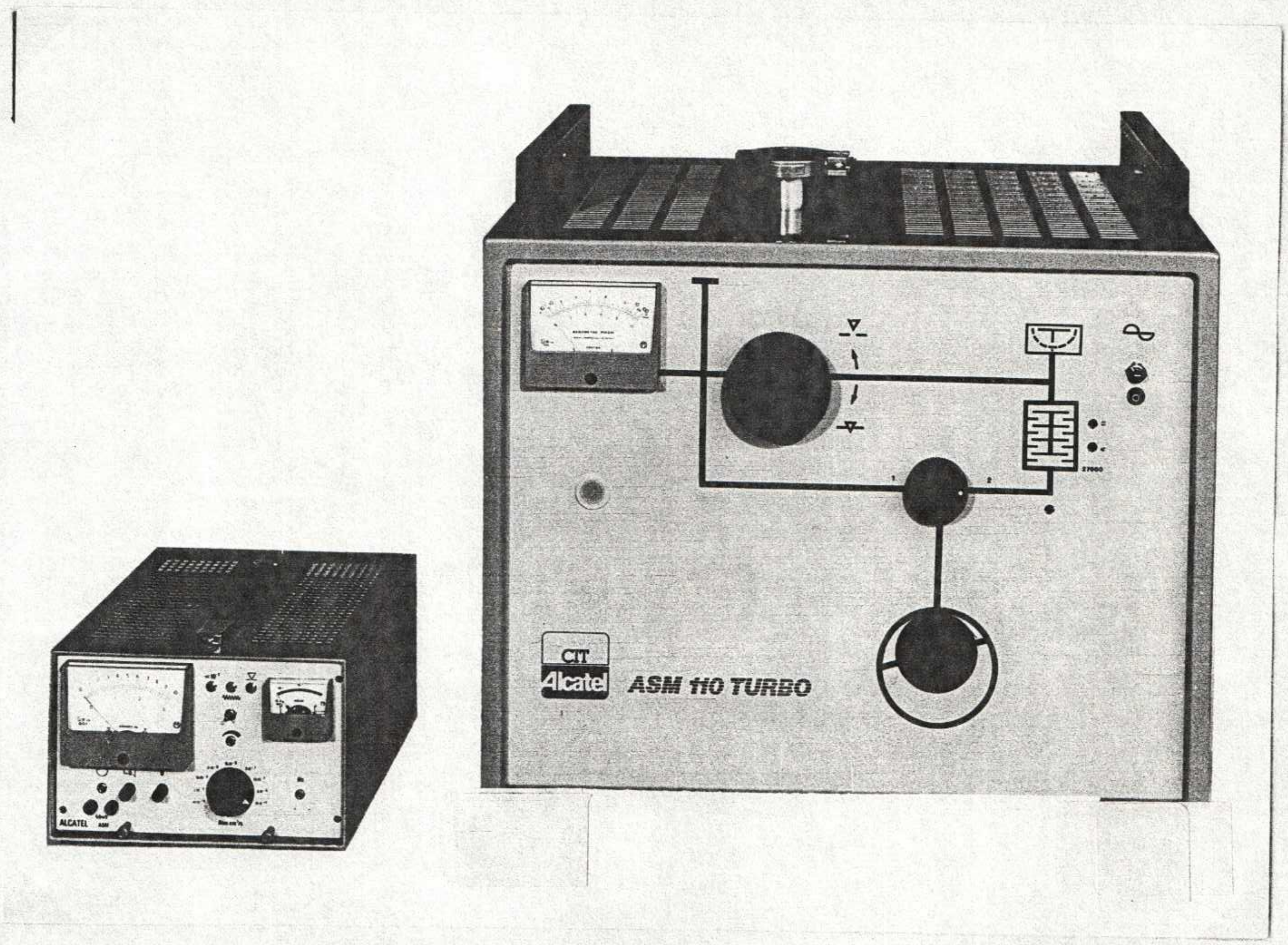


Figure 2 : LEAK DETECTOR PICTURE - COMPLETE

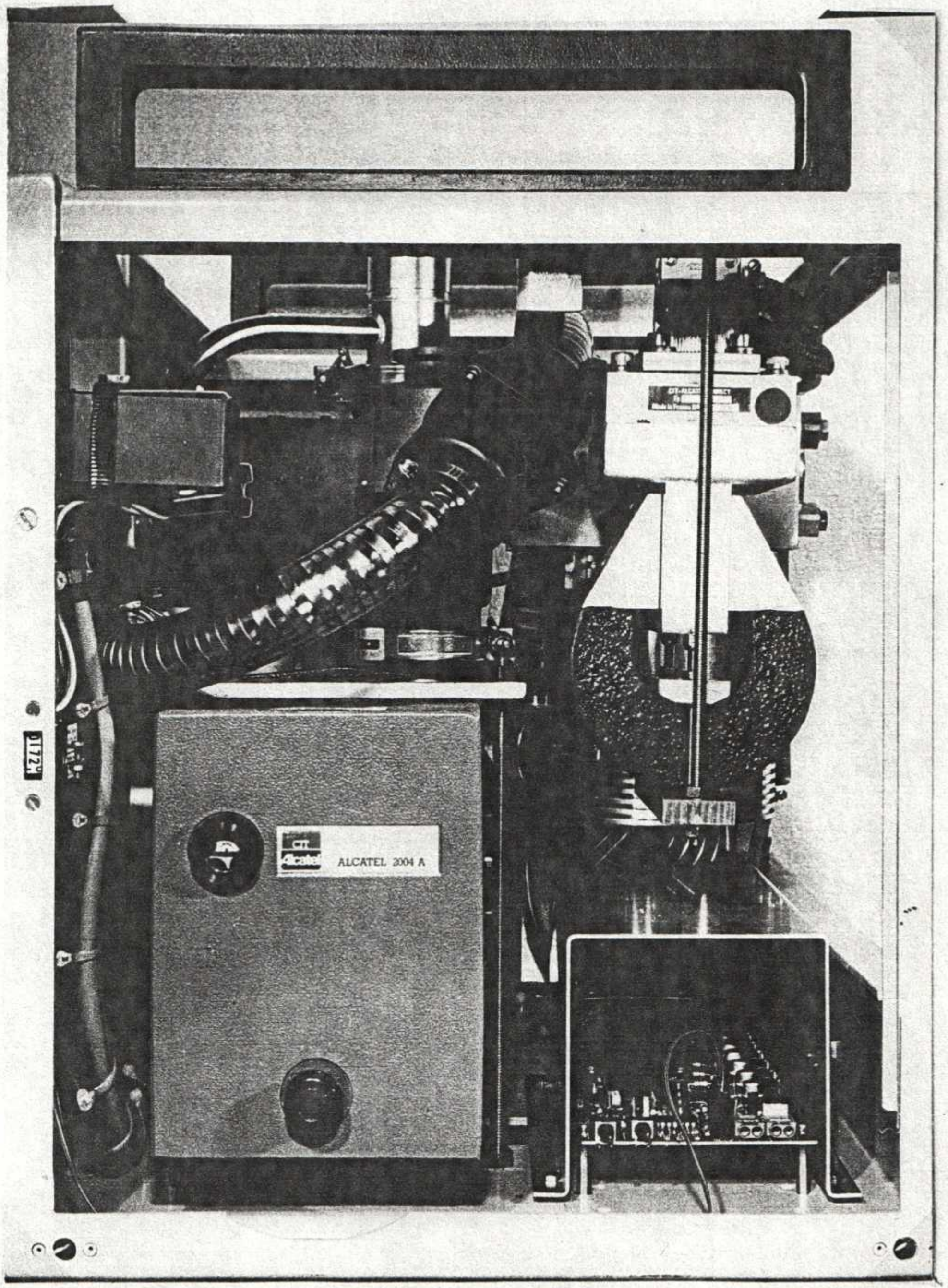


Figure 3 : TURBOMOLECULAR PUMP SIDE

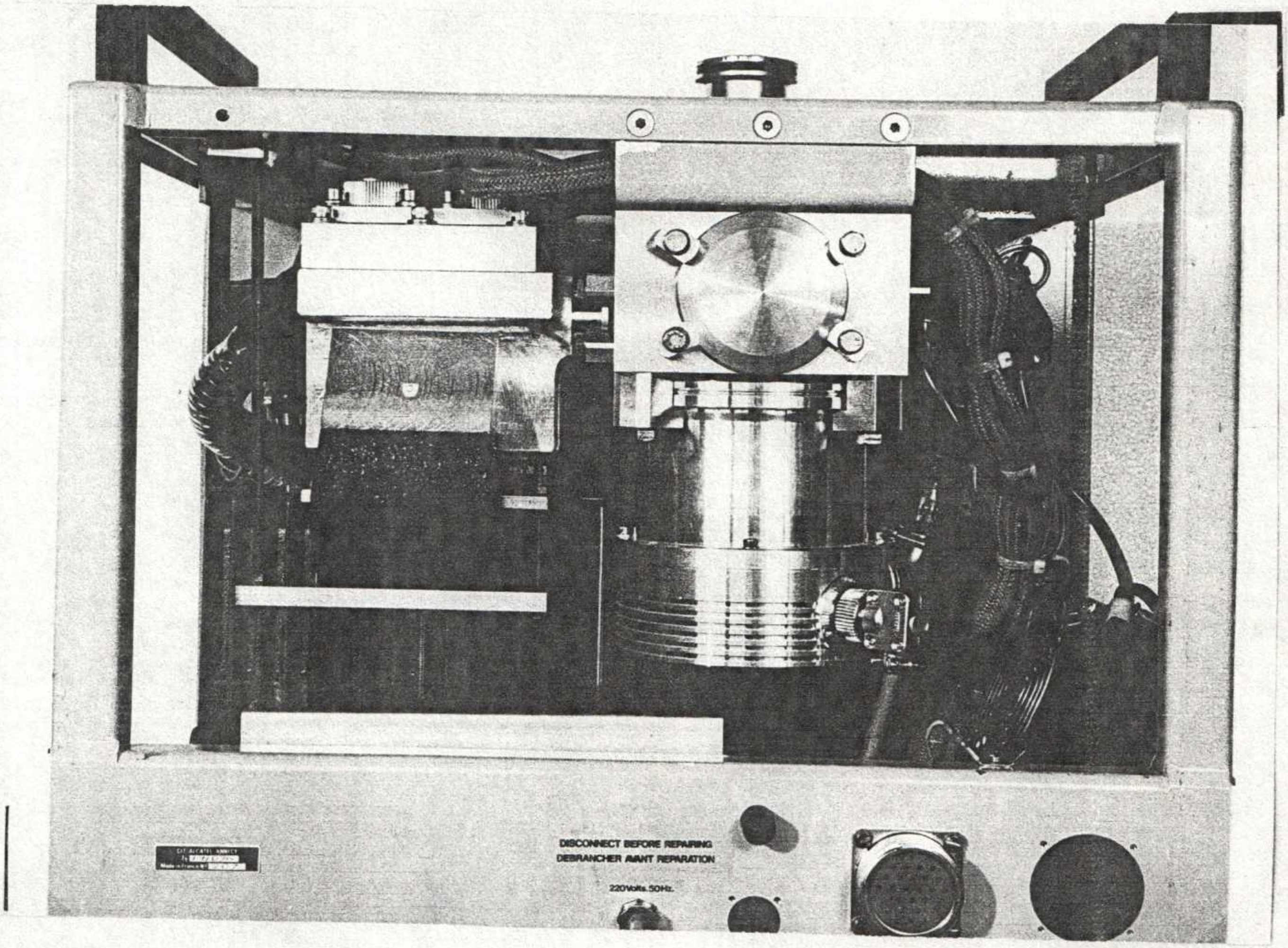
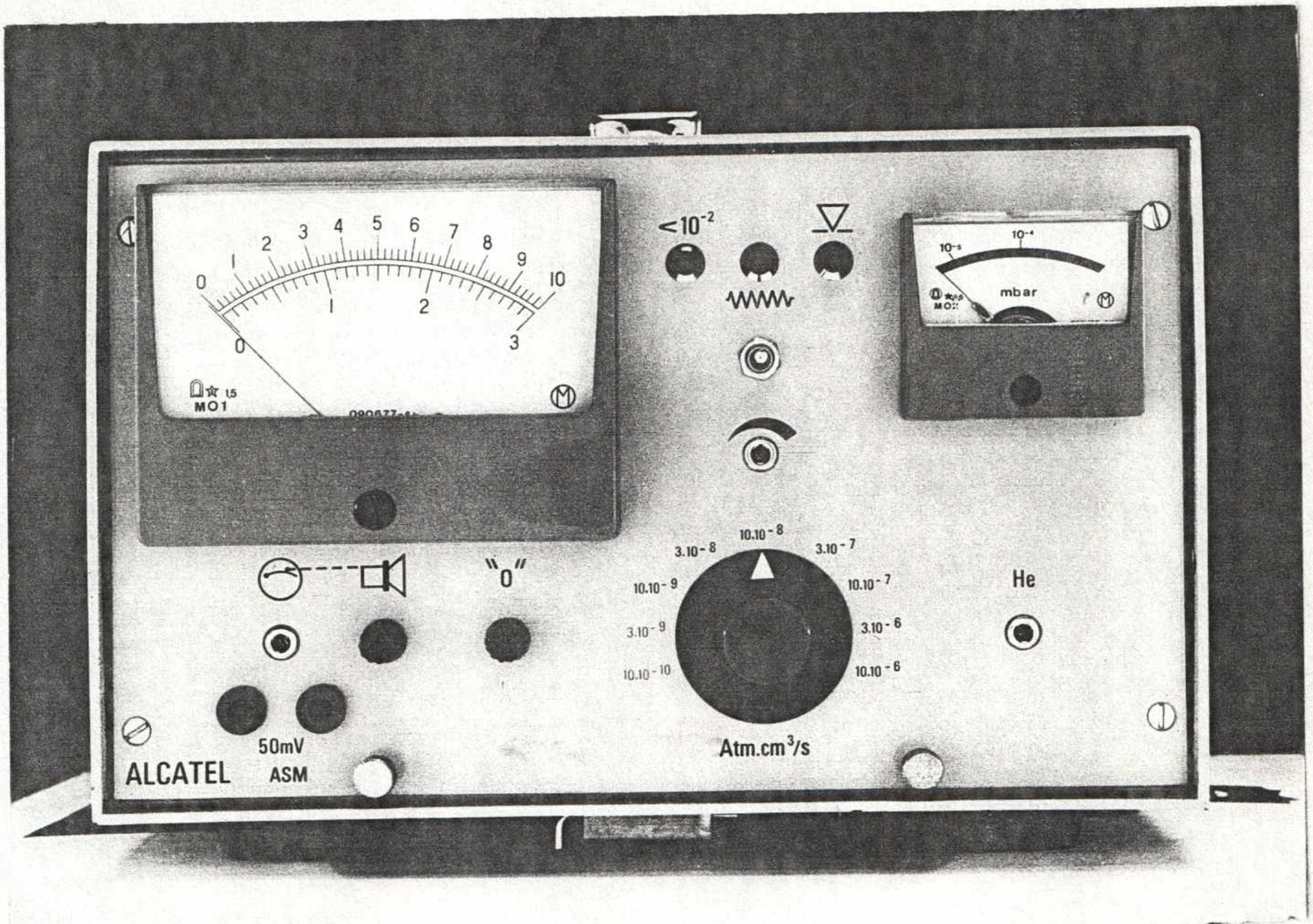


Figure 4 : ANALYSIS CELL SIDE



Electronic cabinet (front)

Figure 5

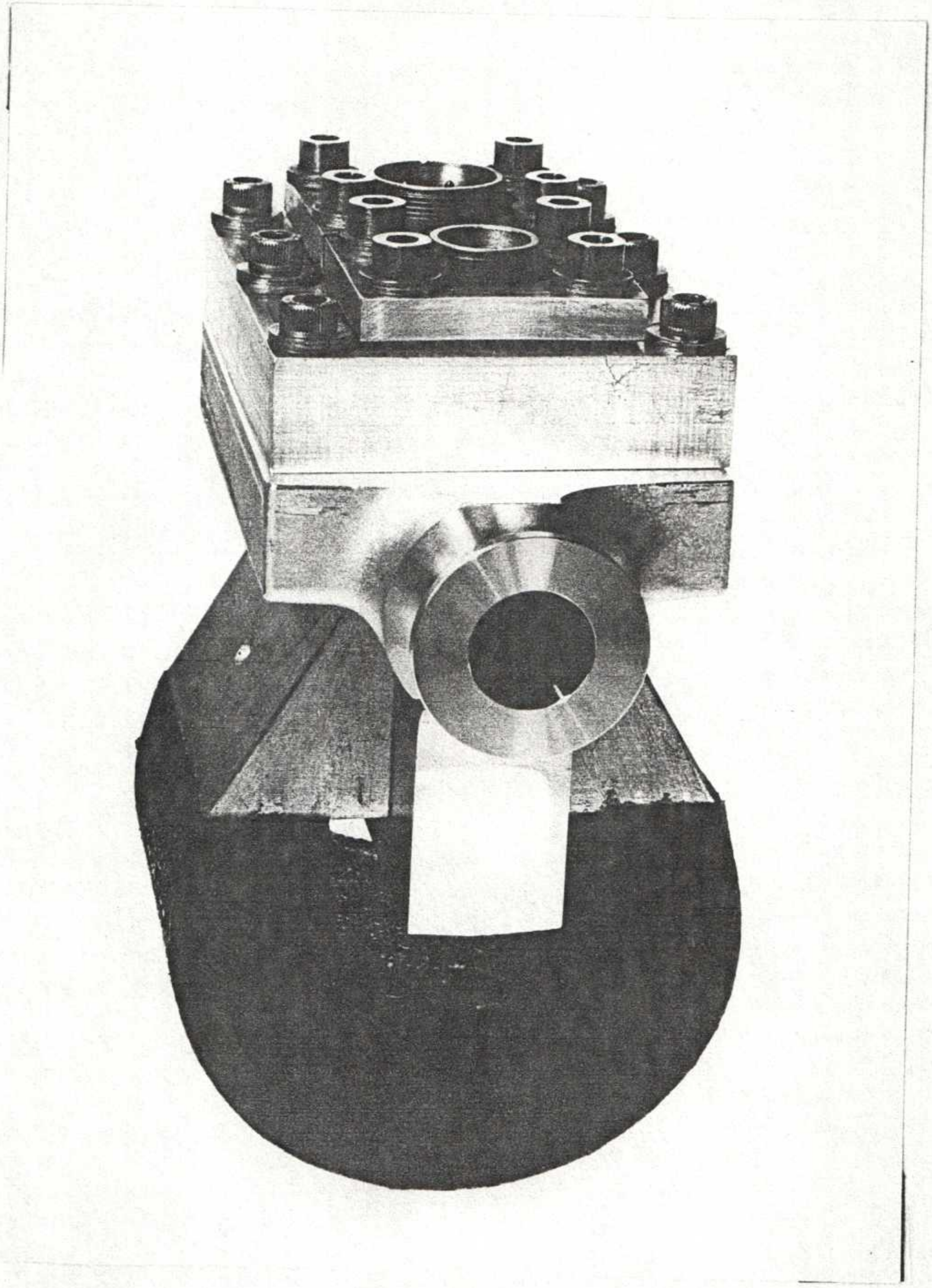
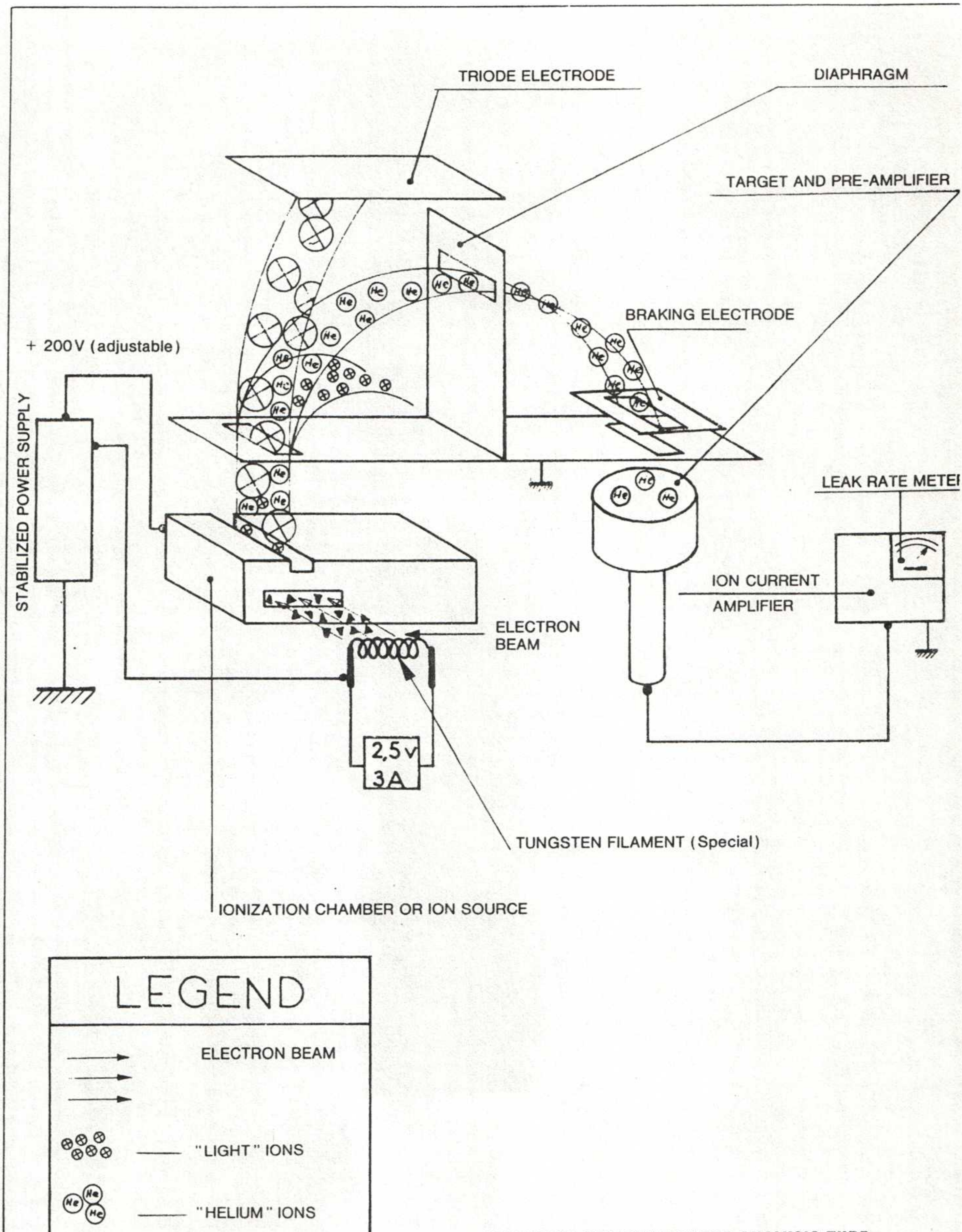


Figure 6 : ANALYSIC CELL PICTURE - OUTSIDE VIEW



OPERATING PRINCIPLE OF THE ANALYSIS TUBE

FIGURE 7

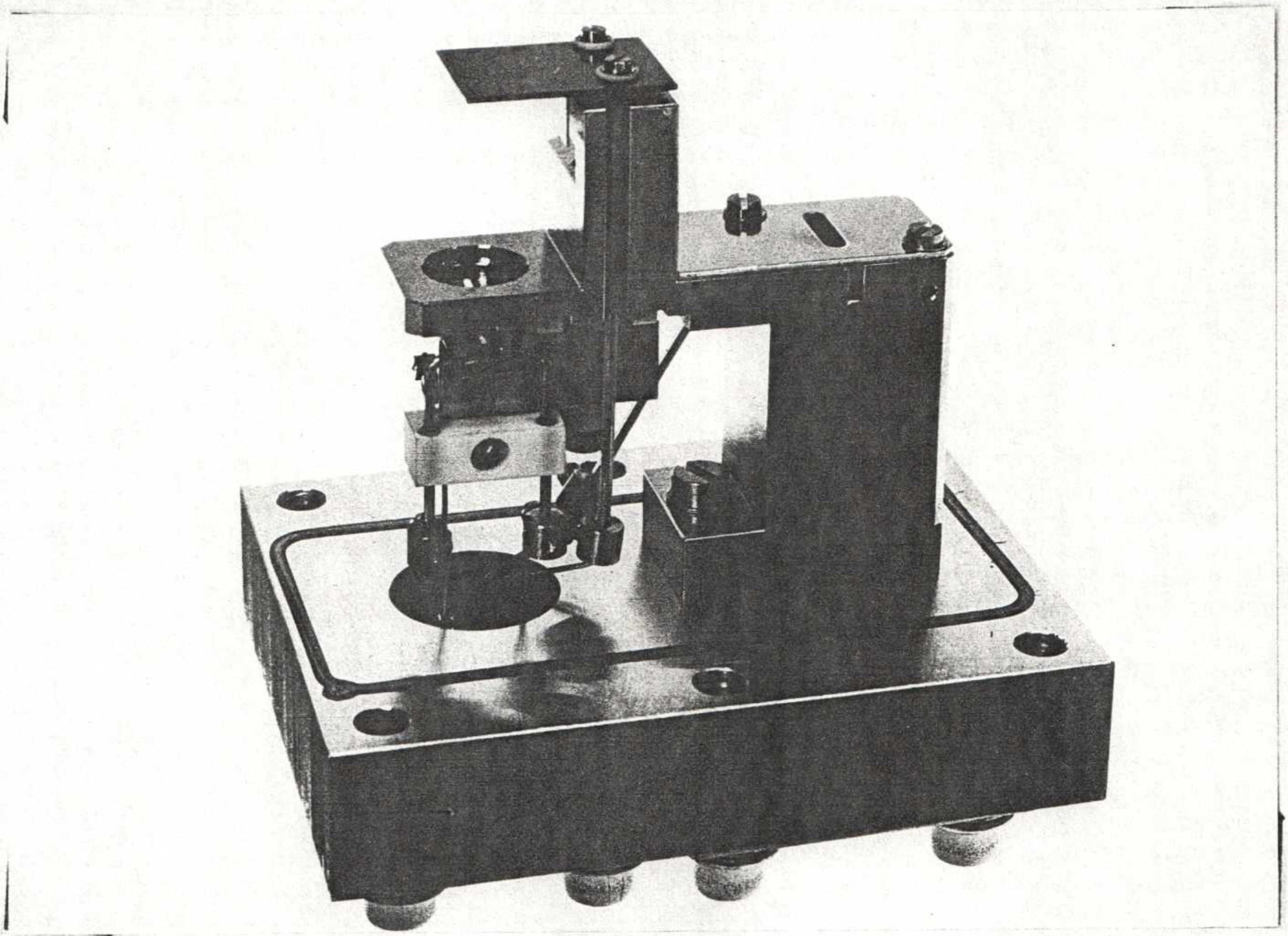
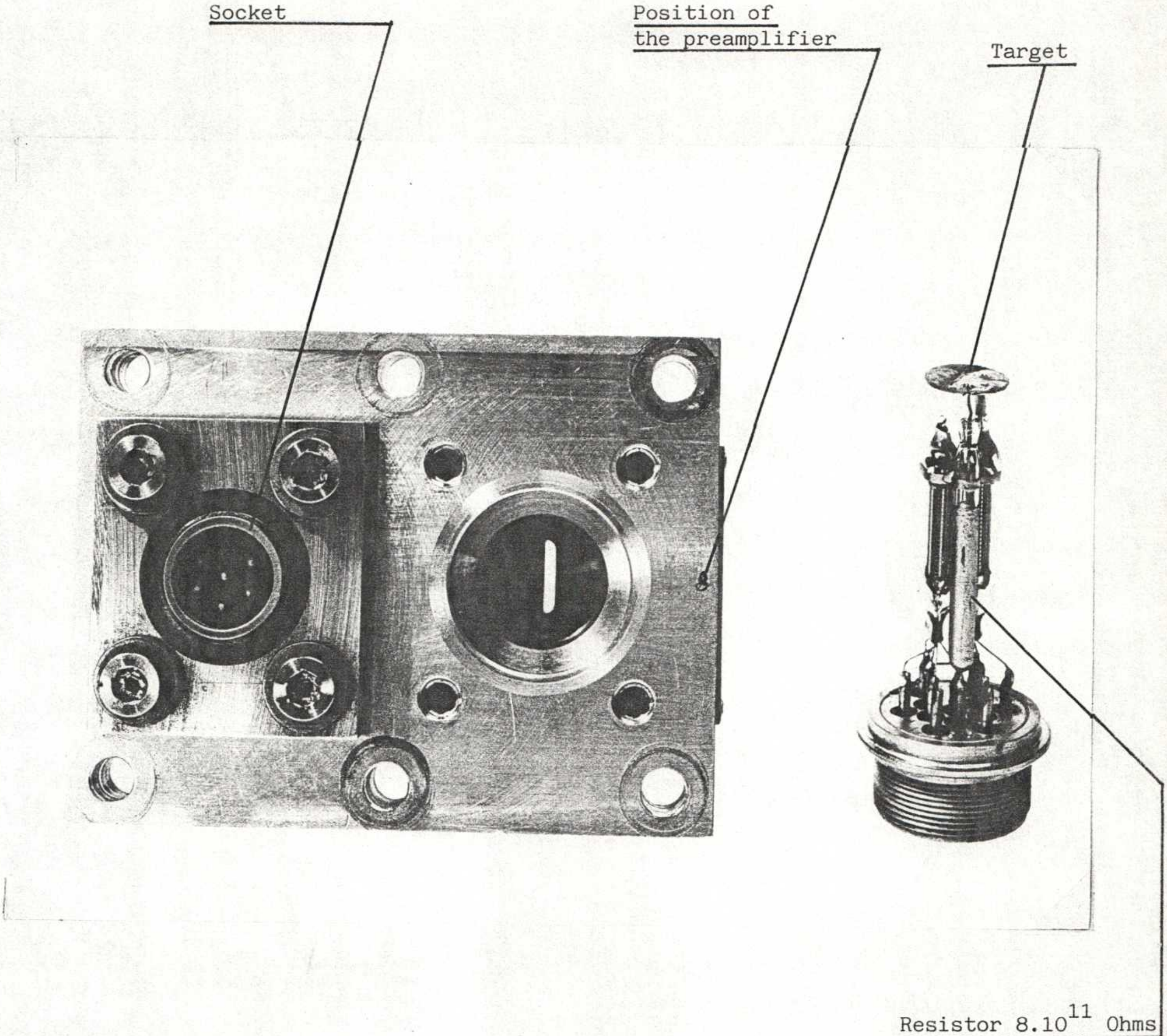


FIGURE 8 ANALYSIS CELL - Inside view



PREAMPLIFIER

- standard P/N 86393
- X 1/10 P/N 86793
- X 1/100 P/N 86787

Figure 9 : PREAMPLIFIER

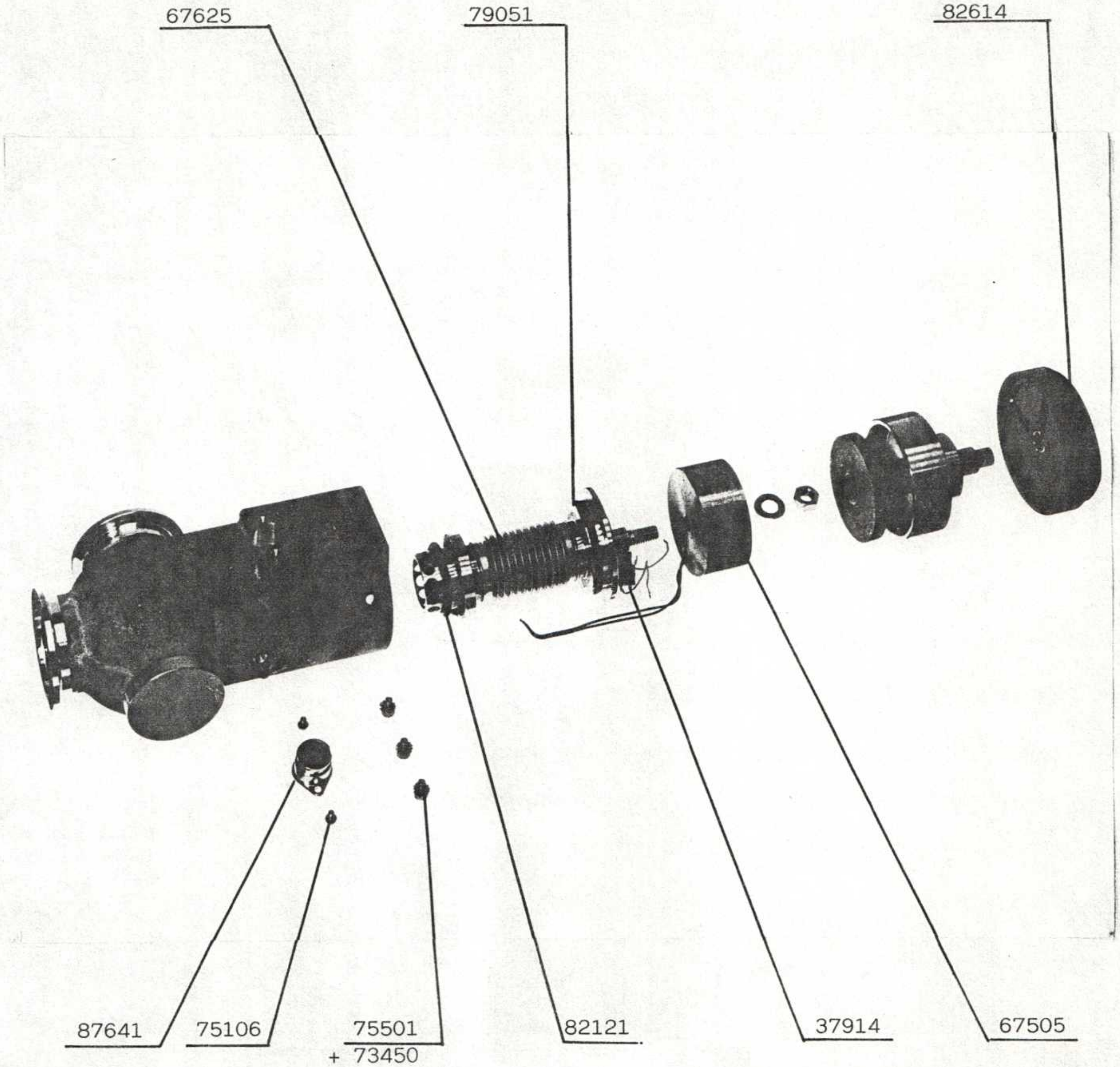
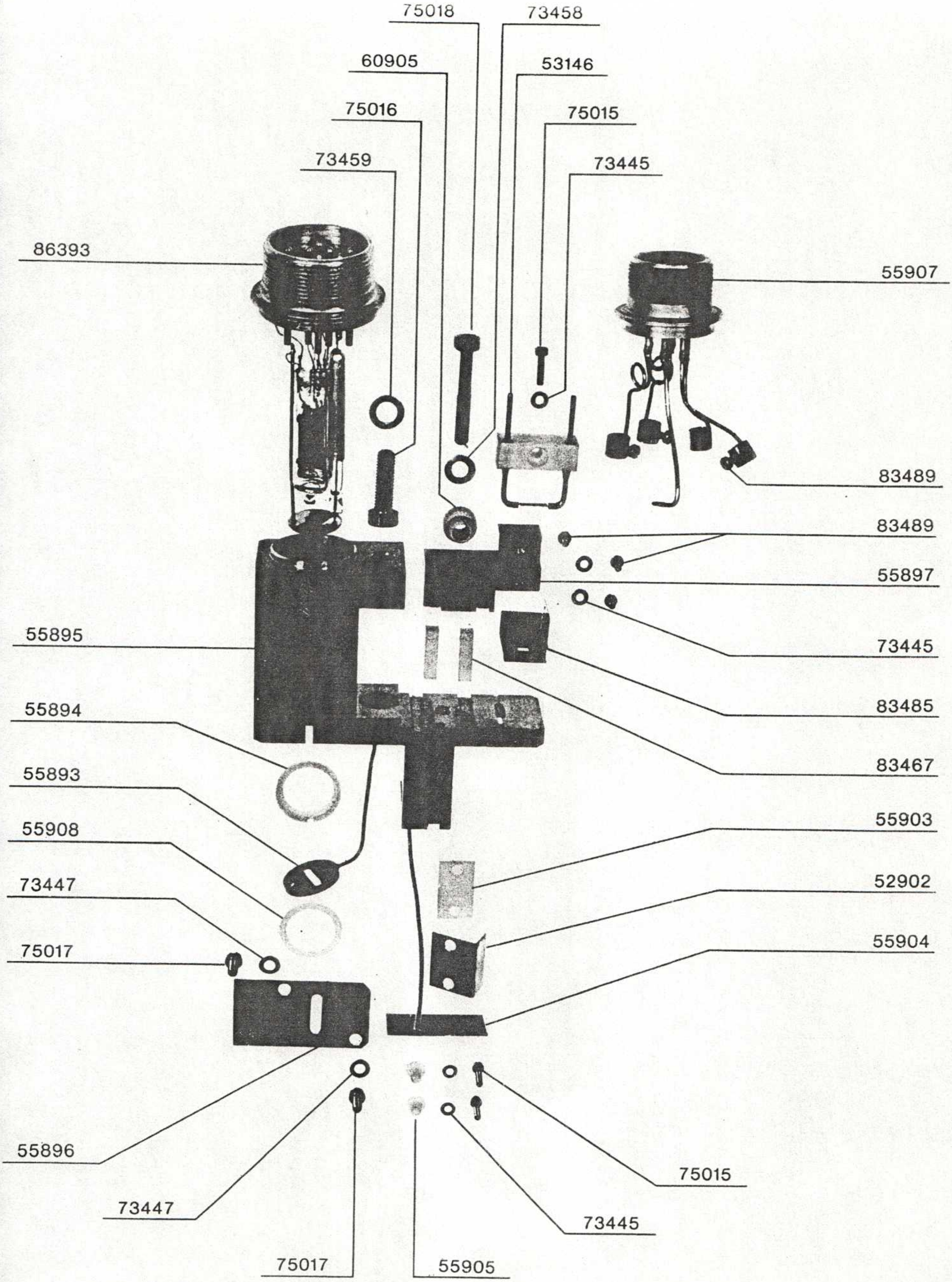


Figure 10 ; VIEW OF THE INLET VALVE



Analysis cell, exploded view

Figure 11

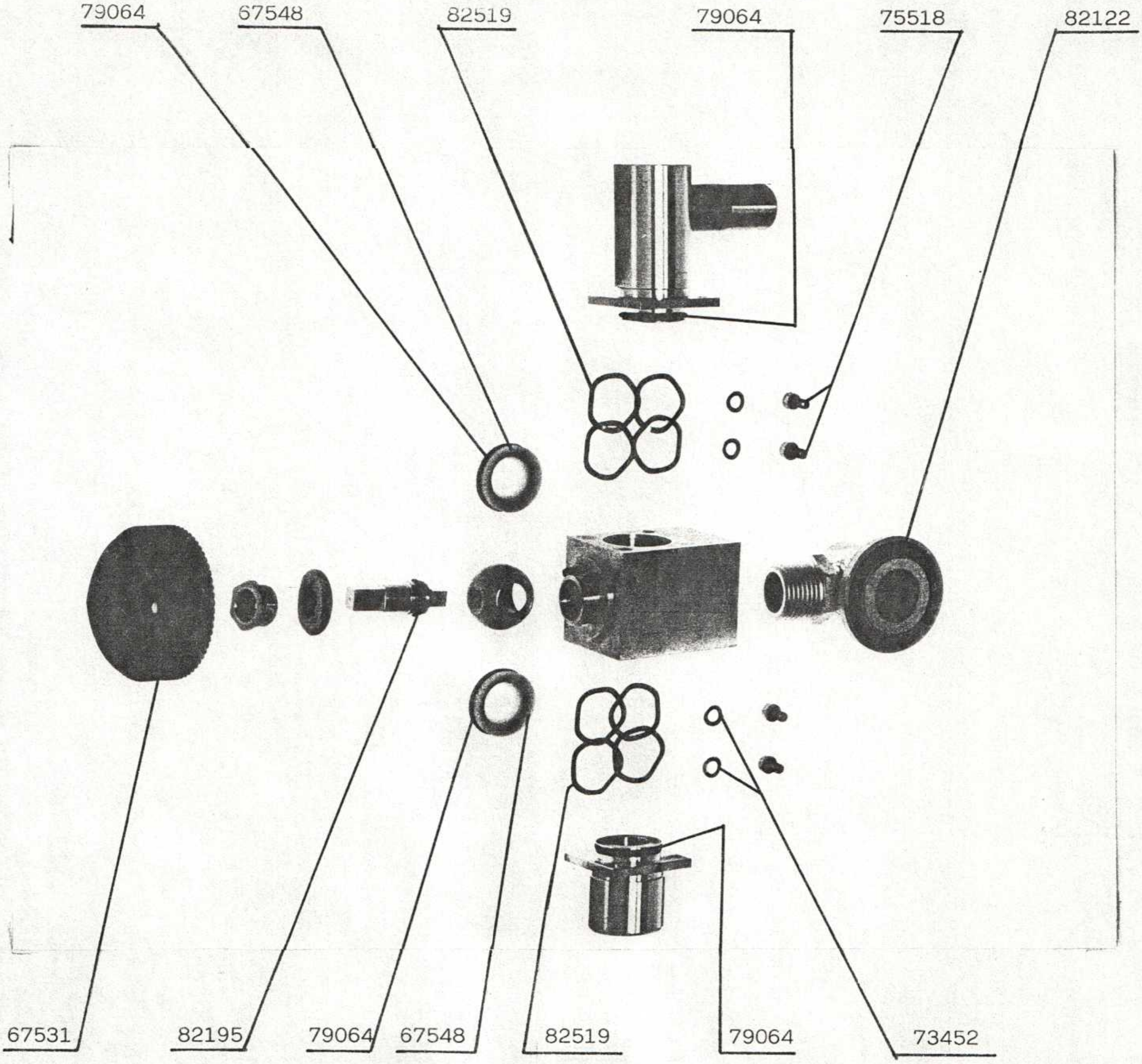


Figure 12 : THREE WAYS VALVE - EXPLODED VIEW

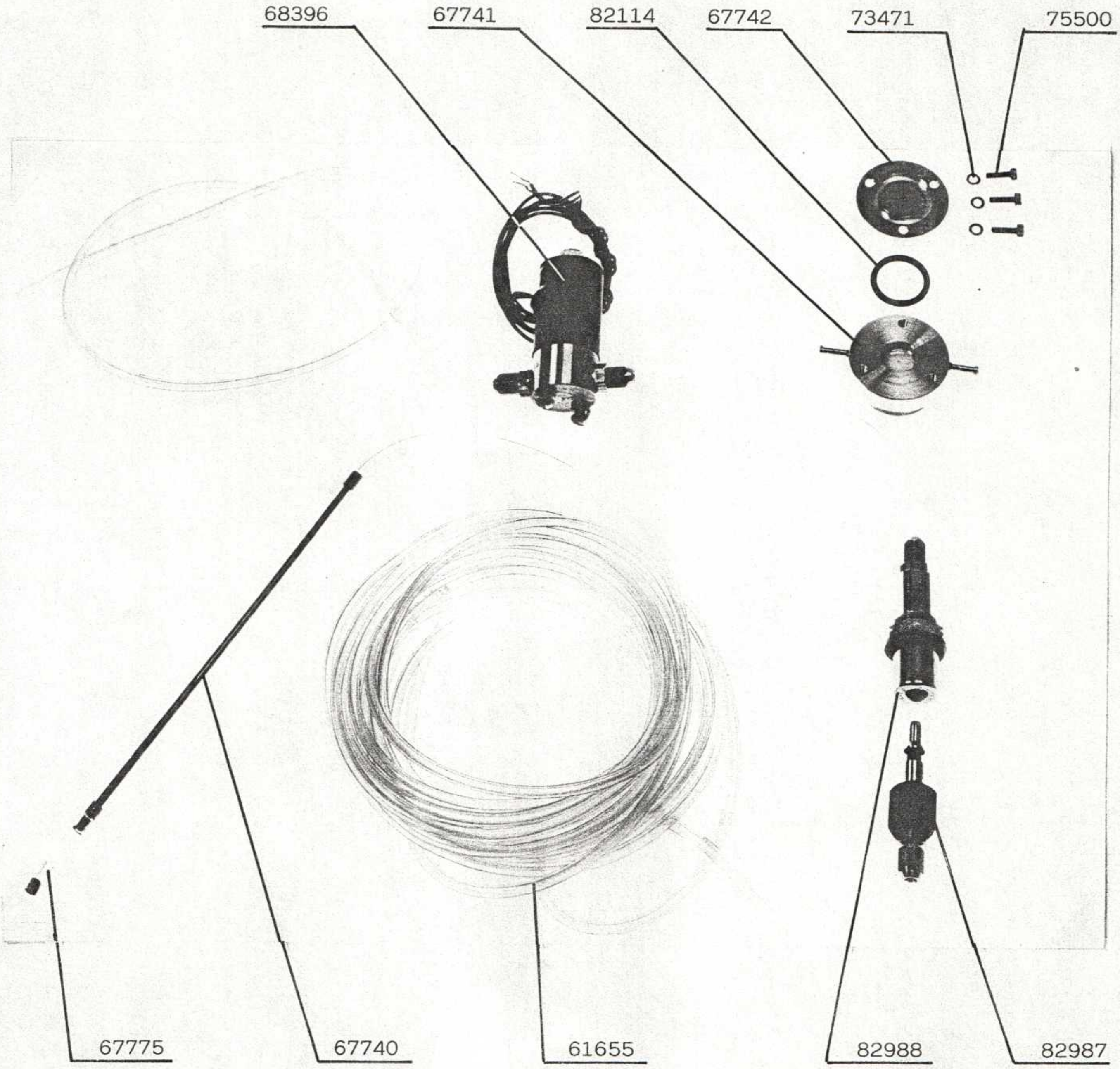


Figure 15 : LONG DISTANCE SNIFFER - OPTION

CHAPTER 8

CONTENTS

ASM 110 LT VERSION

This version of leak detector will suit to users who just need

sniffing operation

8.1. - PRINCIPE

The helium leak testing of any vessel by the sniffing method consists in :

. Pressurizing helium into the object to be tested

. Sniffing any helium leak by means of a probe

. Sending the flow of gas on to an analyser which detects any tracer helium.

To work over a few meters from the detector, an auxiliary pump must be used, which enables the tracer gas to be carried in viscous flow, in order to obtain the right transfer speed.

The detector is then connected in parallel to the sniffing circuit by a diaphragm.

8.2. - DESCRIPTION

The auxiliary pump for gas transfer in the sniffing tube is constituted by the first stage of the vane pump, so the pressure in the tube can be relatively high (viscous flow) whithout perturbing the turbomolecular pump which is connected at the second stage of the vane pump.

The probe is a metallic type pencil, connected by a plastic tube to a pneumatic coupling fixed on the analyser's front plate.

The gas flow through the probe across a sampling device (porous membrane) and is then evacuated by the high pressure stage of the vane pump.

An electromagnetic valve closes automatically in the event of a mains supply failure, in order to avoid an air inrush on the TMP when the vane pump comes to a stop.

The detector is constituted by :

. 1 vane pump

. 1 turbomolecular pump

. 1 cell

There is no throttle valve.

8.3. - PERFORMANCE

Detection of leaks ranging about 1.10^{-6} std.cm3/s

Transfer speed 5 m/s

Pressure in analysis cell : 2.10^{-5} mbar

8.4. - DIRECTIONS FOR USE

All that is necessary is to connect the quick pneumatic coupling and check that this operation increases the triode pressure to 2.10^{-5} mbar.

The probe is fitted with a filter easily replaced when the pressure drops below 2.10^{-5} mbar.