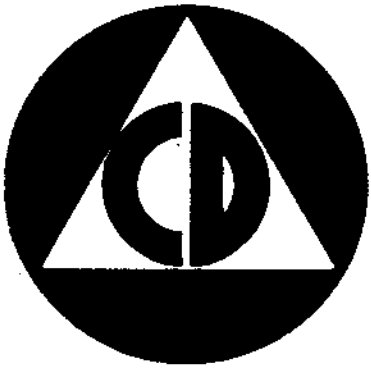
Instruction Manual

FOR

RADIATION SURVEY METER
FCDA Item No. CD V-710-Model No. 3



VICTOREEN MODEL 710

The Victoreen Instrument Co.
5806 HOUGH AVENUE -:- CLEVELAND 3, OHIO

ERRATA SHEET

(Affix to inside front cover)

Page 11

1. Please insert capacitor, C8 (0.0025uf 1.4KV) between B and C of V4 on schematic.
2. Please change value of R14 from 1 megohm to 6.8 megohm.
3. On T1 reverse numbers 2 and 3.

Page 14

1. Physical location of C8 is lower left hand corner adjacent to top of V5.

Page 15

1. C1 should be 1.4KV.
2. Please change R14 to read 6.8 megohm ½ watt 10%.
3. Please change R13 to read 910 ohm ½ watt 5%.
4. Please add to parts list:

Schematic Symbol	Quantity per Equipment	Description and Function	Supplier	Suppliers Part No.	AEL Part No.	Rec. Spares for 5 Units
C8	1	Capacitor 0.0025 uf + 100% - 20% 1.4 KV; stabilizes HV power supply	GDL	Type B	106-177	1

Additional Space for Notes:

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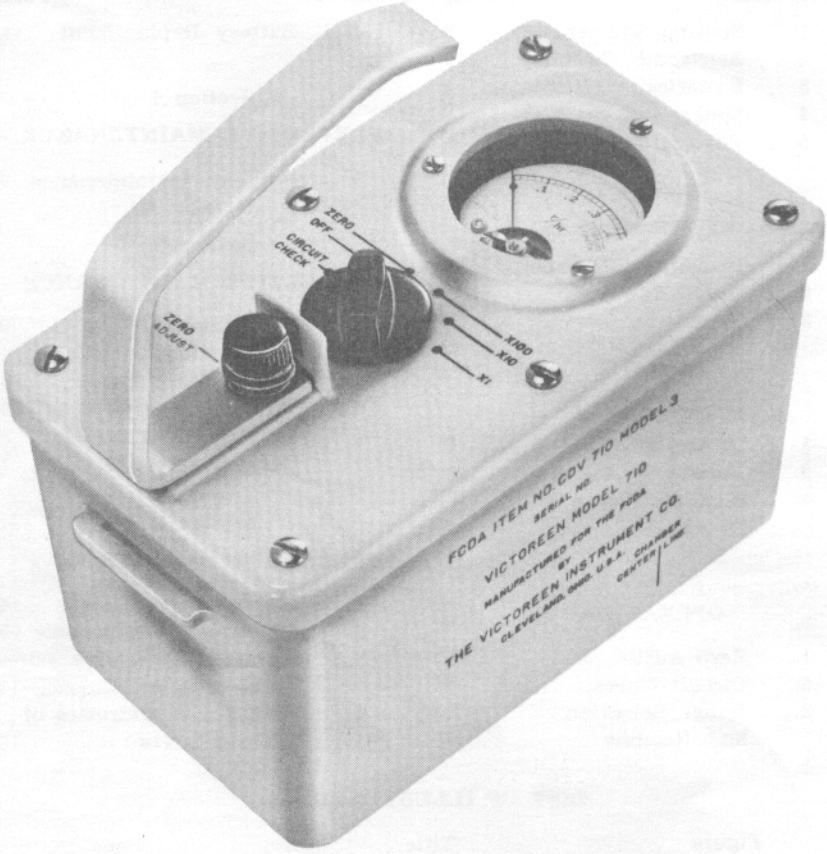
LIST OF ILLUSTRATIONS



CD V–710, Model 3

Section 1
GENERAL DESCRIPTION

The CD V-710, Model 3, Victoreen Model 710 is a portable monitoring instrument for the measurement of gamma radiation intensities as high as 50 roentgens per hour. It is designed to be used by radiological Civil Defense personnel in determining radioactive contamination levels that may result from an enemy attack or other nuclear disaster.

Instrument accuracy on any of its three ranges is ± 20% of the true dose rate. This accuracy is maintained throughout a temperature range of — 20 degrees F to + 125 degrees F, relative humidities to 100% and at altitudes from sea level to 25,000 feet.

1. SENSING ELEMENT.

The detecting element in the CD V-710 is an hermetically sealed ionization chamber. This chamber is located in the lower front portion of the instrument as shown in Figure 1 to make the instrument equally sensitive to radiation from the bottom, front and both sides. The plastic lined, steel chamber has a wall thick enough to make the instrument insensitive to fission product beta rays. It is hermetically sealed to eliminate changes in sensitivity due to altitude air pressure, temperature changes, and moisture effects. The chamber is replaceable without disturbing the calibration of the instrument.

2. ELECTRONIC CIRCUITRY.

A gasketed aluminum circuit box located above the ion chamber, houses all of the electrical components and all of the wiring of the instrument. This circuitry serves to measure the minute current from the ionization chamber which indicates the presence of gamma radiation.

The gasketing serves to eliminate any possible moisture effects in the high resistance portions of the circuitry.

3. BATTERIES.

The CD V-710, Model 3, is powered by a "D" size flashlight cell (NEDA 13) and two 22-1/2 volt miniature hearing-aid batteries (NEDA 215). The batteries will operate the instrument continuously for over 200 hours and much longer on an intermittent basis. The battery contacts and holders are fastend to the circuit box as shown in Figure 1 to make a simple, rugged and unified circuitry.

4. METER AND CONTROLS.

The CD V-710 uses a ruggedized, sealed meter to meet the instrument requirements for watertightness, shock and vibration resistance. Two controls are provided. One, a range switch which turns the instrument on, checks its operation and serves to select the proper range. Two, a "ZERO ADJUST" control which is used to adjust the instrument to assure proper operation.

5. PHYSICAL FEATURES.

The instrument is housed in a tough, shock and scratch resistant plastic case

molded of high-impact polystyrene. Carrying strap loops, "ZERO ADJUST" guard and gasket retainer are permanently molded in. The nameplate and control knob information is indelibly stamped into the case. Six screws on the cover fasten the two halves of the case to provide positive watertight sealing. The instrument is approximately 7-1/2" long, 4" wide, and 4-1/2" high. It weighs three pounds and will float.

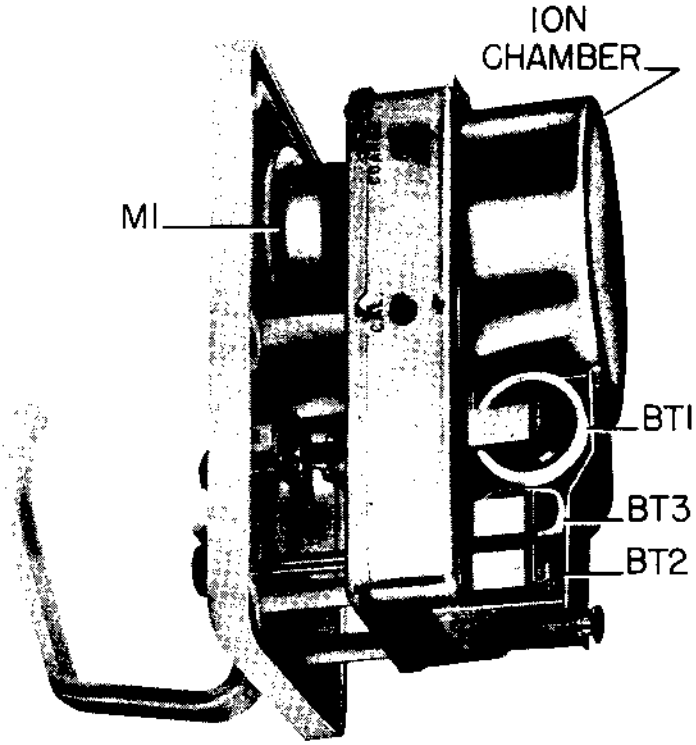


Figure 1. — The CD V-710, Model 3, With Case Removed

Section 2
THEORY OF OPERATION

1. IONIZATION CHAMBER.

The detecting element of the CD V-710 is a hermetically sealed air equivalent ionization chamber. It consists of a conducting cylindrical container of plastic

and steel called the shell and a thin conducting disk located in the center of the shell, called the collector. The collector is insulated from the shell by an extremely high resistance feed thru insulator. A voltage called the collecting voltage is applied between these two chamber electrodes. This makes the shell 22-1/2 volt negative with respect to the collector. See Figure 2.

Gamma radiation, in passing through the air contained in the chamber, causes air molecules to become charged or ionized. These charged particles or ions are attracted to the chamber electrode having the opposite charge, that is, positive ions move toward the negative shell of the chamber and vice versa.

The arrival of these ions at the electrodes of the chamber constitutes a flow of current whose magnitude is proportional to the number of ions collected. Since the number of ions created is proportional to the radiation intensity, this ionization current is proportional to the radiation intensity at the ionization chamber.

The purpose of the electrical circuitry of the instrument is to amplify this current so that it may be read on a meter.

2. INPUT CIRCUIT.

The ionization current is extremely small—about .000005 microamperes at .5 r/hr which is full scale in the most sensitive range. It flows through a very high resistance (100,000 megohms) called a "Hi-Meg" connected to the collector of the ionization chamber as shown in Figure 2. This current flow

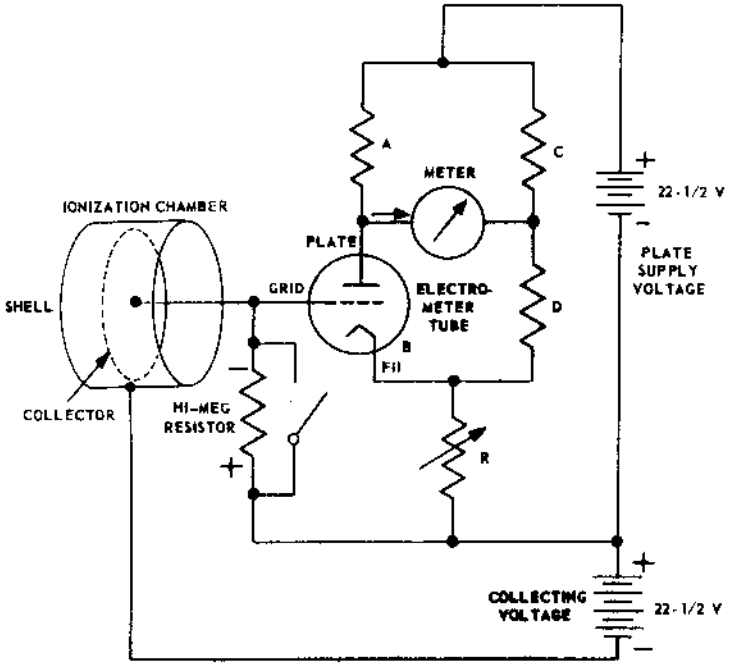


Figure 2. — Simplified Schematic Diagram

develops a voltage of about .5 volts at full scale across the "Hi-Meg" with the polarity shown.

The voltage developed is applied to the grid of a vacuum tube for amplification. Any of the minute ionization current flowing to the grid of the tube instead of through the "Hi-Meg" resistor would result in amplification of only a portion of the signal.

A special vacuum tube called an electrometer tube capable of amplifying voltages at extremely small grid currents is used to prevent this error. This tube is connected as a triode as shown in Figure 2.

3. MEASURING CIRCUIT.

The measuring circuit is a bridge circuit consisting of the arms A, B, C and D. The electrometer tube forms the arm B in the lower left of Figure 2 while the other arms are composed of physical resistors. The resistance of the tube (arm B) is varied by changes of the voltage on its grid. When the ratio of resistances A/B is the same as C/D, the bridge is balanced and no current flows through the meter.

The resistance of the electrometer tube is increased by the change in voltage on its grid due to the ionization current signal. This unbalances the bridge and causes a current to flow in the meter in the direction of the arrow. This meter current is proportional to the signal voltage in the grid and hence the meter reading is proportional to the radiation intensity at the chamber. The meter thus presents the desired reading of radiation intensity.

In order to balance the bridge and obtain zero meter current (zero reading) at zero radiation level, a bias voltage developed by the bridge current flowing through the variable "ZERO ADJUST" resistor R is placed in the grid circuit of the electrometer tube. The "ZERO ADJUST" knob on the face of the CD V-710 varies this resistance to adjust to "zero". In order to permit zeroing the instrument in a radiation field, a section of the range switch is used to short circuit the "Hi-Meg" resistor and prevent any ionization signal from being sensed by the input circuit on the "ZERO" range.

Sensitivity of the instrument is changed by switching "Hi-Meg" resistors. This is another function performed by the range switch.

Section 3
INSTALLATION

1. INSPECTION.

The instrument is shipped with batteries and carrying strap removed. Inspect the batteries for possible leakage before installation. Do not install leaking batteries. Inspect the instrument for damage in shipment. If damage is apparent the batteries should not be installed, thus preventing further damage due to possible short circuits.

2. BATTERY INSTALLATION.

Open the instrument be removing the six screws in the cover and pulling off the case. This exposes the battery holder and battery clips as shown in

Figure 1. Remove the knurled nut and the battery retainer. Insert the batteries in the clips being careful to observe the battery polarity markings stamped on the instrument. Replace the battery hold-down plate and knurled nut. Replace the instrument in its case so that the "CHAMBER CENTER LINE" marking engraved on the case side is adjacent to the meter. Tighten the six screws.

3. SHOULDER STRAP INSTALLATION.

The carrying strap and two carrying strap slides are packed separately. They are assembled to the molded-in carrying strap loops in the end of the case as shown in Figure 3, and length is adjusted to suit the operator.

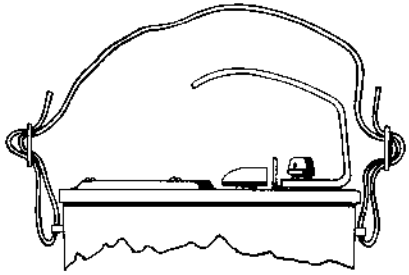


Figure 3. — Method of Attaching Shoulder Straps

Section 4
OPERATION

There are three simple basic steps recommended for proper operation of the CD V-710. They are described as follows:

1. ZERO ADJUST.

Turn the instrument on by turning the range switch from "OFF" to the "ZERO" position. Wait about a minute to allow the electrometer tube to warm up, then orient the "ZERO ADJUST" control until the meter reads "ZERO".

CAUTION

If the instrument is not zeroed properly, readings taken on any of the three ranges will be erroneous. The drift will be in an upscale direction at a very slow rate.

2. CIRCUIT CHECK.

Turn the range switch counter clockwise from the "ZERO" position through the "OFF" position to the "CIRCUIT CHECK" position. This position is spring-loaded to return to "OFF". The range switch must be held in this position for the circuit check. The meter should read in the red outlined section labeled "CIRCUIT CHECK". If it does not, either the batteries are low or trouble exists in the circuit. See Sections 5 and 7 for proper procedures. Make certain the instrument is zeroed before making the circuit check.

Low or dead batteries are indicated by inability to "ZERO" the instrument or by a meter reading below the check band when the range switch is in the "CIRCUIT CHECK" position.

3. RANGE SELECTION AND READING.

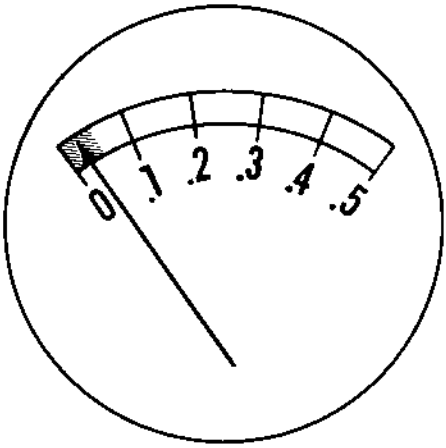
Turn the range switch to the "X100", "X10" or X1" range as necessary to obtain an upscale reading on the meter.

The meter reading observed must be multiplied by the factor indicated by the position of the range switch to obtain the radiation intensity in roentgens per hour (r/hr).

EXAMPLE:	METER READING	.38
	RANGE	"X100"
	INTENSITY OF RADIATION	38 r/hr

Another example is a meter reading of .24 on the "X10" range shows an intensity of 2.4 roentgens per hour while the same scale reading obtained with the instrument turned to the "X100" range corresponds to 24 roentgens per hour.

The "ZERO" or "CIRCUIT CHECK" may be performed at any time, whether the instrument is in a radiation field or not.



READINGS SHOULD NOT BE TAKEN WITH POINTER INDICATING IN LOWER 10% OF SCALE (SHADED IN ILLUSTRATION). TURN TO NEXT MOST SENSITIVE RANGE UNTIL POINTER INDICATES IN UPPER 90% OF SCALE (UNSHADED).

Section 5

OPERATOR'S MAINTENANCE

1. BATTERY REPLACEMENT.

Battery replacement is indicated whenever the instrument can no longer be zeroed or when the meter indicates below the "CIRCUIT CHECK" band. To replace the batteries, remove the instrument from its case by removing the six screws on the case top, and lift the instrument from its case. Remove the knurled nut and battery retainer to expose the batteries. Remove all three batteries from their clips. Install new batteries as indicated in Section 3, Battery Installation.

Section 6
PREVENTIVE MAINTENANCE

1. PREVENTIVE MAINTENANCE.

It is recommended that preventive maintenance procedures be carried out once a month when instrument is in use, and about once every six months when instrument is in storage.
Preventive maintenance should be carried out as follows:

a. Remove the batteries, clean battery contacts and battery terminals, remove any corrosion present.

b. Replace the batteries making certain that all batteries make good contact.

c. Perform the operation indicated in Section 4, 1. ZERO ADJUST, and Section 4, 2. CIRCUIT CHECK.

Batteries should be removed from the instrument and stored separately if the instrument is to be stored more than a few weeks.

Section 7
CORRECTIVE MAINTENANCE

WARNING

Calibration should be attempted only by personnel trained in the use of radioactive isotope sources or X-ray generators.

1. CALIBRATION.

The CD V-710 is calibrated by being placed in a gamma radiation field of known intensity. Such fields are most commonly produced by using an X-ray machine or a radioactive material such as radium or Cobalt 60. As an example a 100 mc. radium source will produce a radiation intensity of .40 r/hr, at a distance of 18.1 inches. The CD V-710 should read this intensity when so positioned. If it does not, the instrument should be recalibrated. This is accomplished by removing it from its case and adjusting the "CAL" control on the side of the circuit box. The instrument may be recalibrated outside of its case in gamma fields from radium or Cobalt 60. On softer X-rays, the instrument should be in its case whenever calibration is checked. The distance from the center of the CD V-710 ionization chamber to the calibrating source should be at least 12 inches to obtain reasonable geometry (reasonably uniform radiation intensity over the volume of the ionization chamber).

2. DISASSEMBLY FOR CORRECTIVE MAINTENANCE.

First remove the batteries from the CD V-710. Open the circuit box by removing the four screws on the bottom of the circuit box (as indicated by the markings on the side of the circuit box). Two of these screws are located between the "D" battery clip and the adjacent "B" battery clips. The other two are located at either side of the ionization chamber at the extreme front end of the circuit box. The insulating shoulder washers on these latter screws are important; make certain that they are replaced when reassembling the

instrument. Do not loosen the glyptal-covered screen between the ion chamber and the "D" battery clips, except when replacing the ionization chamber.

Opening the circuit box exposes all electrical components for ready checking and servicing. A view of the CD V-710 opened for servicing is shown in Figure 4.

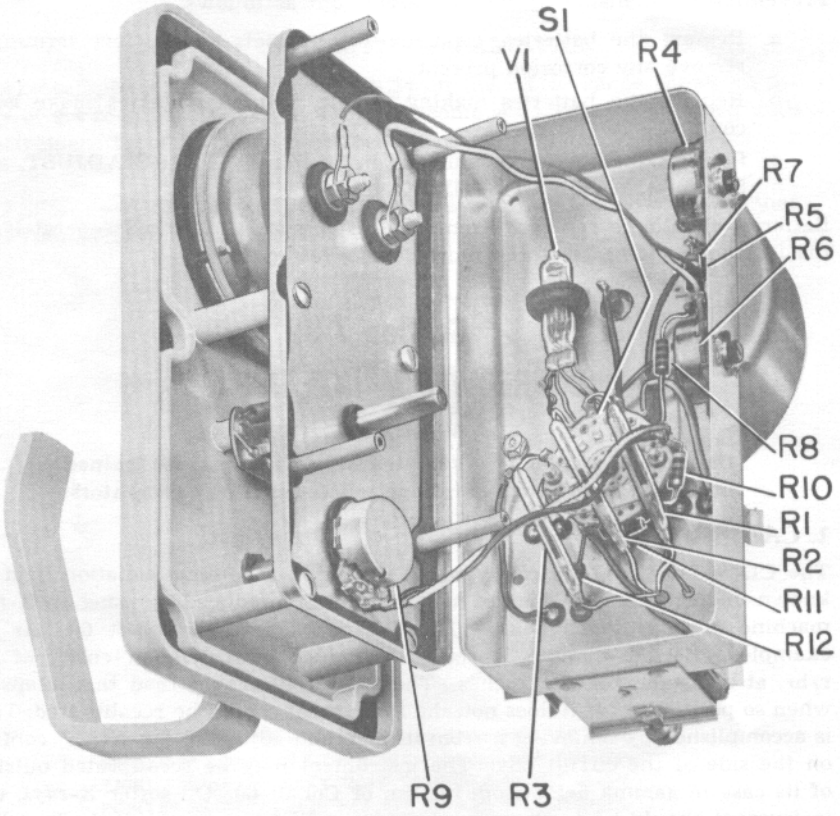


Figure 4. — Circuit Component Box Open

NOTE

Make certain that the range switch is in the "OFF" position and that the slot in the ceramic switch rotor is at right angles to the axis of the circuit box before attempting to close the circuit box.

3. TROUBLE-SHOOTING.

The majority of the electrical components of the CD V-710, Model 3, are standard parts familiar to electronic technicians and are readily checked by

conventional means. The electrometer tube, the "Hi-Meg" resistors, the ion chamber insulator and the ceramic switch section are the only components requiring special precautions. These components are all part of the high resistance input circuit. The insulating portions of these four components should not be handled. They should be touched only with clean tools when repairs are made. If surface leakage on any of these items is suspected, cleaning with clean alcohol using a clean camel hair brush is recommended. Avoid solder flux spattering on these components when repairs are made.

All batteries as well as the measuring circuit are checked by the "CIRCUIT CHECK". If trouble exists, batteries should be checked with a voltmeter. The "D" cell should read higher than 1.2 volt and the "B" batteries higher than 17 volt.

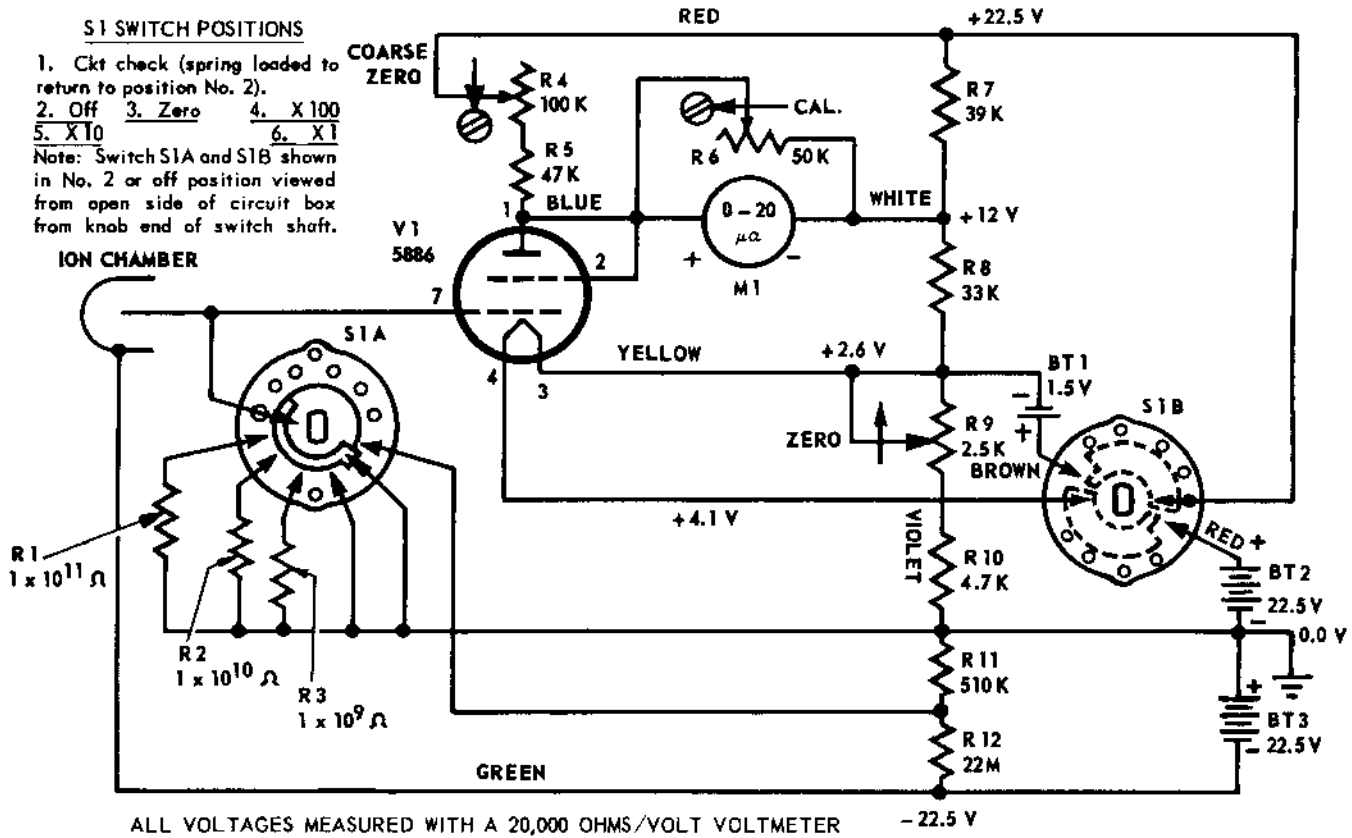
Circuit malfunctions may be traced with the aid of the schematic circuit diagram, Figure 5. Voltage measurements shown on this diagram are measured with respect to ground and are those obtained with a voltmeter having a sensitivity of 20,000 ohms per volt. Such voltage checks should be taken with the instrument turned to the "ZERO" range and with the "ZERO ADJUST" adjusted so that instrument reads "zero".
The following troubles and corrective action are presented as an aid to trouble shooting.

TROUBLE SHOOTING CHART

TROUBLE	CORRECTIVE ACTION
NO READING	
Low Batteries	Replace Batteries
Corroded Battery Contacts	Inspect and Clean Battery Contacts
Calibration Control, Improperly Adjusted	Turn Calibration Control Clockwise and use "CIRCUIT CHECK" Position to Test
Meter Damaged	Replace Meter
Chamber Damaged	Replace Chamber
Open Connection	Inspect All Solder Joints and Wiring
METER WILL NOT ZERO (reads upscale)	
Low Batteries	Replace All Batteries
Corroded Battery Contacts	Clean and Brighten All Battery Contacts
Coarse Zero Control Disturbed	Set "ZERO" Control at Center and Adjust "COARSE ZERO" Control so that Meter Reads "ZERO"

Trouble Shooting Chart (cont'd)

Electrometer Tube Filament Open	Remove "D" Cell, Set Range Switch to "ZERO", Measure Resistance Between Battery Contacts. Should be Approximately 150 ohms.
Open Potentiometer	Check Potentiometers with Ohmmeter
Open Resistor	Check Resistors with Ohmmeter
Open Connection	Inspect All Solder Joints and Wiring
Open Switch Contact	Check Switch Contacts, Clean and, if Necessary, Adjust Contacts
Short Circuit	Inspect for Mechanical Damage.
METER WILL NOT ZERO (reads down scale)	
Defective Resistor	Check Resistors R7, R8 with Ohmmeter, Replace Defective Resistors
INSTRUMENT READS LOW	
Calibration Control Disturbed	Check Calibration as Outlined in Section 7, 1. Calibration.
Faulty Electrometer Tube	Replace with New 5886.
Dirty High Resistance Components	Clean the Hi-Megs, Resistors, Ceramic Switch Deck, Electrometer Tube, and Chamber Insulator with Pure Alcohol.
Chamber Leaks at High Altitudes because seal is broken	Locate and Repair Leak or Replace Chamber
Meter Damaged	Replace Meter
INSTRUMENT READS HIGH	
Calibration Control Improperly Adjusted	Check Calibration as Outlined in Section 7, 1. Calibration.
If High Reading on Only One Range, a Hi-Meg Resistor may be Damaged	Replace Suspect Hi-Meg Resistor
Calibration Control Open.	Check with Ohmmeter and Replace if Necessary



ALL VOLTAGES MEASURED WITH A 20,000 OHMS/VOLT VOLTMETER WITH INSTRUMENT ON ZERO RANGE AND ZERO CONTROL ADJUSTED.

Figure 5. — Circuit Diagram

ELECTRICAL COMPONENTS

CIRCUIT SYMBOL	DESCRIPTION	FUNCTION	MANUFACTURER	MFG. PART NO.	VICTOREEN PART NO.
BT 1	Battery: 1.5 volt; "D" size flashlight	Filament	Nat'l Carbon	Eveready 950	631-11
BT 2	Battery: 22.5 volt; miniature hearing aid	Bridge and plate supply	Nat'l Carbon	Eveready 412	356-38
BT 3	Same as BT 2	Chamber supply	———	———	———
M 1	Meter: 0-20 ua	Indicating	Simpson	125E	710-8
R 1*	Resistor, Hi-Meg; 1 x 10^{11} ohm; ± 10%	Grid resistor Range X 1	Victoreen	185-1034	185-1034
R 2*	Resistor, Hi-Meg: 1 x 10^{10} ohm; ± 10%	Grid resistor Range X 10	Victoreen	185-1035	185-1035
R 3*	Resistor, Hi-Meg: 1 x 10^{9} ohm; ± 10%	Grid resistor Range X 100	Victoreen	185-1036	185-1036
R 4	Potentiometer: 100 K; ± 20%	Coarse zero adjustment	Stackpole	LR60	710-40
R 5	Resistor: 47 K; 1/2 w; ± 10%	Plate load	Stackpole	———	185-254
R 6	Potentiometer: 50 K; ± 20%	Calibration control	Stackpole	LR60	710-41
R 7	Resistor: 39 K; 1/2 w; ± 10%	Bridge arm	Stackpole	———	185-244
R 8	Resistor: 33 K; 1/2 w; ± 10%	Bridge arm	Stackpole	———	185-396
R 9	Potentiometer: 2.5 K	Fine zero control	Stackpole	H 1	710-7
R 10	Resistor: 4.7 K; 1/2 w; ± 10%	Bias resistor	Stackpole	———	185-175
R 11	Resistor: 510 K; 1/2 w; ± 5%	Circuit check voltage divider	Stackpole	———	185-3
R 12	Resistor: 22 M; 1/2 w; ± 5%	Circuit check voltage divider	Stackpole	———	185-935
SIA, B	Switch	Function Switch	Centralab	Series 20	710-6
V 1	Electrometer Tube	Electrometer tube	Raytheon	5886	650-39
——	Ion Chamber Assembly	Detecting Element	Victoreen	710-59	710-59

* These resistors are matched in decade sets to ± 2%.

MECHANICAL COMPONENTS

REQ'D	DESCRIPTION & FUNCTION	MFG. & NO.	VICTOREEN NO.
1	Case Cover	Victoreen	710-10
1	Case	Victoreen	710-11
1	Switch	Centralab	710-6
1	Handle	Victoreen	710-24
1	Range Switch Knob	Rogan Bros. Type RB-31	710-30
1	Zero Control Knob	Harry Davies Moulding Co. 1450	247-176
1	Meter Gasket	Victoreen	710-32
1	Case Cover Gasket	Victoreen	710-16
1	Meter Mounting Ring	Victoreen	710-31
1	Circuit Box Cover	Victoreen	710-20
1	Circuit Box Gasket	Victoreen	710-21
4	Circuit Box Spacer	Victoreen	710-33
1	Circuit Box and Battery Clips Ass'y	Victoreen	710-58
1	Battery Retainer Clip	Victoreen	710-55
1	Knurled Nut (for battery retainer clip)	United Screw & Bolt 6/32-LP	710-25
4	Extruded Fiber Washer	H. H. Smith 2151	382-31
1	Zero Control Panel Bearing	H. H. Smith 119	710-29
2	Carrying Strap Slide	Waterbury 8075	710-44
1	Carrying Strap	Keller Prod. Co.	710-45
1	"O" Ring	Parker Appliance 5427-1	710-42
1	Instruction Manual	Victoreen	710-46

MAINTENANCE SUPPLY PARTS

Suggested supply for five instruments for one year (400 hrs) of operation.

QTY.	CIRCUIT SYMBOL	DESCRIPTION	VICTOREEN PART NO.
5	BT 1	"D" cell	631-11
10	BT 2; 3	22-1/2 V. battery	356-38
1	V 1	Electrometer Tube	650-39
1	M 1	Meter	710-8

Maintenance Supply Parts (cont'd)

1	R 1	Hi-Meg, 1 x10^{11} ohm *(Red dot)*	185-1034
1	R 2	Hi-Meg, 1 x10^{10} ohm *(Yellow dot)*	185-1035
1	R 3	Hi-Meg, 1 x10^{9} ohm *(Orange dot)*	185-1036
1	R 9	Zero Potentiometer, 2.5 K	710-7
1	Ion Chamber	Ionization Chamber Asembly	710-59
1	——	Knob, Zero Control	247-176
1	——	Knob, Range Switch	710-30
1	——	Handle	710-24
1	S1A; S1B	Switch	710-6
8	——	Extruded Washer	382-31

NAMES AND ADDRESSES OF MANUFACTURERS

ASSEMBLY PRODUCTS, INC.
Chesterland, Ohio

CENTRALAB, INC.
900 East Keefe Avenue
Milwaukee, Wisconsin

HARRY DAVIES MOLDING CO.
1428 North Wells Street
Chicago 10, Illinois

KELLER PRODUCTS
3099 Vine Street
Cleveland 13, Ohio

NATIONAL CARBON COMPANY
30 East 42 Street
New York, N. Y.

PARKER APPLIANCE
3865 Carnegie Avenue
Cleveland, Ohio

RAYTHEON MFG. CO.
55 Chapel Street
Newton 58, Massachusetts

ROGAN BROTHERS
8025-33 N. Monticello Avenue
Skokie, Illinois

SIMPSON ELECTRIC COMPANY
5200 West Kinsie Street
Chicago 44, Illnois

H. H. SMITH
2326 Nostrand Avenue
Brooklyn 10, N. Y.

STACKPOLE CARBON COMPANY
St. Mary's, Pennsylvania

UNITED SCREW & BOLT
3590 West 58 Street
Cleveland 2, Ohio

VICTOREEN INSTRUMENT CO.
5806 Hough Avenue
Cleveland 3, Ohio

WATERBURY
Waterbury, Connecticut