Marlow Stangler

Instruction Manual

FOR

GEIGER SURVEY METER

CD V-700

(VICTOREEN MODEL No. 661)

PART No. 661-45

The Victoreen Instrument Co.

5806 HOUGH AVENUE -:- CLEVELAND 3, OHIO

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Geiger Survey Meter CD V-700
VICCO Model #661

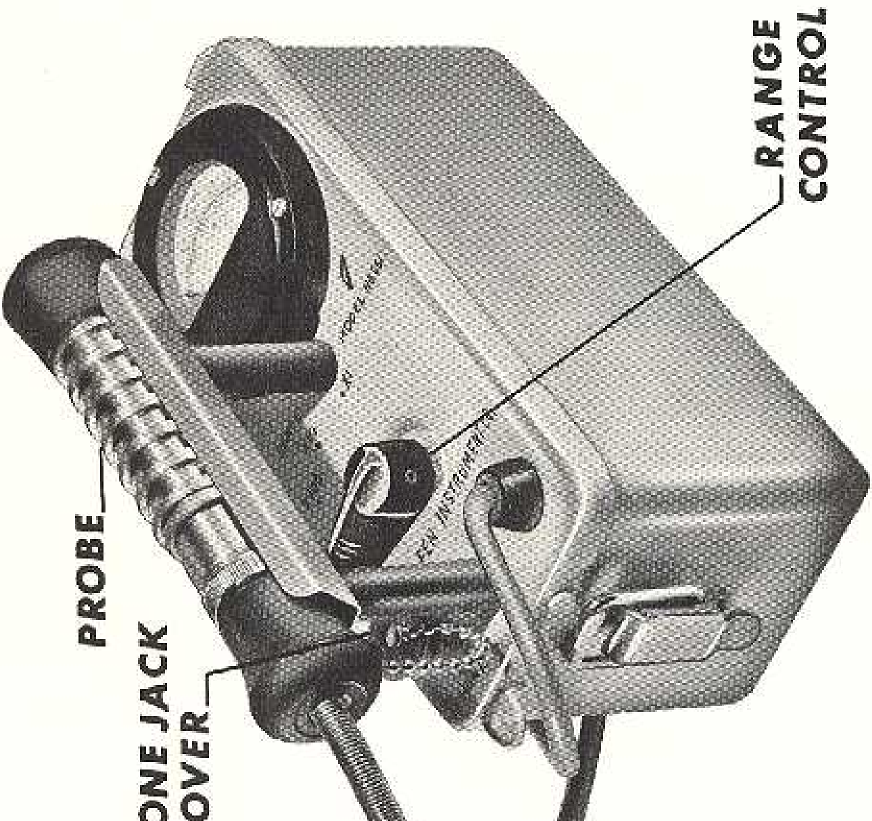

Figure 1. View of Instrument Showing Operating Controls

Geiger Survey Meter CD V-700
VICCO Model #661

INSTRUCTION MANUAL

1. GENERAL DESCRIPTION

1.1 INTRODUCTION:

This instrument is a portable survey meter using a geiger tube as the detector. The geiger tube is mounted in a probe on the end of a thirty-six inch cable. The entire instrument and its accessories comprise a circuit box, a probe, a headphone and a carrying strap; a radioactive sample is mounted under the instrument nameplate.

1.2 THE PROBE:

The probe comprises a chrome-plated brass shield with a window which may be opened in order to admit beta radiation. Within the probe is mounted a plug-in type geiger tube which is sensitive to moderate and high energy beta radiation and to gamma radiation down to low energies. Because the geiger tube is fragile, shock mounts are provided on both ends of the tube. In addition rubber gasketing is used to seal against moisture. A ring nut at the base of the probe permits easy access for exchange of the geiger tube.

1.3 THE CIRCUIT BOX:

The circuit box comprises the supply batteries, an electronic high voltage supply, an electronic pulse shaping and metering circuit and a radioactive sample. The system is shockproof and waterproof and is secured with rapid take-down clamps in order to make access very simple. The entire battery complement is mounted with press clamps for rapid removal and replacement. The entire electronic circuit is mounted on a single card with connections going to the probe, the phone connector and to the meter.

1.4 THE HEAD PHONE:

The head phone is a single piece magnetic type device with a connector suitable for the sealed jack mounted on the circuit box.

1.5 THE CARRYING STRAP:

The carrying strap, made of vinyl for easy decontamination is provided with easily operated spring clips.

2. THE THEORY OF OPERATION

2.1 INTRODUCTION:

Operationally this instrument comprises a gieger tube radiation detector, a regulated high voltage supply, a pulse shaping and metering circuit, an indicating meter and headphone for audible detection of activity.

2.2 THE GEIGER TUBE:

The geiger tube (See Figure 2) is a gas filled device which detects the presence of ionization within its gaseous volume. The ionization results from the passage of ionizing type radiation through the gas. The primary type of radiation it detects is beta rays (high speed electrons). These are produced as a primary breakdown product of radioactive substances and in addition are produced within the geiger tube and within the walls of the probe by gamma radiation. A shield is provided which stops external beta radiation, thus making the detector sensitive to gamma radiation only, but a window in the probe may be opened to make the system sensitive to beta radiation also. The geiger tube operates at 1000 volts which is essentially the center of a plateau extending from about 850 volts to about 1150 volts.

2.3 THE HIGH VOLTAGE SUPPLY:

The high voltage supply is a relaxation oscillator driven "fly-back" type circuit in which pulses are generated by a relaxation oscillator comprising a type NE-7 glow tube, V-5, a high valued resistor R-11, and a small condenser C-9. The battery supply is 100-135 volts and the mean operating voltage of the glow tube is 60-65 volts. The pulse amplitude is of the order of 18 to 25 volts; the pulses are capacitively coupled through C-8, into the grid of a cut-off pentode-diode type 1AK5, tube V-4. Positive pulses operating the grid of this tube instantaneously causes the tube to draw current through a high impedance, specially designed, high voltage coil, T-1. Interruption of the current through the coil produces a field-collapse potential of over 1000 volts. This 1000 volt pulse is capacitively coupled into the diode of the tube, producing approximately 950 volts DC with a negative potential. This pulsating DC is fed back through a series of resistors, R-12 through R-22, to the grid circuit of the tube and to the oscillating glow tube which serves as a standard against which the high voltage is compared. In this way variation in filament and plate voltage of the generating tube are greatly compensated by the grid bias on the generating tube.

2.4 THE PULSE SHAPING AND METERING CIRCUIT:

The pulse shaping and metering circuit comprises two type CK6418 vacuum tubes, V-2 and V-3. These are connected in a cathode coupled one-shot multivibrator circuit with the integrating and metering circuit in the plate of the V-3. Under steady state conditions the V-2 draws approximately 250 microamperes, which current passing through the common cathode resistor of 18,000 ohms R-10, provides a bias of between 4 and 4.5 volts on V-3 thereby effectively cutting it off. Whenever a negative pulse of greater than 0.3 volts operates the grid of V-2, this tube's plate current is sufficiently cut off so that the combination of increased plate voltage of V-2 and decreased cathode voltage on V-3 causes the latter to start to draw current. Under these conditions the circuit "fires" drawing an instantaneous current of approximately 1-1.2 milliamperes through V-3. This current pulse constitutes an increased charge on the intergrating or time-constant condenser C-7. This condenser discharges through the series combination of meter M-1 and resistor R-9, with a time constant of approximately three seconds. When pulses arrive at the grid of the first tube at a given rate, the average rate is indicated by the amount of current flowing from the charge stored in the integrating condenser C-7 in the plate circuit of V-3.

2.5 SCALE RANGES:

Three ranges of operation are provided. The first range X-1, requires 500 pulses per minute for full scale indication; the second range X-10, 5000 pulses per minute, and the third range, X-100, 50,000 pulses per minute. These correspond respectively to 0.5 milliroentgens per hour, 5 milliroentgens per hour and 50 milliroentgens per hour of radium-equivalent radiation. Scale-changing is effected by switching condensers thus changing the "on-time" at the multivibrator.

2.6 THE HEADPHONE:

The audio device is a headphone which detects the pulses from the cathode of the trigger circuit. An isolating resistor R-5 and condenser C-2, are used so that the presence of the headphone has no effect upon the operation of the system.

3. INSTALLATION

3.1 INSTALLING THE BATTERIES:

The instruments are shipped with the batteries removed. In order to put the instrument into operation:

a. Open the circuit box by releasing the clamps at both ends.

b. Remove the batteries from their package, taking care not to short-circuit the terminals of the "B" batteries.

c. Place the "D" cells in position with their center terminals at the center contact strip of their recess. Observe polarity markings in "D" battery compartment. Press the retaining clamp in place, taking care that the negative contact clip is properly centered within the battery shelf. (See Figure 3.)

d. Press the "B" batteries into their terminals. These terminals clamp very tightly and it is difficult to press in both contacts simultaneously. The best method is to tilt the base of the "B" battery up (See Figure 3), press in the upper contact and then lower the base of the "B" battery and press in the lower contact. These batteries are firmly held in place by the rubber pad in the bottom of the circuit box when it is clamped together.

4. OPERATION

4.1 OPERATING THE CIRCUIT THE FIRST TIME:

Clamp the circuit box back together and turn the switch to the X-10 scale. Make certain that the sliding beta window of the probe is closed. Wait thirty seconds for the system to reach stability. The indicator should remain substantially at zero.

Open the window on the probe and present it to the center of the nameplate under which is a beta radiation sample (see Figure 4). The indicator should fall between 1.5 mr/hr and 2.5 mr/hr, averaging about 2 mr/hr.

4.2 CALIBRATION:

NOTE: ***The beta source under the name plate must constitute the sole source of radiation when calibration is performed. Calibration must not be undertaken when the background is above normal or in a radiation field other than that produced by the known beta source under the name plate.***

If the indication falls above or below this range, it may be corrected by the screw-driver adjustment inside the box under the rear pillar of the handle. To gain access to this adjustment, loosen both clamps, tilt up the rear end of the lid of the box and the screw will be seen through a hole in the inner frame. Advancing the screw clockwise increases the reading, rotating it counter-clockwise decreases the reading. (See Figure 4.)

4.3 SCALE RANGES:

There is only one control on this instrument for the operator to use. It is the range control, comprising an "OFF" position and three ranges labelled, "X-100," "X-10," and "X-1." These are respectively both 100 times, 10 times and 1 time the scale reading in milliroentgens per hour and counts per minute shown on the meter. This scale is 0.5 milliroentgens per hour and 500 counts per minute respectively with the major divisions all indicated on a 50-division scale.

4.4 USING THE HEADPHONES:

If the operator choose to use a headphone with the instrument, it is screwed into the connector provided immediately to the left of the rear post of the handle. The red plastic protection cap is removed. In using the headphone, the operator will note that each pulse arriving at the instrument is indicated by a distinctly audible "click" in the headphones.

4.5 NORMAL BACKGROUND:

Since normal background of radioactivity is of the order of 0.01 to 0.02 milliroentgens per hour, little activity will normally be overheard. Under background conditions only about 20 per minute of these clicks occur and they are randomly spaced so that one may wait for several seconds before any click is observed and then there may be two or three.

4.6 CHECKING CALIBRATION:

The operator should periodically check the calibration of the instrument to verify that it is correct. This operation is described in paragraph 4.2. He may confidently make an adjustment of the sensitivity wherever necessary. This operation is calculated so that any one should be able to adjust the instrument correctly.

4.7 USING THE CARRYING STRAP:

The instrument may be carried in the hand or by a strap over the shoulder. The strap anchors are arranged in such a way that the meter is visible when carried over the right shoulder.

5. OPERATORS MAINTENANCE

5.1 BATTERY REPLACEMENT:

To replace the "D" cells, open the circuit box by releasing the clamp at either end, press the base of the clamp that holds the "D" cells until it springs open at the center support and remove depleted cells.

Place the new "D" cells in position, observing polarity markings in "D" battery compartment, with their center terminals at the center contact strip of their recess. Press the retaining clamp in place, taking care that the negative contact clip is properly centered within the battery shelf.

To remove "B" batteries tilt the base end of each cell forward to release the rear contact first. Then pull battery out.

Position the new battery with terminals properly aligned. Tilt the base forward and press down securing the front contact, then lower the base of the battery, pressing down on the base at the same time until the contact grips.

6. PREVENTIVE MAINTENANCE

6.1 BATTERY LIFE:

CAUTION: MAKE CERTAIN THE INSTRUMENT IS TURNED OFF AT ALL TIMES THAT IT IS SET ASIDE, otherwise the batteries will certainly be depleted and the instrument rendered ineffective. The shortest lived battery in the instrument is the "D" cell. This has a normal life of 200 hours of continuous operation or approximately 300 hours at six hours per day. The "B" batteries in the instrument have continuous life of about 400 hours, or about 600 hours in intermittent duty. There is no indication that the instrument is turned on excepting the position of the control lever, clicks in he headphones and the meter indication. The latter two are not obvious at any distance from the instrument so that the operator should become accustomed to noting that the operating lever is in the "OFF" position when the instrument is set aside.

6.2 STORAGE:

For storage purposes it is best, wherever possible, to keep the instrument in a moderately cool area as this will provide greater shelf life for the batteries. At all times one should attempt to prevent radiological contamination of the instrument and particularly of the probe.

7. CORRECTIVE MAINTENANCE

7.1 REPLACING THE BATTERIES:

Whenever the instrument fails to respond to the beta sample the condition of the batteries must be checked as indicated above. The "D" cell will deplete first in the instrument and should be replaced every 200 to 300 hours of operation. Replacing the "D" cells calls for opening the case, pressing the base of the clamp that holds the "D" cells until it springs open at the center support, removing the depleted "D" cells and replacing them with fresh ones. Every second time the "D" cells are replaced, the "B" batteries should probably be replaced. It is recommended that the operator install the "D" cells with the label down the first time they are put in and with the label up the second time they are put in, so that whenever the "D" cells are ready for replacement and the label is up, it is an indication that it is time to replace the "B" batteries also. If a meter is handy, one can check the "D" cells to show that they have reached their useful end point. With the circuit turned on, the end point for "D" cells is approximately 1 volt. They will operate at a lower voltage than this if the "B" batteries are in good condition but if the "B" batteries and the "D" cells both are depleted, one volt is the end point for the "D" cells and thirty-three volts is the end point for each of the "B" batteries.

7.2 REPLACING THE GEIGER TUBE:

The chief maintenance on this instrument is replacing the battery (see paragraph 7.1), however, the geiger tube also expends itself with use and must be replaced occasionally but one cannot predict precisely the life of a geiger tube since the total number of counts it has accumulated and the operating conditions of temperature, voltage and load characteristics are very important. Whenever fresh batteries are installed into the instrument and the instrument does not work correctly, it is wise first to try replacing the geiger tube before making any further attempts at circuit checking.

7.3 CHECKING THE HIGH VOLTAGE SUPPLY:

In order to check the high voltage supply one should use, where possible, an electrostatic voltmeter operating between the test point indicated in Figure 2. The normal voltage will be 1020 volts plus or minus 20 volts. This voltage may be read with an electrostatic voltmeter. As an alternative one may test with a 20,000 ohm per volt meter operating on the 1000 volt scale between the points shown in Figure 2. The proper reading will be between 300 and 350 volts. Should the voltage under these conditions read low, check again that the battery supply voltage is correct; if it is, check from screen (pin 2 of V-4) of the high voltage generating tube to ground. This should read between 55 and 70 volts on the 20,000 ohm per volt meter. If this reads correctly and the high voltage is low it suggests that something is incorrect in the rectifier system and the 1AK5 should be replaced. If, on the other hand, this voltage reads low, it suggests that it may be either a bad 1AK5 tube or a bad NE-7 glow tube. Check the voltage from the NE-7 glow tube to ground, operating on the 250 volt scale of a 20,000 ohm per volt meter and the voltage should read between 60 and 65. The most likely causes of failure of the high voltage supply are: 1. A defective 1AK5 tube; 2. A defective NE-7 glow lamp; or 3. A defective choke, T-1. The latter should be tested for resistance and should properly show from 4100 to 4500 ohms depending upon temperature. When the high voltage reads low, it may be the result of a defect in the probe cable, and accordingly one should remove the black wire of the chassis end of the probe cable from its terminal on the circuit board and recheck the high voltage to verify whether leakage in the cable has reduced the high voltage.

7.4 CHECKING THE PULSE SHAPING AND INTEGRATING CIRCUIT:

In order to check the pulse shaping and integrating circuit, one should connect the headphone and listen to it while he touches the input circuit (pin 4 of V-2) with an insulated screwdriver. This should create sporadic clicking in the headphone and should cause the meter to read when operating on the X-1 scale. If this does not occur one should check the filament to ground voltage of the trigger circuit (see Figure 2). This voltage should be between 3.8 and 4.2 volts reading on the 10 volt scale of a 20,000 ohm/volt meter depending upon the condition of the batteries and tubes. Should the meter read continuously without an input signal, one should short-circuit pin 4 of V-3, to ground thus preventing pulsing of the multivibrator. If the reading still shows, it almost certainly indicates that the second CK6418 V-3 is defective and should be replaced.

7.5 NORMAL VOLTAGE RANGES:

Under normal conditions when read with a 20,000 ohm/volt meter operating on the 250 volt scale, the voltage readings shown in Figure 2 will be indicative of the condition of operation of the circuit. If the cathode voltage is low and the plate voltage is high on V-2, it probably indicates a depleted filament and the tube should be replaced. This same condition can cause continuous running of the trigger circuit producing an off-scale reading of the meter. Grounding the grid of the second half of the circuit as indicated above will correct this. Remember to wait for the comparatively long time constant of the integrating circuit to correct itself to zero.

7.6 CHECKING FOR HIGH VOLTAGE PULSING:

Should the indicating meter read off-scale continuously and if the first CK6418 seems to be correct, remove the "D" cell from the high voltage supply in order to eliminate the high voltage and see if this corrects the condition. If it does, it probably indicates a defective cable. If the defect is at the probe end, the entire cable assembly must be replaced in one section for the entire connector is filled with an epoxy resin; thus eliminating one of the chief sources of failure of probe type instruments.

8. REPLACEABLE PARTS LIST

8.1 Electrical Components

Circuit Symbol	Description and Function	Manufacturer	Mfr's No. or Designation	Victoreen Part No.
C1	Capacitor; 120 Mmfd.—Ceramic, Tubular	CRL	Type BC	661-27
C2	Capacitor; .01 Mfd.—450 V—Ceramic Disc Type, ⅜" dia. x 5/32" thick	CRL	Type BC	661-28
C3	Capacitor; 4700 Mmfd.—Silver Mica, ± 5%	EL-MENCO	CM-30-472	661-29
C4	Capacitor; 470 Mmfd.—Silver Mica, ± 5%	EL-MENCO	CM-15-E-471-J	661-30
C5	Capacitor; 47 Mmfd.—Silver Mica, ± 5%	EL-MENCO	CM-15-E-470-J	661-31
C6	Capacitor; .25 Mfd.—Metallized Paper	CD	MP-2P-25	661-32
C7	Capacitor; 8 Mfd.—250 V—Electrolytic	CD	Type BR	661-33
C8	Condenser; .01 Mfd.—150 V (or higher) Ceramic, ± 10%, ⅜" diameter	CRL	882CI03MW6W	661-63
C9	SAME AS C8	------	------	------
C10	Capacitor; .01 Mfd.—1600 V—Ceramic Disc	AEROVOX	DCBH-4965	661-47
C11	SAME AS C10	------	------	------
C12	SAME AS C6	------	------	------
C13	SAME AS C6	------	------	------
C14	SAME AS C8	------	------	------
J1	Phone Connector (less washer)	SWITCHCRAFT	2501-MPA	661-42
M1	Meter; 0-50 ua	BURLINGTON	321-M-7	661-8
R1	Resistor; ½ watt, ± 10%, 22 Meg.	IRC	BTS	185-275
R2	SAME AS R1	------	------	------

8.1 Electrical Components (con't.)

R3	Resistor; ½ watt, ± 10%, 680 K	IRC	BTS	185-337
R4	Resistor; ½ watt, ± 10%, 470 K	IRC	BTS	185-259
R5	Resistor; ½ watt, ± 10%, 33 K	IRC	BTS	185-396
R6	Resistor; ½ watt, ± 10%, 1.8 Meg.	IRC	BTS	185-353
R7	SAME AS R4	-------	-------	-------
R8	Potentiometer; ¼ watt, 2 Meg.	CL	47	661-7
R9	Resistor; ½ watt, ± 10%, 330 K	IRC	BTS	185-258
R10	Resistor; ½ watt, ± 10%, 18 K	IRC	BTS	185-360
R11	SAME AS R6	-------	-------	-------
R12	Resistor; ½ watt, ± 5%, 20 Meg.	IRC	BTS	185-935
R13 thru R23	SAME AS R1	-------	-------	-------
R24	SAME AS R3	-------	-------	-------
S1	Switch	OAK	Type F	661-6
T1	Choke	TTI	3592	661-35
V1	Tube; GM	RCL	Mark 1, Model 22	661-36
V2	Tube; vacuum	RAYTHEON	CK-6418	661-37
V3	SAME AS V2	-------	-------	-------
V4	Tube vacuum	RAYTHEON	1AK5	661-38
V5	Lamp; glow	GE	NE7	517-40
BT1	Battery, 1.5 volt	NAT'L CARBON	950	263-17
BT2	SAME AS BT1	-------	-------	-------
BT3	Battery; 45 volt	NAT'L CARBON	415	661-49
BT4	SAME AS BT3	-------	-------	-------
BT5	SAME AS BT3	-------	-------	-------

8.2 Mechanical Components

Quantity	Description and Function	Mfr. and Catalog Number	Victoreen Part No.
1	Probe Assembly (less tube)	NMC A-A	661-40
1	Grommet; Strain Relief Plug	NMC C-187	661-13
1	Grommet; GM Tube Mounting	NMC A-317	661-64
1	Gasket; GM Tube	NMC A-310	661-18
1	Knob, Control	DAVIES-2110	263-107
1	Handle Assembly	NMC	661-20
1	"O" Ring, phone, ⅜" I.D. x ½" O.D. x $\frac{1}{16}$" thick	VICO	661-52
1	Case Bottom Assembly	NMC A-B	661-41
1	Strap, Carrying; vinyl	WA	661-55
2	Instruction Manual	VICO	661-45
1	Cover Gasket	NMC B-132	661-16

8.3 Maintenance Supply Parts (per 5 instruments)

Quantity	Circuit Symbol	Description and Function	Victoreen Part No.
1	M1	Meter; O-50 ua	661-8
1	V1	Tube: GM, Mark 1—Model 22 RCL	661-36
2		Knob; control	263-107
1	S1	Switch	661-6
4	V2-V3	Tube	661-37
2	V4	Tube	661-38
1	V5	Lamp; NE7	517-40
4	BT1, 2	Batteries	263-17
6	BT3, 4, 5	Batteries	661-49

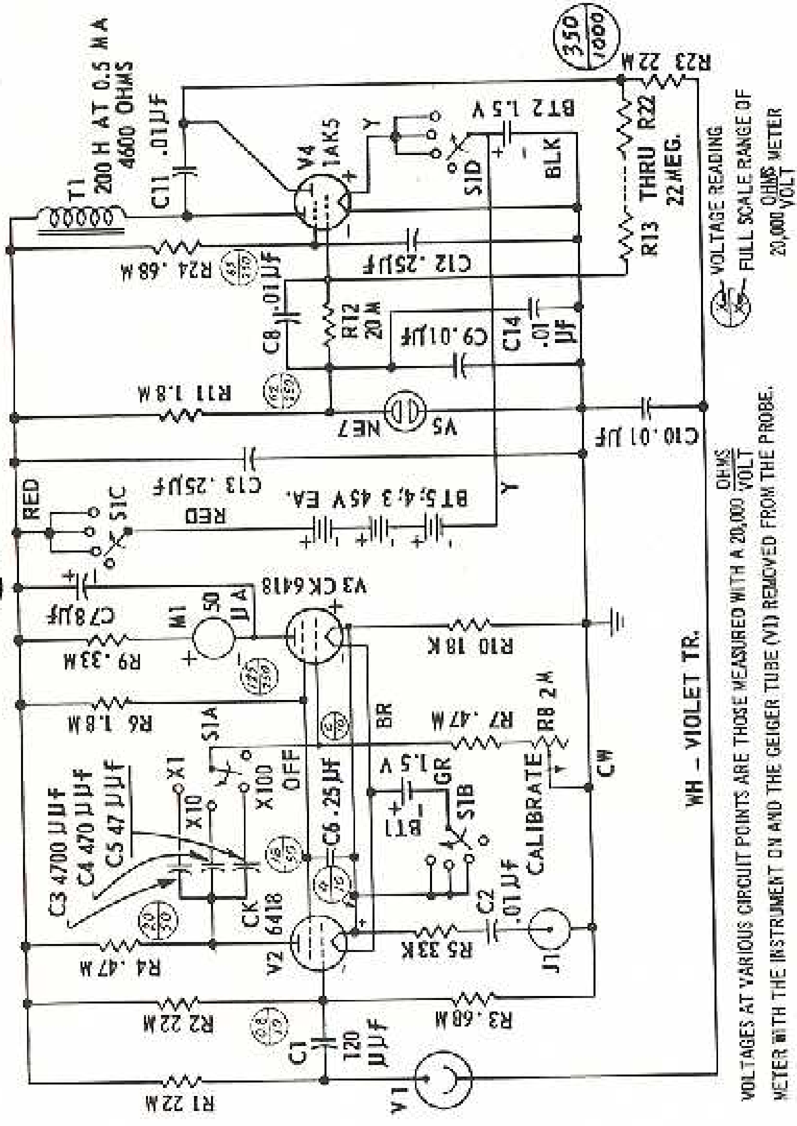

Figure 2. Circuit Diagram

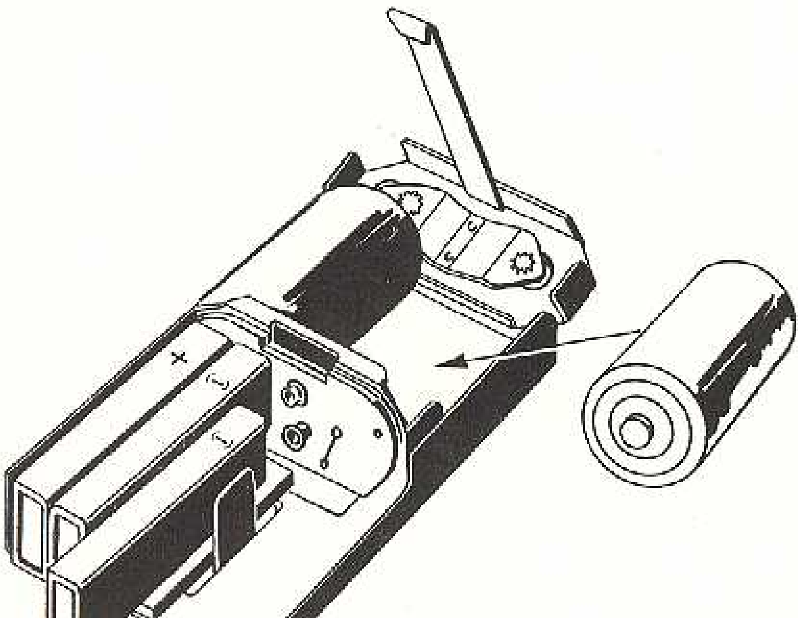

Figure 3. Battery Installation

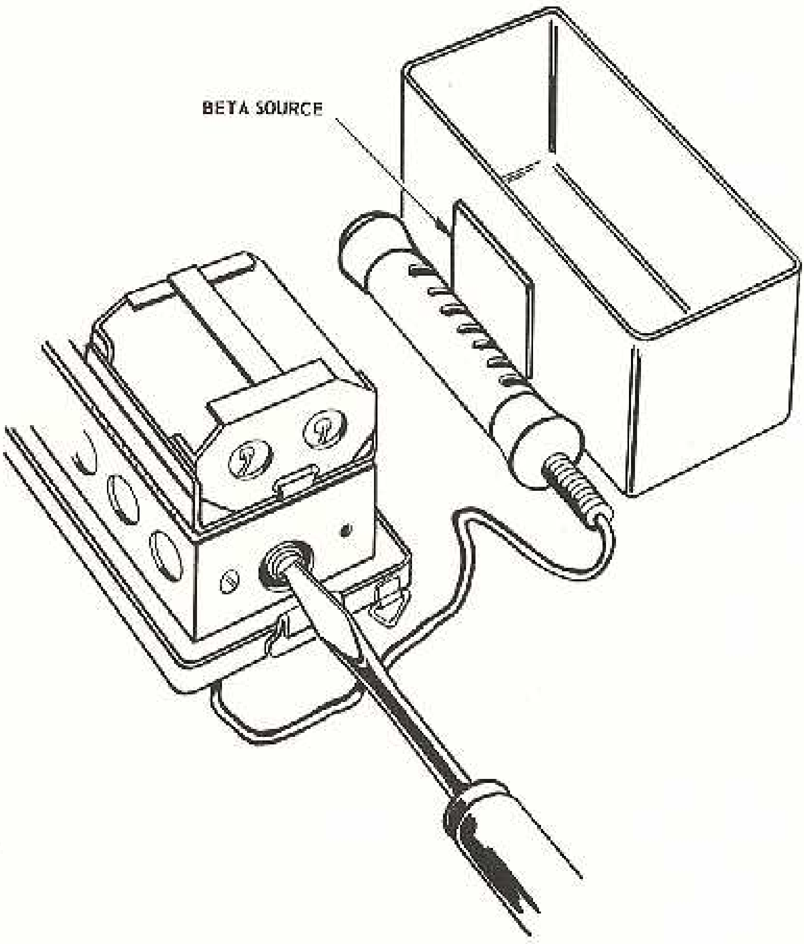

Figure 4. Calibration Adjustment

8.4 Manufacturers and Addresses

AEROVOX	AEROVOX CORPORATION, 740 Belleville Avenue, New Bedford, Massachusetts
BURLINGTON	BURLINGTON INSTRUMENT COMPANY, Burlington, Iowa
CD	CORNELL-DUBILIER CORPORATION, South Plainfield, New Jersey
CL	CLAROSTAT MANUFACTURING COMPANY, INCORPORATED, Dover, New Hampshire
CRL	CENTRALAB, INCORPORATED, 900 East Keefe Avenue, Milwaukee 1, Wisconsin
DAVIES	HARRY DAVIES MOULDING COMPANY, 1428 North Wells Street, Chicago 10, Illinois
EL MENCO	ELECTRO-MOTIVE MANUFACTURING COMPANY, Willimantic, Connecticut
GE	GENERAL ELECTRIC COMPANY, LAMP DIVISION, P.O. Box 2442, Cleveland, Ohio
IRC	INTERNATIONAL RESISTANCE COMPANY, 401 North Broad Street, Philadelphia, Pennsylvania
NATIONAL CARBON	NATIONAL CARBON COMPANY, 1251 West 76th Street, Cleveland, Ohio
NMC	NUCLEAR MEASUREMENTS CORPORATION, 2460 North Arlington Ave., Indianapolis, Indiana
OAK	OAK MANUFACTURING COMPANY, 1260 Clybourn Avenue, Chicago 10, Illinois
RAYTHEON	RAYTHEON MANUFACTURING COMPANY, 55 Chapel Street, Newton 58, Massachusetts
RCL	RADIATION COUNTER LABORATORIES, INCORPORATED, 5122 West Grove St., Skokie, Ill.
SWITCHCRAFT	SWITCHCRAFT, 1328 North Halsted Street, Chicago, 22, Illinois
TTI	TRANSFORMER TECHNICIANS, INCORPORATED, 2608 North Cicero Ave., Chicago 39, Illinois
VICO	VICTOREEN INSTRUMENT COMPANY, 5806 Hough Avenue, Cleveland 3, Ohio
WA	WAGNER AWNING AND MANUFACTURING COMPANY, 2658 Scranton Rd., Cleveland, Ohio

The Victoreen Instrument Co.