INSTRUCTION MANUAL

for

JORDAN MODEL AGB-10G-SR RADIATION SURVEY METER

JORDAN ELECTRONICS

A Division of The Victoreen Instrument Company

Alhambra, California

OPERATING AND MAINTENANCE INSTRUCTIONS

1.0 General Description

1.1 PURPOSE: The Model AGB-10G-Sr is a highly sensitive portable instrument for use in health monitoring, food and water monitoring, and other measurements of radiation from background levels to a maximum of 10,000 r/hr. Three models are available as follows:

- Model AGB-1G-SR: 2 ranges, 0.01 to 1 mr/hr and 1 to 100 mr/hr
- Model AGB-10G-SR: 2 ranges, 0.01 to 10 mr/hr and 0.01 to 10 r/hr
- Model AGB-10KG-SR: 3 ranges, 0.01 to 10 mr/hr and 0.01 to 10 r/hr and 10 to 10,000 r/hr.

The three models are identical in construction and operation with the exception that, as the range is increased, additional switch positions and calibration adjustments are required. All three instruments use a logarithmic scale on the meter; the AGB-1G-SR having a two decade scale, and the two higher range instruments having three decade scales. A cutaway drawing showing internal construction of the instrument and arrangement of components is shown in Figure 1. This drawing will be used as a reference in describing controls and components of the instrument.

An internal check source (Fig. 1-B) is included in the instrument for checking calibration. This source consists of a hermetically sealed capsule of strontium (Sr90) which is factory preset to give calibration check points.

1.2 THE BASIC CIRCUIT: The basic circuit used in the instrument is quite simple, as illustrated in Figure 2.

The plate current of the 5886 flows through the meter shunted by R_1. A bucking current flows through R_2 and is adjusted to balance out the plate current at the lowest value of radiation to be read on the scale.

A filament voltage is adjusted by R_3 to a value that produces the greatest stability in plate current over the life span of the filament battery. The shell voltage in this basic circuit is obtained from the bucking line.

1.3 CONSTRUCTION OF NEHER-WHITE IONIZATION CHAMBER: The Neher-White Ionization Chamber is essentially a steel shell with a 5886 electrometer tube sealed inside at ten atmospheres of pure argon. The grid of the electrometer tube is connected only to the ion collector, and the insulation resistance is maintained above 10^{15} ohms. In this floating grid circuit the positive ionization current from the collector balances the negative electron current from the filament, and the plate current is a logarithmic function of the ionization current. The plate current change is 10-15 μa. per decade change in radiation.

1.4 CHARACTERISTICS OF NEHER-WHITE CHAMBER: The Neher-White Ionization Chamber differs from ordinary ionization chambers in the following respects:

1. The output current from the chamber drives the indicating meter directly without requiring intermediate amplification.
2. Logarithmic current output is obtained directly.
3. Argon under high pressure is used instead of air at atmospheric pressure to increase ionization chamber efficiency. Since ionization current for a given radiation is directly proportional to the mass of gas present, higher output current is obtained. The larger mass of gas present also results in a lower temperature coefficient since the percentage of contaminant molecules remaining in the chamber after baking and evacuation is smaller.
4. The electrometer tube (Fig. 1-A) is sealed in the

chamber with the grid connected only to the ion collector. All other leads going outside the chamber are low impedance, minimizing insulation requirements in the instrument.

5. The chamber is of all-metal construction and sealed with silver solder. This type of construction enables the instrument to withstand considerable abuse.
6. The steel chamber wall increases gamma and X-ray efficiency by producing more "secondary" or Compton electrons than an air equivalent chamber wall. The response to different energies is compensated by covering the steel with a thin sheet of lead.
   This construction provides response essentially independent of the energy of the gamma radiation from 80 kev to 1.2 mev. The response is about 10% high at 250 kev and drops off sharply below 70 kev.

2.0 Operation and Field Maintenance

2.1 DESCRIPTION: The information presented in this section is for normal operation and field maintenance. Instrument calibration and battery condition can be checked directly with the instrument. If the instrument is to be used without laboratory calibration for long periods of time, remember that the 25 year half life of the Sr^{90} calibration check source results in a radiation decrease of 5.5% every two years.

2.2 HOW TO USE INSTRUMENT:

(a) Turn control knob (Fig. 1-C) to "Test" positions 1, 2 and 3 to check condition of batteries. Meter should indicate above "test" area at high end of meter scale for all three positions.

(b) Turn control knob past "Test" positions to radiation range required, mr/hr, r/hr, etc.

(c) Instrument is ready to measure radiation after two minute "warm up".

2.3 TO MEASURE RADIATION:

(a) Measure gamma radiation with beta shutter (Fig. 1-D) covering beta windows. Gamma radiation intensity is indicated directly on logarithmic meter scale. (See section 4.1 to read logarithmic scale.

(b) Measure beta radiation in the presence of a gamma field by opening beta shutter, exposing beta windows. Multiply reading increase due to beta radiation by 10 to obtain beta reading. This factor is required due to the physical design of the chamber and its sensitivity ratio between beta and gamma rays.

(c) In measuring radiation, it should be remembered that the logarithmic scale shows no "zero". In the absence of any radiation, the meter pointer will indicate below the lowest point on the scale.

2.4 TO CHECK CALIBRATION:

(a) Stand instrument upright on chamber end.

(b) Set control knob on mr/hr range.

(c) Rotate source to its clockwise stop and hold. Meter should read 10 mr/hr (full scale). If not, adjust B_1 to obtain this reading.

(d) Set control knob to r/hr scale. Meter should read .01 r/hr (bottom scale). If not, adjust B2 to obtain this reading.

NOTE: THE FOLLOWING STEPS PERTAIN TO MODEL AGB-10KG-SR ONLY.

(e) Set control knob to position 3A. Adjust 3A to make meter exactly 10 (full scale).

(f) Set control knob to position 3B. Meter should read bottom scale (.01). If not, adjust 3B to obtain this reading.

(g) Release source knob and turn control knob to desired range to take readings.

NOTE: THE FULL SCALE READING FOR THE MODEL AGB-1G-SR IS 1.0 MR/HR. WITH THIS EXCEPTION, THIS MODEL IS CHECKED AS DESCRIBED IN STEPS (A) THROUGH (D) ABOVE.

2.5 TO CHECK BATTERIES:

(a) Set control knob to position 1 (filament battery check), position 2 (shell battery check), position 3 (plate battery check).

(b) If meter reads below the "test" mark, the batteries in the position indicated are weak and should be replaced as soon as possible.

2.6 TO REPLACE BATTERIES:

(a) Remove meter housing (Fig. 1-E) by removing two screws indicated on instruction plate.

(b) Lift up round plate (Fig. 1-F) on which the 30 V. batteries are mounted to gain access to filament and plate batteries (Fig. 1-G).

(c) Remove and replace necessary batteries. Mercury cells must be removed negative end first. Check battery clip compression and contact surfaces.

(d) Replace battery section in proper position. Replace meter housing and screws.

3.0 Servicing:

3.1 The chart below summarizes the most commonly encountered trouble symptoms, and the probable location of the faults.

TROUBLE SHOOTING CHART

Symptom	Probable Location of Fault	Corrective Procedure
1. Meter reads 0.01 in all battery check positions.	Meter wire broken.	Remove meter housing and resolder meter lead.
	Meter is open.	Replace meter.
	Switch assembly	Check and clean switch contacts with carbon tetrachloride.
2. Meter will not read full scale on mr/hr range with B1 full clockwise.	Dead batteries.	Carefully check voltage of all batteries.
	No shell voltage.	Measure voltage from common negative point on switch to chamber shell. If batteries are good but no shell voltage, look for shorts inside rear of detector unit.
	Plate circuit shorted.	Check resistance between meter terminal with brown lead attached and inside of shell. Unplug control unit connector first. Resistance of less than 10 megs indicates short.
	Chamber is damaged.	If R1 has been replaced as described above and symptom is still present, chamber should be replaced.
3. Meter pulsates or drifts excessively mr/hr range.	Battery clips loose.	Tighten battery clips (3.2 a).
	Glass chamber seal dirty.	Brush glass seal clean with alcohol, or carbon tetrachloride. Glass seal is exposed by pulling tube socket away from chamber.
4. Meter reads high and bucking potentiometer has no control.	Bucking battery dead.	The test positions do not check the bucking battery. Check this battery with a voltmeter. The voltage should be 1.34 V. If not, replace battery.
	Bucking potentiometer open.	Check bucking potentiometer B1 for mr/hr range; B2 for r/hr range.

Symptoms	Probable Location of Fault	Corrective Procedure
5. Meter reads high and shunt potentiometer has no control.	Plate circuit shorted to filament or shell.	Follow circuit diagram and trace out short.
	Shunt potentiometer open.	Check shunt potentiometer S1 for mr/hr range; S2 for r/hr range.

3.2 GENERAL TROUBLE SHOOTING CHECKS:

(a) Clean and check compression of battery clips. Remove batteries, (see section 2.6) if battery leak discharge is visible on battery ends, and wipe battery ends clean. If battery clips are corroded on contact surface, wipe clean and polish with Crocus cloth or fine emery paper. Replace batteries and try to roll or move them when clipped into position. If batteries move easily, remove them and bend battery clips to increase compression on batteries until batteries are difficult to move.

(b) Voltage Checks. The rear view of the chamber assembly shows a brass ring containing a nine-pin miniature tube socket (Fig. 1-H). Count clockwise from the one blank position. The voltages measured should be as follows:

VOLTAGES AT CHAMBER SOCKET

Pins	Voltage	Function
7	0.8 to 1.25 dc	Positive filament
1, 4, 5, 6, 9	Common negative	Negative filament
2, 3	5.34 dc	Plate
8	70-90 dc	Shell

NOTE: Use a DC voltmeter with an input impedance of 20,000 ohms per volt or greater.

CAUTION: Never short plate or shell voltages to either filament connections. A voltage of 1.35 volts or higher on the filament indicates the chamber assembly has been damaged and should be replaced.

(c) Current Checks. With instrument turned "on" mr/hr range, remove batteries as follows: Connect a DC current meter in series with the batteries and the battery clips using test leads. Battery currents should be as follows:

BATTERY CURRENT

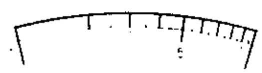
Meter Used	Battery Drain Tested	Current
100 microampere	Plate	20-50 μa
100 microampere	Bucking	10-35 μa
10 milliampere	Filament	9-11 ma
100 microampere	Shell	0

4.0 General Information

4.1 READING THE LOGARITHMIC SCALE:

The logarithmic scale has many desirable qualities and, with a little practice, it can be read with greater accuracy than the more common linear scale.

The spacing of the marks is repeated identically through each ten-fold increase in readings. Thus the spacing of the marks from .01 to .1 is identical to that from .1 to 1 or from 1 to 10. These major divisions are called decades. The scale on this instrument has three decades. One decade of a logarithmic scale is shown below. It is obvious that the space from 9 to 10 is far less than the space from 1 to 2. The space between numbers decreases as the numbers increase. This takes place also between whole numbers and thus the space from 1.5 to 2 is less than that from 1.0 to 1.5. Keeping this in mind it is easy to obtain accurate readings between the major divisions.



4.2 RADIOLOGICAL SAFETY:

The Sr^{90} check sources used in the Model AGB-10-SR, AGB-10K-SR, and AGB-1-SR are very small sources and perfectly safe under normal circumstances. Strontium-90 is however a dangerous poison and because of its long half life and retention in the body, can cause serious trouble. These sources have been carefully constructed and sealed to prevent leakage. They should however be tested for leaks periodically to insure complete safety. The A.E.C. recommends a "Wipe Test" every six months. This test is performed as follows:

(a) Obtain a cotton swab. "Q-tips" available at drug stores are suggested.

(b) Dip the swab in hot water and carefully wipe the surface of the source window.

(c) Dry the swab and hold it as close as possible to one of the large Beta windows on the Detector Unit. Any increase in reading indicates leakage.

If the source is found to be leaking, it should be removed, placed in a closed glass jar and returned to Jordan Electronics for disposal and replacement, unless suitable disposal facilities for radioactive material are available. Be very careful in handling a damaged source. Touch it only with pliers and wash your hands when finished.

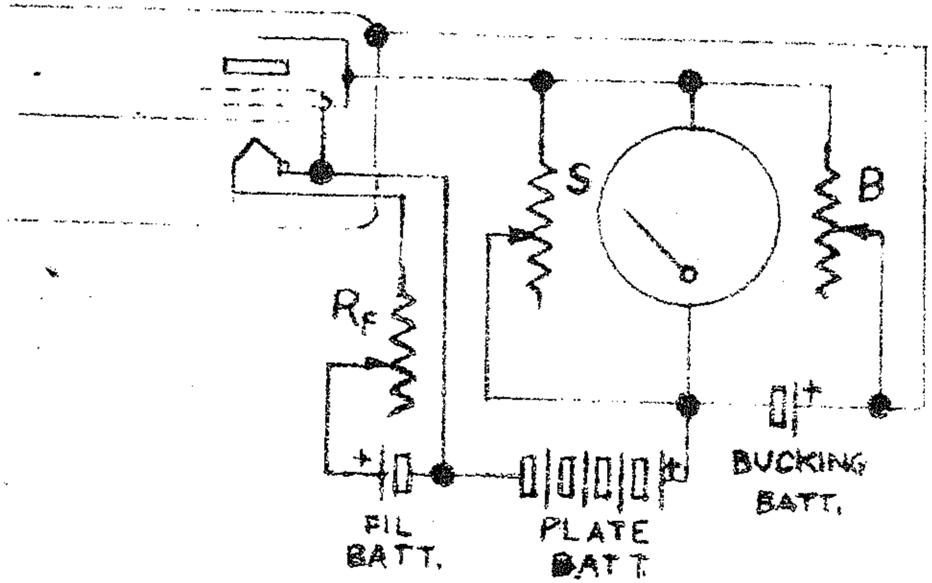
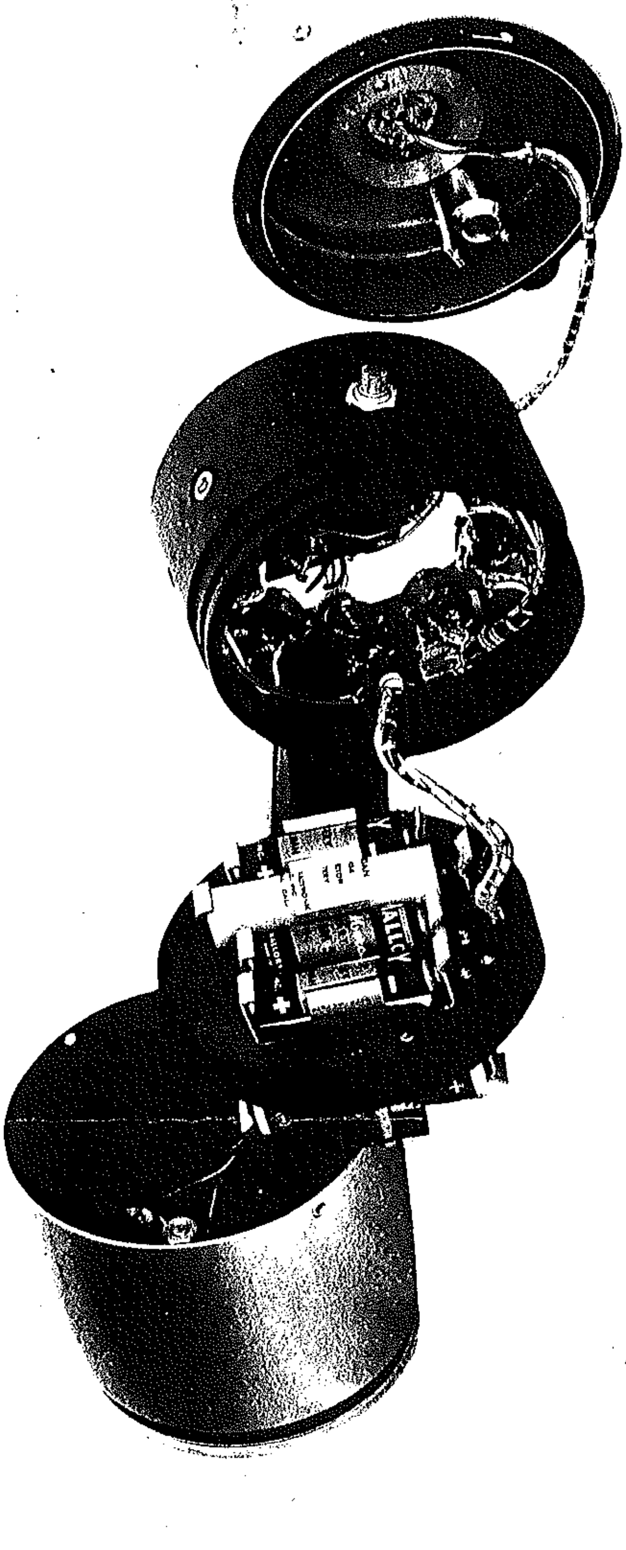
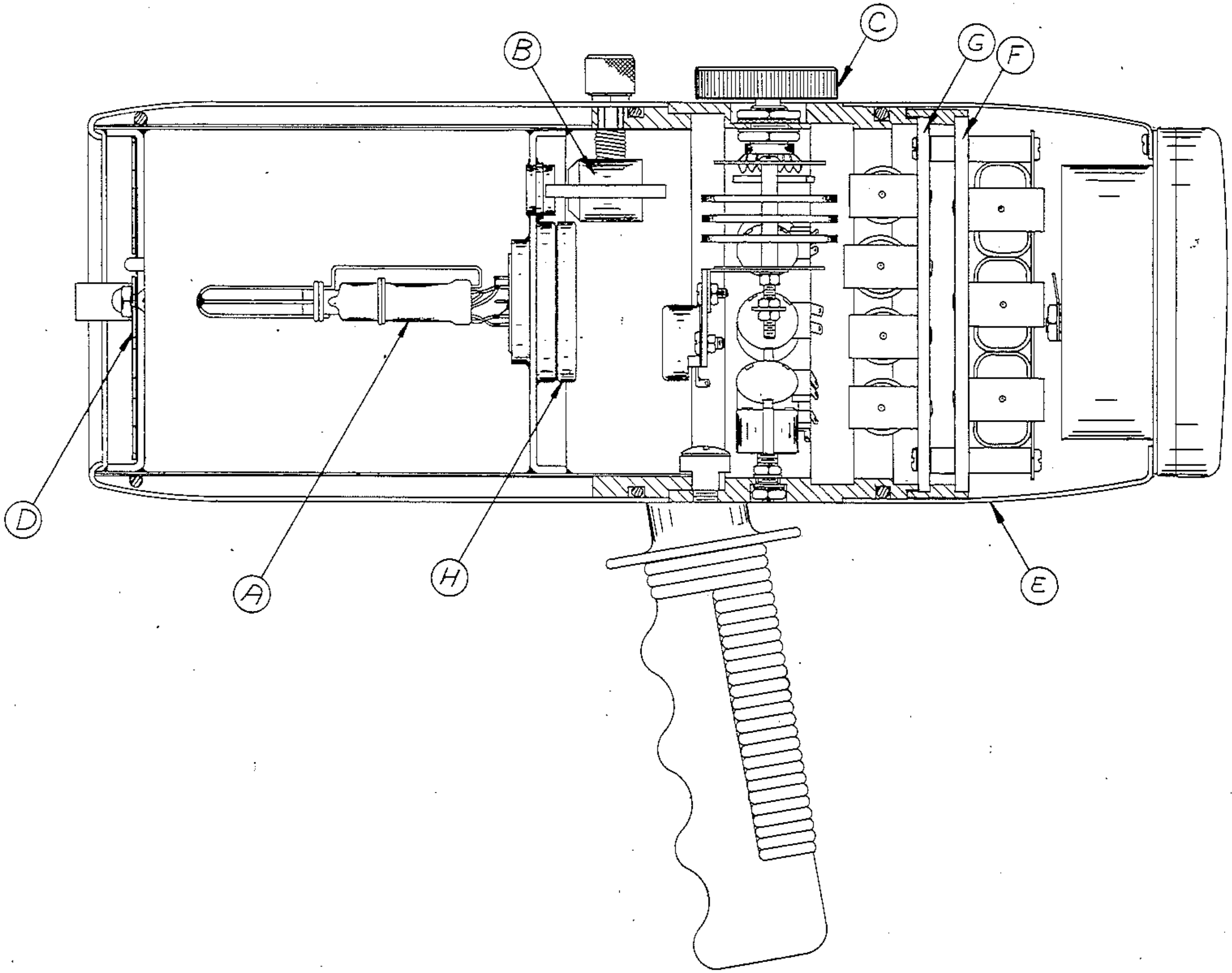


FIG 2
BASIC CIRCUIT.





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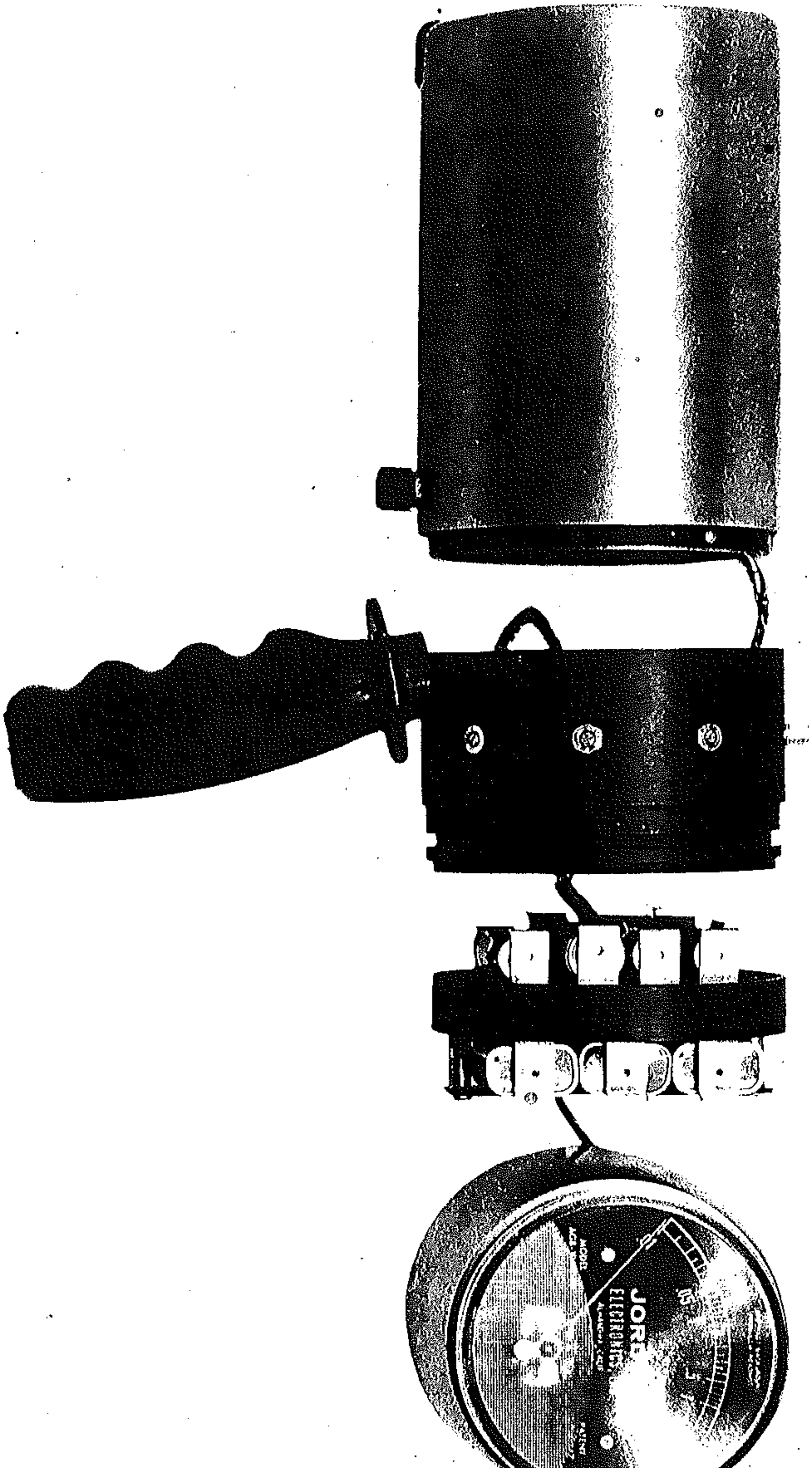
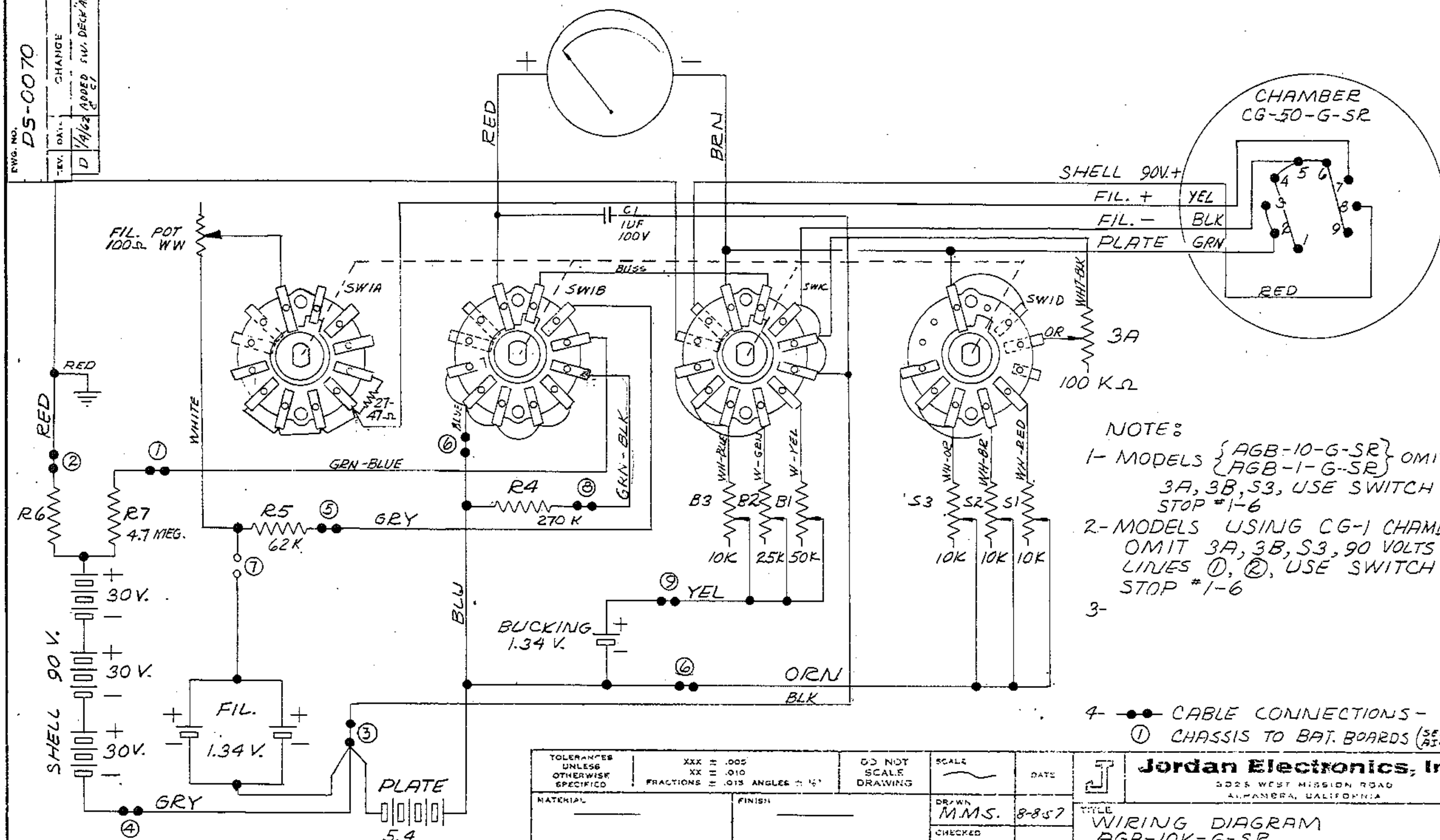


DWG. NO.			REV.
DS-0070			D
REV.	DATE	CHANGE	BY
D	1/4/62	ADDED SW. DECK "A" & C1	DBH



NOTE:

1- MODELS {AGB-10-G-SR, AGB-1-G-SR} OMIT 3A, 3B, S3, USE SWITCH STOP #1-6

2- MODELS USING CG-1 CHAMBER, OMIT 3A, 3B, S3, 90 VOLTS LINES ①, ②, USE SWITCH STOP #1-6

3-

4- ●● CABLE CONNECTIONS - ① CHASSIS TO BAT. BOARDS (SEE AI-0008A)

TOLERANCES UNLESS OTHERWISE SPECIFIED	XXX ± .005 XX ± .010 FRACTIONS ± .015 ANGLES ± ½°	DO NOT SCALE DRAWING	SCALE	DATE	Jordan Electronics, Inc. 3025 West Mission Road, Alhambra, California
MATERIAL	FINISH		DRAWN M.M.S.	8-8-57	TITLE WIRING DIAGRAM AGB-10K-G-SR.
			CHECKED		
			APPROVED		~~SUPERSEDES~~ USED ON: AU-0007 — DWG. NO. DS-0070 — D