CO-AN 08-35TS15-2

HANDBOOK OF MAINTENANCE INSTRUCTIONS

For

TEST SET TS-15A/AP

CONFIDENTIAL

Approved 26 August 1944

2286

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CONFIDENTIAL
CO - AN 08 - 35TS15 - 2

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Unsatisfactory Report

FOR U. S. ARMY AIR FORCE PERSONNEL:

In the event of malfunctioning, unsatisfactory design or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54 or a report in similar form shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54, listing:

1. Station and organization.
2. Nameplate data (type number and serial number, or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

FOR U. S. NAVY PERSONNEL:

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112 "Report of Unsatisfactory or Defective Material" or a report in similar form and forwarded in accordance with the latest instruction of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the Bureau of Ships and to the Inspector of Naval Material, (insert proper address of the Inspector concerned). Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data (type number and serial number, or complete nomenclature if nameplate is not attached to the equipment).
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

FOR BRITISH PERSONNEL:

Form 1022 procedure shall be used when reporting failure of radio equipment.

Destruction of Abandoned Materiel in the Combat Zone

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

MEANS:—

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

PROCEDURE:—

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
5. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

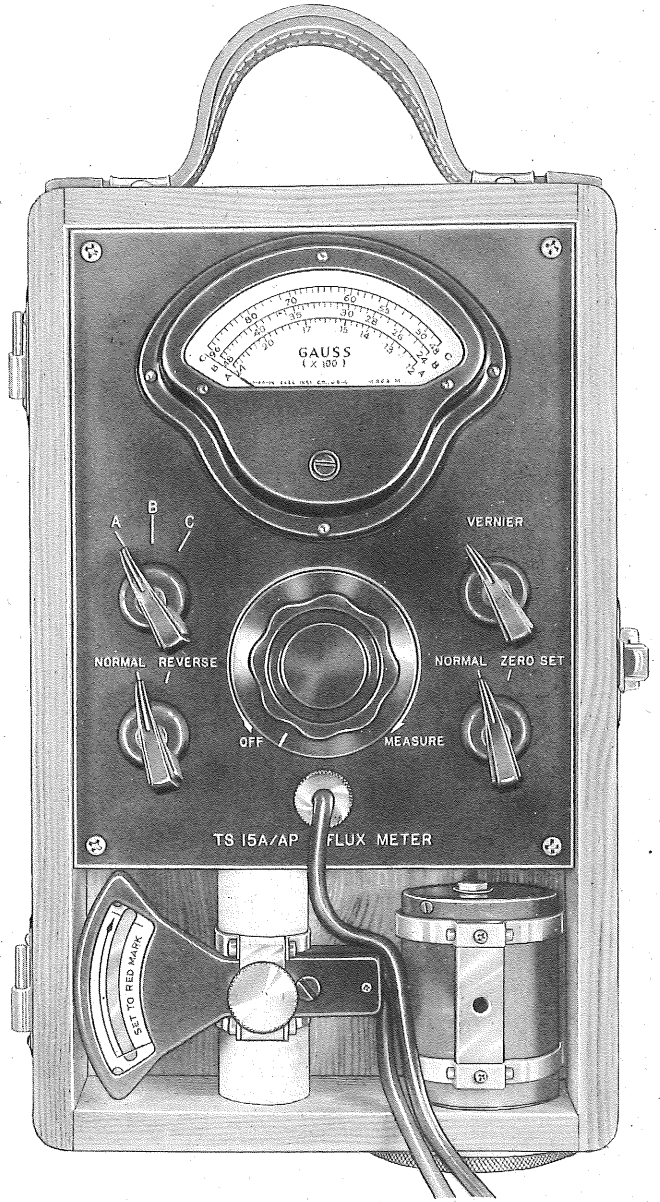

Figure 1 — Front View of Instrument

SECTION I

GENERAL DESCRIPTION

1. GENERAL.

This specification covers the operation and maintenance of Portable Magnetic Flux Measuring Set, type TS-15A/AP.

2. PURPOSE.

This instrument is designed to permit the ready measurement of magnetic field strengths existing between the pole faces of various magnetic structures.

3. APPLICATIONS.

The instrument is intended primarily for use with magnets whose field strengths lay within the range of 1200 to 9600 gauss, and having air-gaps of 0.550 inches to 1.51 inches, and pole face diameters from ¾ inch to 1⅝ inches.

The instrument may be employed to measure flux density in gaps other than those covered by the foregoing physical dimensions; PROVIDED, THAT THE INTERSECTION OF THE HORIZONTAL AND VERTICAL PLANES OF THE PROBE UNIT IS POSITIONED AT THE GEOMETRIC CENTER OF THE GAP UNDER MEASUREMENT.

The horizontal plane of the Probe is indicated by the center of the knurled yoke attachment knob. The vertical plane is determined from the center of the circle formed by the springs on the yoke-bar when it is in position. (See fig. 3)

4. COMPONENTS.

The instrument is comprised of three basic units:

A — The Gauss meter assembly.
B — The Probe assembly.
C — The source of power.

5. POWER SUPPLY.

One dry cell — Commercial type D, Navy type C, or Army type BA-30 is supplied with the instrument. No other power sources are used.

6. EQUIPMENT SUPPLIED.

This Test Set is supplied fully equipped. No external or additional materials are required.

7. DIMENSIONS AND WEIGHT.

The units are contained in an climatically-treated Oak Case, which is furnished with a leather carrying handle.

The over-all outside dimensions are 5 inches by 6 inches by 10½ inches. Weight is 6½ pounds.

SECTION II

OPERATION AND ADJUSTMENT

1. INSTALLATION.

Test Set TS-15A/AP is a portable instrument. Therefore, no installation is required.

2. ADJUSTMENT.

(a) — Remove Probe unit from its recess, (located at the bottom of the Carrying case — See fig. 1) and place it in a level position, (with Probe-meter face horizontal on edge of table, or any flat surface which will clear cable.)

(b) — Zero-set Probe pointer by turning bakelite adjusting screw on cover until the pointer is aligned with the BLACK mark. (The pointer and its image in the mirror scale should coincide with the Black mark when the pointer is directly above it.)

CAUTION! DO NOT ADJUST PROBE ZERO SET WHEN PROBE IS IN MAGNET GAP, OR IMMEDIATE VICINITY.

(c) — Set A/B/C Selector switch on "C". Adjust zero-set on gauss meter, by rotating OFF-MEASURE control knob, clockwise from OFF position, until gauss meter pointer is lined up with the mark at "48" on scale "C". Hold NORMAL-ZERO SET switch on ZERO SET position. This should line up gauss meter pointer with the mark at "96" on scale "C". If pointer is not lined up, turn zero adjusting screw on face of gauss meter to displace pointer an equal amount on the opposite side of the "96" mark.

(d) — Recheck step (c) and repeat adjustment of zero adjusting screw if necessary.

Note

For maximum accuracy, the gauss meter ZERO-SET adjustment should be made with the instrument at a temperature of 16°C (60°F) to 30°C (85°F).

3. WARNING.

The gauss meter is magnetically shielded. However, CLOSE PROXIMITY TO POWERFUL MAGNETS OF THE TYPE WITH WHICH THIS INSTRUMENT IS INTENDED TO BE USED, WILL INTRODUCE SERIOUS ERRORS IN ITS READINGS.

CONTINUED EXPOSURE OF THE INSTRUMENT TO INTENSE MAGNETIC FIELDS WILL RESULT IN PERMANENT ERRORS.

ACCIDENTAL DIRECT CONTACT BETWEEN THE GAUSS METER AND A MAGNET WILL NECESSITATE REPLACEMENT OF THE GAUSS METER, AND PROBABLE RECALIBRATION.

CONFIDENTIAL
CO - AN 08 - 35TS15 - 2

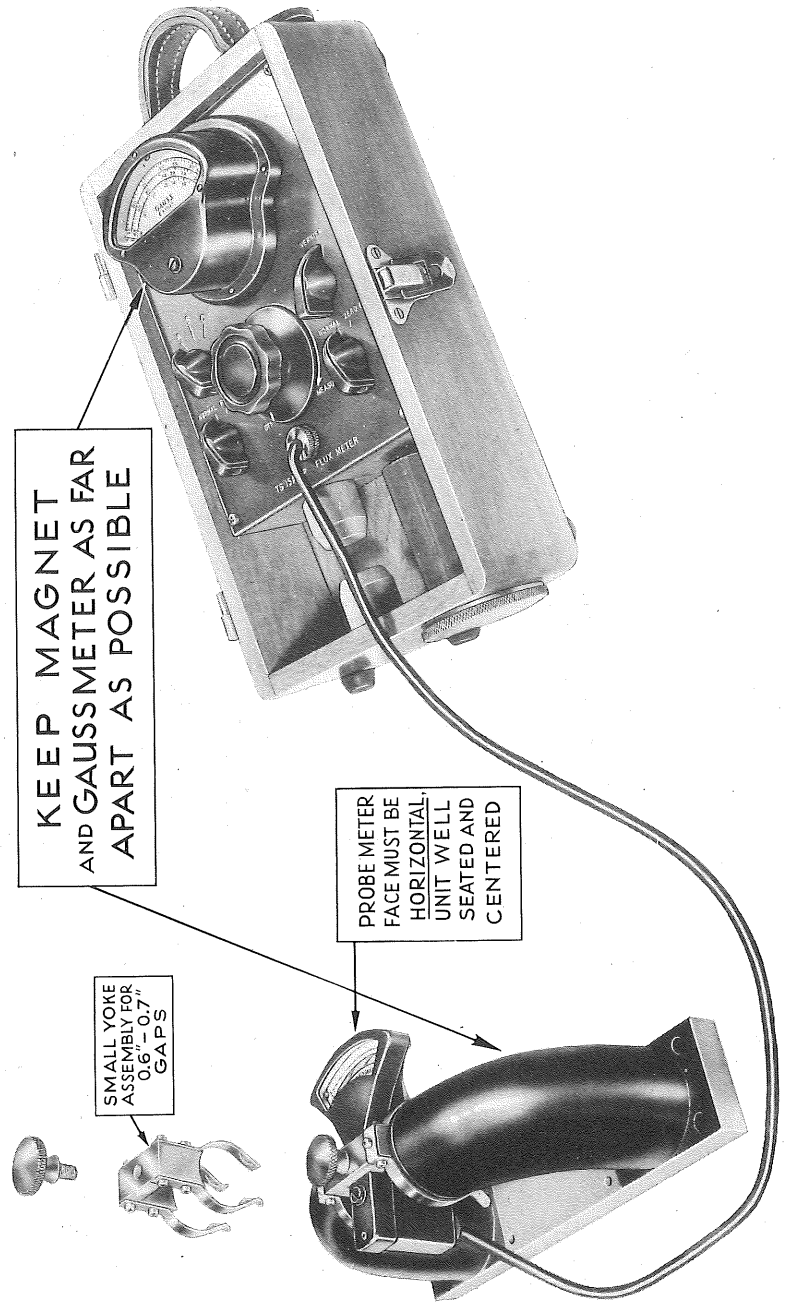

Figure 2 — Operational View of Instrument

SECTION III

OPERATION

CAUTION

THE MAGNET UNDER MEASUREMENT AND THE GAUSS METER SHOULD BE SEPARATED AS FAR AS POSSIBLE.

(1) Refer to fig. 1, which illustrates the various panel controls.

(2) Select yoke to be used, (Small yoke for 0.6" to 0.75" gaps) (Large yoke for 1.3" to 1.5" gaps,) and attach to the Probe unit by means of the knurled knob.

(3) With OFF-MEASURE control knob in OFF position, place Probe unit between pole faces of magnet to be measured, making certain that the Probe is well seated, and centered. (The face of the Probe must be horizontal.)

(4) Unless the approximate strength of the magnet is known, set Selector switch to position "C". If the approximate strength of the magnet is known, set Selector switch to appropriate range.

(5) With the DIRECT-REVERSE switch in DIRECT position, turn OFF-MEASURE control knob clockwise from OFF position. If the Probe pointer moves backward, turn OFF-MEASURE control knob to OFF position. Set DIRECT-REVERSE switch to REVERSE position and proceed.

(6) Rotate OFF-MEASURE control knob until Probe pointer is aligned with RED mark, or the gauss meter pointer reaches full scale. If the latter occurs, return OFF-MEASURE control knob to OFF position, set A/B/C Selector switch to next lower range and repeat.

(7) When Probe pointer is set to RED mark — (use Vernier control to position pointer exactly) the gauss meter reading on the scale corresponding to the A/B/C Selector switch setting gives magnetic flux directly in hundreds of gauss.

Note

BEFORE STORING INSTRUMENT TURN CONTROL KNOB COUNTERCLOCKWISE UNTIL SWITCH SNAPS TO OFF POSITION.

CONFIDENTIAL
CO - AN 08 - 35TS15 - 2

SECTION IV

THEORY OF OPERATION

1. GENERAL.

The TS-15A/AP Magnetic Flux Measuring Set consists basically of a D.C. power source, and two milliammeters, all connected in a series circuit. The milliammeter which is calibrated in gauss, derives its field power, in the usual manner, from a self-contained permanent magnet. The second milliammeter, used as a Probe, secures its field power from the Magnet under test.

The gauss meter is an accurately calibrated milliammeter which measures the D.C. current flowing through the Probe. The deflection of the Probe is a product of the direct current passing through it, and the strength of the magnetic field or flux in which it is immersed. With a known field strength, the current required to set the Probe pointer to the RED mark can be measured. Conversely, the current required to set the Probe pointer to the RED mark is a measure of the field strength of the magnet in gauss.

The TS-15A/AP is provided with three ranges:

8 MA A — 1200 to 2400 gauss.
4 MA B — 2400 to 4800 gauss.
2 MA C — 4800 to 9600 gauss.

The instrument is initially calibrated on the "C" range, reading 4800 gauss with 2 milliamperes of current flowing through the Probe and gauss meters. For range "B" the gauss meter is shunted so that its full-scale sensitivity is now 4 milliamperes, and is calibrated to read 2400 gauss with 4 milliamperes flowing through the Probe. The "A" range is obtained by shunting the gauss meter so that at 1200 gauss on Scale "A", 8 milliamperes of current are flowing through the Probe unit.

2. THE PROBE.

The Probe unit (See fig. 3) consists of a double-pivoted moving coil assembly, wound with 200 turns of .002" electrolytic silver wire — Formex insulated. All components of the moving assembly must be carefully graded and tested for the most minute magnetic impurities, in order that the unit will function satisfactorily. The pivots have phosphor bronze shanks, tipped with an osmium alloy, and these pivots turn on polished sapphire jewels. The moving coil system rotates through an angle of 52° (between the BLACK and RED marks on the scale). At the RED mark, the moving coil system is lined-up perpendicular to the pole faces of the magnet into which the Probe has been inserted. THE ALIGNMENT OF THE COIL AT FULL-SCALE IS CRITICAL.

3. THE GAUSS METER.

The gauss meter is a steel encased, precision, D'Arsonval type D.C. milliammeter. In order to secure good scale spread, in a small portable instrument, and permit the accuracy of reading required, the gauss meter is constructed with what is known as a retarded, or suppressed, zero. The first mark on the scale is reached when one milliampere of current is flowing through the gauss meter, and the full-scale reading is obtained when two milliamperes are flowing through the meter.

This is accomplished by coiling the hair springs so that their neutral, or rest position, is 105° counterclockwise, below zero. For this application, the scale length is thus effectively doubled. In order to satisfactorily use an instrument of this type, some means of mechanically setting the zero adjustment must be made. Since it is impossible to do this when the pointer is against the stop pin, (below zero), it must be done, by precisely shunting the meter, so that the full-scale current is divided exactly in half, and the mechanical adjustment is then made at zero on the scale, with one half full-scale current flowing through the instrument. Since the moving coil must be wound of high temperature coefficient material, (copper) this zero setting will be affected by changes in temperature. There is incorporated inside the meter case, a large swamping resistor of manganin wire to minimize this effect.

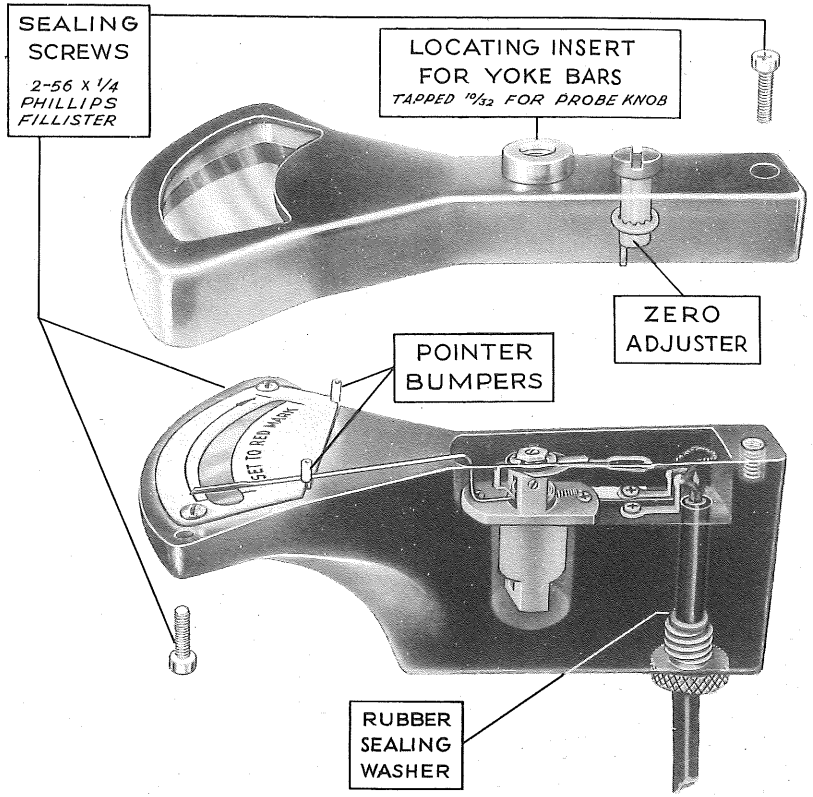

Figure 3 — Probe Assembly

SECTION V

MAINTENANCE

1. GENERAL.

Since Field Calibration facilities for this type of equipment are non-existent, extensive field repairs are impracticable. In emergencies, the equipment can be checked — using the same magnets — against another TS-15A/AP.

RESISTORS R6 AND R7 (SEE FIG. 4) MUST NOT BE ALTERED IN ANY WAY, NOR SHOULD ANYTHING BE DONE TO THE PROBE UNIT, OTHER THAN AS DESCRIBED UNDER EMERGENCY REPAIRS.

2. BATTERY.

If the battery voltage is insufficient to give a full-scale deflection on the gauss meter, with knobs of OFF-MEASURE control, and Vernier in the extreme clockwise position, and with A/B/C Selector switch in "A" position, — remove the cap on the bottom of the carrying case, and replace dry cell with appropriate type. (See Par. 5, sec. 2.)

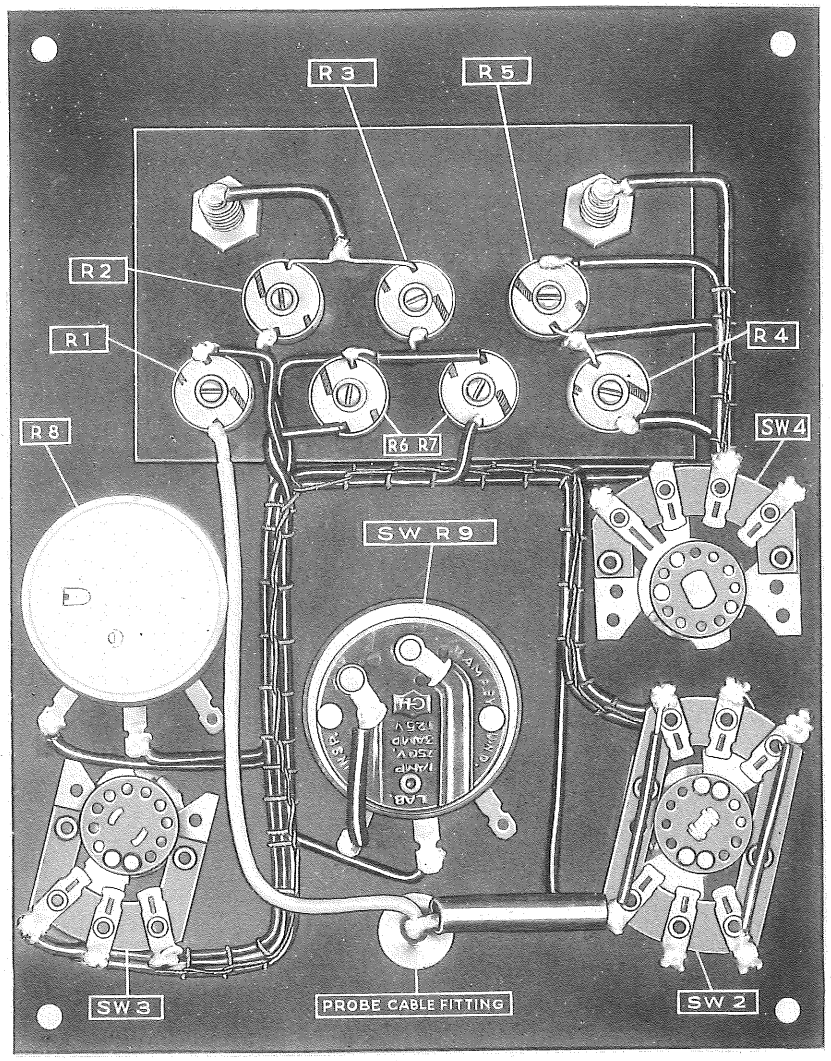

Figure 4 — Rear View of Panel

SECTION VI
EMERGENCY OPERATION AND REPAIR

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Instrument Dead.	Dead Battery. Battery not making contact in Case. Switch 1, R8 or R9 open.	Replace battery. Clean contacts. Make certain cap tightly seated. Replace defective parts.
2. Cannot zero set Probe.	Current on. Probe near source of magnetic flux.	Turn OFF-MEASURE knob to OFF. Remove Probe from Magnetic Field.
3. Probe deflects on all ranges, but gauss meter does not.	Dry cell reversed in battery case. Gauss meter open or shorted.	Remove and reverse dry cell. Replace gauss meter.
4. Gauss meter does not return to zero, when NORMAL-ZERO SET switch is in ZERO position.	Poor connections on NORMAL-ZERO SET switch. R3 open. Defective gauss meter. R2 shorted.	Clean and check switch points. Replace defective parts.
5. Gauss meter returns to extreme left position when NORMAL-ZERO SET switch is in ZERO set position. Will not Zero Set.	R2 open. R3 shorted. Defective gauss meter.	Replace defective parts.
6. Probe does not deflect. (Although gauss meter does on all ranges.)	Poor connections on DIRECT-REVERSE switch. Open, or shorted Probe cable. Open, or shorted Probe coil.	Clean and check contacts. Replace cable. Field repairs impracticable.
7. Probe pointer will not reach RED mark on any range.	Exhausted battery. Magnet field strength below 1200 gauss. Obstruction inside Probe.	Replace battery. Remove cover of Probe by removing 3 Phillips screws on case. Check for: foreign matter catching pointer, obstructing moving coil. Also, lead wire catching on balance tail. Remove with tweezers, or careful blowing.

SECTION VI
EMERGENCY OPERATION AND REPAIR (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY
8. Probe pointer sticks past RED mark.	Catching on pointer bumper.	Remove Probe cover, replace ceramic bumper.
9. Gauss meter off Calibration on Range "C".	Zero settings improperly made. Gauss meter too close to a magnet. Yoke not securely attached to Probe. Probe not properly seated in magnet gap. R1, R6, or R7, shorted, open, high resistance connection, or partial short. Probe unit damaged. Gauss meter off calibration.	See Section 11, and re-zero. Separate. Recheck. Reseat. Replace defective parts. Field replacement impracticable. Replace gauss meter.
10. Gauss meter OK on range "C", but off on range "B".	Defective connections on selector switch. R5 defective.	Clean and check contacts. Replace R5.
11. Gauss meter OK on ranges "B" and "C", but off on range "A".	Defective connections on selector switch. R4 defective.	Clean and check. Replace.
12. Gauss meter sticks at any point.	Foreign matter impeding moving system.	Replace meter.
13. OFF-MEASURE or Vernier controls erratic, jumpy, and difficult to set Probe pointer on RED mark.	Dirty contact between wiper arm and resistance winding. Broken winding on control R8 or R9.	Clean, and lubricate with mineral oil. Replace.

SECTION VII
TABLE OF REPLACEABLE PARTS

MODEL - TS - 15A/AP

Reference Symbol	Army Stock Number Navy Stock Number British Stock Number	Name of Part and Description	Function	Mfr. and Design or AWS Type	Cont. or Govt. Dwg. or Spec. No.
C-1		CABLE — Probe, rubber jacket, single stranded No. 20, shielded, (lapel microphone type); diameter —5/32″ to 3/16″, 4′ 6″ long.	Connects Probe and gauss meter.		M-202
		KNOB — Round brass nickel plated; small end threaded 10-32 head ¾″ diameter; overall length 13/16″.		MARION	M-203
		YOKE ASSEMBLY — With springs small size for .550″–.750″ gaps. Consists of nickel plated powdered bronze bar with four nickel plated beryllium copper springs attached with eight 2-56 Phillips Filister head screws and split lockwashers.	Secures Probe in magnets.	MARION	M-204
		YOKE ASSEMBLY — With springs large size for 1.3″–1.5″ gaps. Consists of nickel plated powdered bronze bar with two nickel plated beryllium copper springs attached with six 2-56 Phillips Filister head screws and split lockwashers.	Secures Probe in magnets.	MARION	M-205
		COVER PROBE COMPLETE — Transfer molded bakelite BM120 with bakelite zero adjusting screw and celluloid window installed.		MARION	M-206
		CAP — Battery container; with spring; 2¼″ diameter nickel plated brass; four point star shaped phosphor bronze contactor spring, fastened to underside with 1-72″ x ⅛″ round head machine screw threaded 1-7/16″ x 20.	Holds battery in container and makes negative contact.		M-207
		METER — Milliammeter, D'Arsonval, range 0–2 milliamperes; resistance 200 ohms ±.1% at 70°F.; retarded zero construction, special scale calibration; flush mounting fan shaped steel case. Case dimensions and materials per Signal Corps Spec. for IF-93.	Gauss meter.	MARION MRO-2	M-208
R9 SW1		RHEOSTAT — With switch, wire wound single section 1500 ohms; S.P.S.T. switch on back; shaft ⅜″ long with one 9/16″ nut and lockwasher.	OFF-MEASURE control and switch.	CRL W-130	M-209
R8		RHEOSTAT — Wire wound single section 50 ohms; shaft ⅜″ long with one 9/16″ nut and lockwasher.	Vernier control.	CRL V-116	M-210
SW2		SWITCH — Rotary D.P.D.T., non-shorting contacts; one section; bakelite insulation.	NORMAL-REVERSE switch.	CRL 1462	M-211
SW3		SWITCH — Rotary S.P.D.T.; spring return, non-shorting contacts; bakelite insulation.	NORMAL ZERO-SET switch.	CRL 1463	M-212

SECTION VII

TABLE OF REPLACEABLE PARTS (Continued)

MODEL - TS-15A/AP

Reference Symbol	Army Stock Number Navy Stock Number British Stock Number	Name of Part and Description	Function	Mfr. and Design or AWS Type	Cont. or Govt. Dwg. or Spec. No.
SW4		SWITCH — Rotary selector; single pole three position; non-shorting contacts; bakelite insulation.	A/B/C Selector Switch.	CRL 1461	M-213
		KNOB — Bakelite 2-1/16" diameter; brass insert for ¼" shaft; ⅜" long; spec. countersunk recess on underside.	OFF-MEASURE control knob.		M-214
		KNOB — Bakelite pointer type for ¼" shaft ⅜" long.	Knob for R8, SW2, SW3, SW4.	ICA 1125	M-215
R1		RESISTOR — Precision wire wound (manganin) 75 ohm ±.1%; ceramic bobbin ½" x 7/16"; mounting through center with 2-56 screw. Normalized and triple impregnated for fungus resistance.	Swamping resistance.	MARION	M-216
R2, R3		RESISTOR — Precision wire wound (manganin) 200 ohm ±.1%; ceramic bobbin ½" x 7/16"; mounting through center with 2-56 screw. Normalized and triple impregnated for fungus resistance.	Gauss meter zero set resistors.	MARION	M-217
R4		RESISTOR — Precision wire wound (manganin) 100 ohm ±.1%; ceramic bobbin ½" x 7/16"; mounting through center with 2-56 screw. Normalized and triple impregnated for fungus resistance.	"A" range shunt.	MARION	M-218
R5		RESISTOR — Precision wire wound (manganin) 300 ohm ±.1%; ceramic bobbin ½" x 7/16"; mounting through center with 2-56 screw. Normalized and triple impregnated for fungus resistance.	"B" range shunt.	MARION	M-219

SECTION VIII

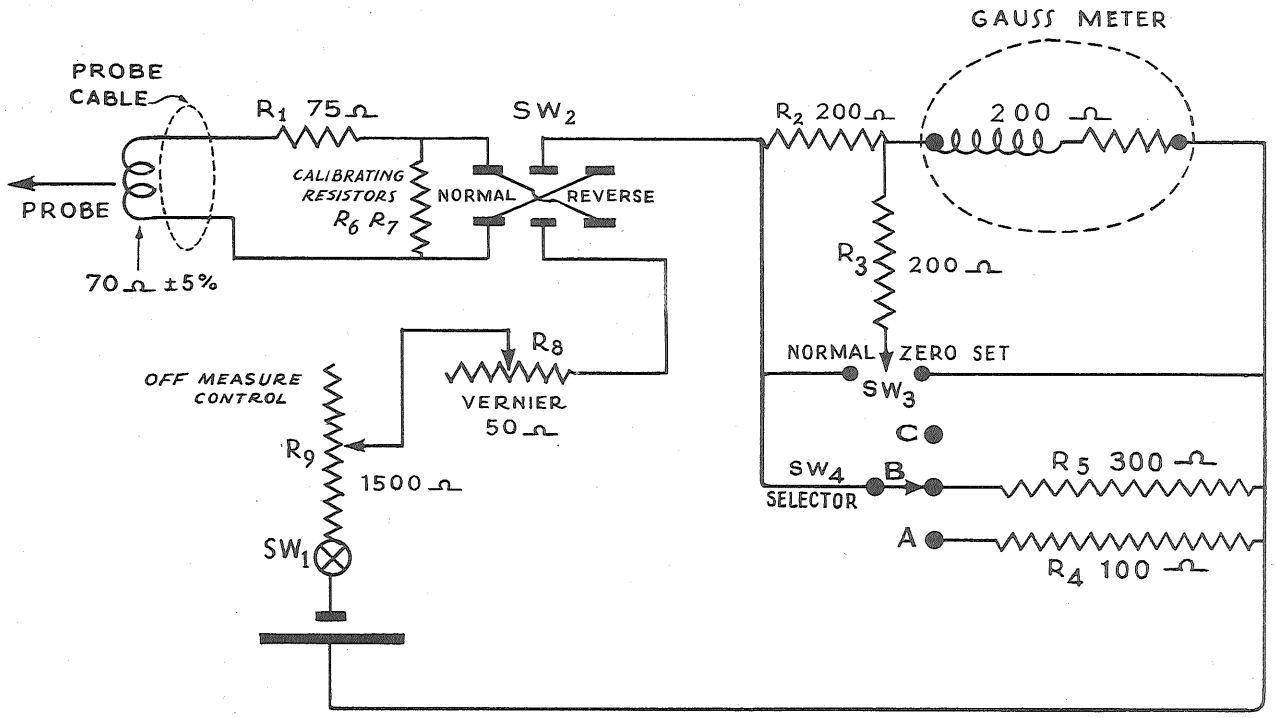

Figure 5 — Schematic Diagram