

Folks,

*Transmitter Servicing Course 503/4*, 1945, is a training manual that focuses on WW II naval transmitters TAJ, TBK, TBL, TDE and TBS.

Thank you Rob Flory for providing a scan of the manual.

In this online version of the manual we have attempted to keep the flavor of the original layout while taking advantage of the Web's universal accessibility. Different browsers and fonts will cause the text to move, but the text will remain roughly where it is in the original manual. In addition to errors we have attempted to preserve from the original, this text was captured by a combination of optical character recognition and human typist. Each method creates errors that are compounded while encoding for the Web. Please report any typos, or particularly annoying layout issues with the [Mail Feedback Form](#) for correction.

Richard Pekelney  
Webmaster



### *Notes on TBS*

1. K101 is energized all except on MCW  
Contacts open when energized
2. K102 energized only MCW
3. K101 & K102 never energized at same time
4. K104 & K103 Contacts B+ to all stages except audio sec.
- 5 K104 must be energized to energize K103

TRANSMITTER SERVICING  
COURSE 503/4  
  
NAVAL TRAINING SCHOOL  
(RADIO MATERIAL)  
  
TREASURE ISLAND  
SAN FRANCISCO, CALIFORNIA

MAY 1945

---

1

**COURSE 503114**

**TRANSMITTER SERVICING**

The transmitters covered in this book are communication type, for transmitting CW, MCW and PHONE signals.

**INSTRUCTION BOOKS**

1. **PURPOSE:** To provide information for installing, operating, maintaining and servicing specific equipment.

2. **GENERAL CONTENTS:**

- (a) Safety precautions.
- (b) Introduction to equipment.
- (c) Manufacturers' guarantee.
- (d) Description of equipment.
- (e) Installation.
- (f) Operation.
- (g) Maintenance.
- (h) List of major units.
- (i) Spare parts list.
- (j) Diagrams and illustrations.

3. **WHERE TO OBTAIN:** Two instruction books should accompany each equipment. If not packed with the equipment, the books may be mailed to the Commanding Officer. Ask for them through the Communications or Security Officer.

4. **USE OF INSTRUCTION BOOKS:**

- (a) As study material from which the technician can make his own servicing block and simplified schematic diagrams.
- (b) As a guide in setting up a regular maintenance schedule.
- (c) As a reference during installation and servicing.

5. **TYPICAL TEST DATA:** Usually two copies of typical test data are furnished with each set of instruction books- This data is compiled from extensive performance tests and measurements taken at the factory, and is a reliable guide to normal operation of the equipment. Typical test data includes:

- (a) Frequency tests.
- (b) Control circuit tests.
- (c) Power output tests,
- (d) Emission tests.
- (e) Vibration and shock tests.
- (f) Voltage and current measurements.

As many as possible of these tests should be duplicated with the ship's own test equipment after the installation is complete and is working properly. A permanent record of such tests should be kept in the equipment log.

---

TRANSMITTER SERVICING

RADIO EQUIPMENT LOG BOOK

1. **PURPOSE:** The new log furnished by the Bureau of Ships is a permanently bound book of 335 pages, designed to record a complete history of all equipment in an average radio room for two years. The log book replaces the Communication Equipment Index and Communication Equipment History card files.



Fig. 1 Front Cover and Contents of Radio Equipment Log Book.

2. **WHERE TO OBTAIN:** The log book has been distributed to all ships and stations on the basis of one for each radio space. More copies may be obtained from Radio Materiel Officers or from the Bureau of Ships.

3. **USE:** The blank forms in the log book are designed to cover all routine inspections and tests required by Chapter 67 of the Bureau of Ships Manual (formerly Chapter 31 of the Manual of Engineering Instructions). Special inspections and tests required by individual equipments, outlined in the manufacturers' instruction books, should be added to the log. Official modifications and improvements announced in al Ships Communication Equipment Maintenance Bulletins (CEMB) are to be made and logged without further notification.

A Sonar Equipment Log book has been issued, and a Radar Equipment Log book will be issued for similar use with Sonar and Radar equipment. The counterparts of the Communication Equipment Maintenance Bulletins (CEMB) are: Sonar Maintenance Bulletins (SMB) and Radar Maintenance Bulletins (RMB).

RECORDS AND REPORTS

**CALIBRATION CHARTS:** A calibration chart similar to the one in Fig. 2 is mounted on the front panel of each transmitter to provide, for immediate reference, all tuning dial settings for several of the most important frequencies used. Additional charts are included in the Radio Equipment Log Book for recording dial settings of many more frequencies. The original dial settings are Obtained by first tuning the transmitter very carefully to each desired frequency. Repeat settings then may be made from the charted readings without checking with a frequency meter and instruction book tuning curves. Charted readings should be checked and corrected where necessary after any replacement of tubes or parts, any severe shock, changes in antenna characteristics, etc.

CALIBRATION CHART													
TBM-7 TRANSMITTER: SERIAL NO. 50													
FREQUENCY KILOCYCLES	M.O. FREQ. KILOCYCLES	INSERT CONTROL LETTER DESIGNATIONS IN THESE COLUMNS											
		A	B	C	D	E	F	G	H	J	K	L	
2099	2099	1	2456	18.8	35	1112	1312	CUR.	1814	31	2775	2000-4000	
3550	3550	6	2892	68	85	686	712	CUR.	1619	58	933	2000-4000	
4350	4350	8	2756	83	35	568	595	VOLT.	1622	30	15	4000-18,100	
6100	3050	5	3489	67	74	1109	1089	VOLT.	334	51	1356	4000-18,100	
9525	2381.25	2	3928	22	36	980	988	VOLT.	738	88	1122	4000-18,100	
10272	2568	3	2407	39	56	1056	1065	VOLT.	606	51	1249	4000-18,100	
14200	3550	6	3065	72	85	64	1245	CUR.	1167	73	1041	4000-18,100	

Fig. 2 Typical Calibration Chart for front panel of transmitter.

**VACUUM TUBE SERVICE RECORDS:** A vacuum tube service record such as the one shown in Fig. 3 must be kept for at least each Service Life Guaranteed tube, each special Radar tube, and each transmitting tube of the class of types 849, 851, 861 and larger. These cards then provide the necessary information for filling out the official report of vacuum tube failure on the new FAILURE REPORT - ELECTRONIC EQUIPMENT, revised 3-45, shown in Fig. 4.

Navy Type <b>CWL-861</b>	Serial No. <b>41364</b>	Date Received <b>10-9-44</b>	Received From <b>NYD MARE IS.</b>	Date Initial Service <b>1-26-45</b>	Capacity Card No. <b>NONE</b>		
VACUUM TUBE SERVICE RECORD (RESTRICTED)							
U.S.S. <b>RMS, T.I.</b>							
USE ONE LINE FOR INITIAL TEST ON RECEIPT, FOR EACH QUARTERLY TEST WHEN TUBE IS NOT IN USE, AND FOR MONTHLY RECORD WHEN IN USE.							
Date	Location Transmitter	Bucket	Motor Reading	Month Hours	Total Hours	REMARKS	Entry By
10-9-44	TBM-7 PA	67	0	0	0	INITIAL TEST OK. STORED	JA
1-2-45	TBM-7 PA	240	0	0	0	QUARTERLY TEST OK. "	JA
1-26-45	TBM-7 PA	273	0	0	0	INSTALLED FOR SERVICE.	JA
2-25-45	TBM-7 PA	325	52	52	52	MONTHLY TEST OK.	KR
4-25-45	TBM-7 PA	372	47	99		" " "	KR
5-25-45	TBM-7 PA	428	56	155		" " "	JA
6-25-45	TBM-7 PA	513	54	240		" " "	JA
7-25-45	TBM-7 PA	561	48	288		" " "	JA
8-10-45	TBM-7 PA	587	26	314		OPEN FILAMENT, REPLACED WITH CWL-861 SERIAL 45026. DEFECTIVE TUBE RETURNED TO NYD, MARE IS.	EDB

Fig. 3 Sample Vacuum Tube Service Record Card.

TRANSMITTER SERVICING

Front, as used for reporting vacuum tube failures.

FAILURE REPORT—ELECTRONIC EQUIPMENT

NAVSHIPS (NRS) 381 (REV. 3-45)

FORMERLY NAVSHIPS (NRS) 381 AND NAVSHIPS (NRS) 380

SHIP NUMBER AND NAME OR STATION

RMS, TREASURE ISLAND, CALIF.

NAME OF PERSON MAKING REPORT

C. E. Bloom, CRT

DATE

8-10-45

CHECK ONE:

☒ RADIO

☐ RADAR

☐ SONAR

☐ OTHER

EQUIPMENT MODEL DESIGNATION

TBM-7

SERIAL NO. OF EQUIPMENT

50

NAME OF CONTRACTOR

WESTINGHOUSE

CONTRACT NO.

80646

TYPE NUMBER AND NAME OF MAJOR EQUIPMENT INVOLVED

CAY-52218 TRANSMITTER UNIT

SERIAL NO. OF UNIT

50

DATE EQUIPMENT INSTALLED

7-15-44

THIS SIDE FOR TUBES

TUBE TYPE, INCLUDING PREFIX LETTERS

CWL-861

TUBE MANUFACTURER

WESTINGHOUSE

FAILURE OCCURRED IN:

☐ STORAGE

☒ OPERATION

☐ HANDLING

☐ OTHER (SPECIFY)

☐ INSTALLING

GUARANTEED HOURS (NOTE 7)

1000

ACTUAL HOURS

314

TYPE OF FAILURE (NOTE 8)

3

DATE OF ACCEPTANCE (NOTE 7)

7-17-44

DATE OF FAILURE

8-10-45

TUBE CIRCUIT SYMBOL

V-T-4

THIS SIDE FOR COMPONENTS

NAME OF PART

CIRCUIT SYMBOL (e.g. R10)

NAVY TYPE, STOCK, OR MFR. S. NO.

BRIEF DESCRIPTION AND CAUSE OF FAILURE INCLUDING APPROXIMATE LIFE:

OPEN FILAMENT. RETURNED TO NYD, MARE IS.

(Do not delay submitting this form—Insert in envelope—Seal—Mail)

CONTINUE REMARKS ON REVERSE SIDE

Back, containing complete instructions.



REMARKS (Continued)

1. This form supersedes previous versions of Navy Forms NBS 304 and 383. Previous instructions pertaining to the preparation and submission of these report forms are being amended to conform to current procedures.
2. This simplified report form shall be used to report immediately **all failures** (whatever the cause) of electronic equipment parts (tubes and components) to Bureau of Ships, Code 950, Washington 25, D. C. No copies are required; fill in with TYPEWRITER, PEN, or PENCIL.
3. The purpose of this report is to indicate the cause and rate of failures; it will form the basis for improvements in design, and for contractual adjustment, should the latter action be in order. Adjustments of contractual matters will be made between authorized representatives of the Bureau and the contractor.
4. If **CONFIDENTIAL** information is included in this report, mark in accordance with **SECURITY REGULATIONS**. **TYPE** and **MODEL DESIGNATIONS** are **NOT** confidential.
5. This report is **NOT** a requisition; replacements must be ordered from your Tender, Supply Depot, Supply Officer, or Radio Material Officer.
6. Select appropriate **NUMBER** from table below to describe **TYPE OF FAILURE**. (This procedure will permit failure analysis by IB machines.)
  - (1) Broken by physical cause, e. g., shell hit, dropped.
  - (2) Failed due to shock, e. g., electrical failure or mechanical failure due to shell explosion or to gunfire shock.
  - (3) Internal electrical failure, e. g., low output, poor focus, open filament, noise.
  - (4) Failure due to overload, e. g., short due to failed resistor, capacitor, or other similar component.
7. The contract number and number of hours guaranteed are stamped on the body or base of guaranteed tubes. The date of acceptance by the Government inspector can be obtained from the carton, when it does not appear on a form accompanying the tube, and should be reported if available. Nonguaranteed tubes are not marked as above; hence this data need not be supplied.
8. **DISPOSITION OF MATERIAL**—All components or tubes failing should be disposed of in accordance with existing Salvage and Security Regulations. (No items need be retained for official survey, disposition instructions or return to supplier.) In the case of excessive failures of any particular item, special action will be taken by the Bureau for collection and return of samples for examination.

U. S. GOVERNMENT PRINTING OFFICE 16-43921-1

FAILURE REPORT—ELECTRONIC EQUIPMENT

NAVSHIPS (NBS) 383 (REV. 3-45)  
(FORMERLY NAVSHIPS (NBS) 383 AND NAVSHIPS (NBS) 342)

SHIP NUMBER AND NAME OR STATION

RMS, TREASURE ISLAND, CALIF.

NOTICE—Read notes on reverse side. Additional forms and envelopes may be obtained from nearest BMO.

DATE 8-14-45

NAME OF PERSON MAKING REPORT

JOHN J. DOE, RT 3/4

ELECTRONIC EQUIPMENT INVOLVED

CHECK ONE: ☒ RADIO

☐ RADAR

☐ SONAR

☐ OTHER

(SPECIFY)

EQUIPMENT MODEL DESIGNATION

TBM-7

SERIAL NO. OF EQUIPMENT

50

NAME OF CONTRACTOR

WESTINGHOUSE

CONTRACT NO.

80646

TYPE NUMBER AND NAME OF MAJOR EQUIPMENT INVOLVED

CAY-52218 TRANSMITTER UNIT

SERIAL NO. OF UNIT

50

DATE EQUIPMENT INSTALLED

7-15-44

ITEM WHICH FAILED

THIS SIDE FOR TUBES

TUBE TYPE, INCLUDING PREFIX LETTERS

SERIAL NO.

TUBE MANUFACTURER

CONTRACT NO. (NOTE 7)

FAILURE OCCURRED IN:

☐ STORAGE ☐ OPERATION

☐ HANDLING ☐ OTHER (SPECIFY)

☐ INSTALLING

GUARANTEED HOURS (NOTE 7)

ACTUAL HOURS

TYPE OF FAILURE (NOTE 6)

DATE OF ACCEPTANCE (NOTE 7)

DATE OF FAILURE

TUBE CIRCUIT SYMBOL V-

NATURE OF FAILURE AND REMARKS (NOTE 8):

THIS SIDE FOR COMPONENTS

NAME OF PART

KEYING CIRCUIT

CIRCUIT SYMBOL (e.g. R10)

R-30 63067E

NAVY TYPE, STOCK, OR MFR. S. NO.

BRIEF DESCRIPTION AND CAUSE OF FAILURE INCLUDING APPROXIMATE LIFE:

RESISTOR OPEN

LIFE ABOUT 600 HOURS

(Do not delay submitting this form—Insert in envelope—Seal—Mail)  
CONTINUE REMARKS ON REVERSE SIDE

16-43921-1

Fig. 4 Sample FAILURE REPORT - ELECTRONIC EQUIPMENT, Navships (NBS) 383 (REV. 3-45).

## MOTOR-GENERATOR SERVICING

- (a) Never clean commutators or work on a machine while it is running.
- (b) Use only fine sandpaper to smooth commutators; never use emery cloth or other conducting abrasives.
- (c) Keep both the interior and exterior of Machines, panels and control boxes clean.
- (d) Keep all electrical connections tight.
- (e) Inspect machines during each watch. If any unit is not operating properly it should be shut down and the defect remedied.
- (f) Keep protective devices such as circuit breakers, fuses and inter-locks in working order and operating at their proper settings. .
- (g) After an overhaul, never start a machine until a careful inspection has been made for loose bolts, tools, broken insulation, metallic dust or chips, improper clearance, loose or improper connections, and lubrication.
- (h) When a motor or generator bearing overheats, flush it with new lubricant and cool it before the machine is stopped, to avoid freezing the bearing to the journal.

2. **VISUAL INSPECTIONS:** Many defects can be discovered quickly without making extensive tests or electrical measurements.

3. **TESTING FOR LEAKY INSULATION AND GROUNDED COILS:**

- (a) Remove brushes and other connections from field coil leads to avoid parallel circuits in testing.
- (b) Make insulation tests as shown in Fig. 5, using a megger or a high range Ohmmeter.
- (c) Normal reading should be several megohms.
- (d) Absorbed moisture may cause the insulation resistance to be as low as one megohm. Dry thoroughly by plow heating or baking.
- (e) A reading of less than one megohm indicates defective insulation. Isolate the defective coil or commutator bar by testing each one individually.

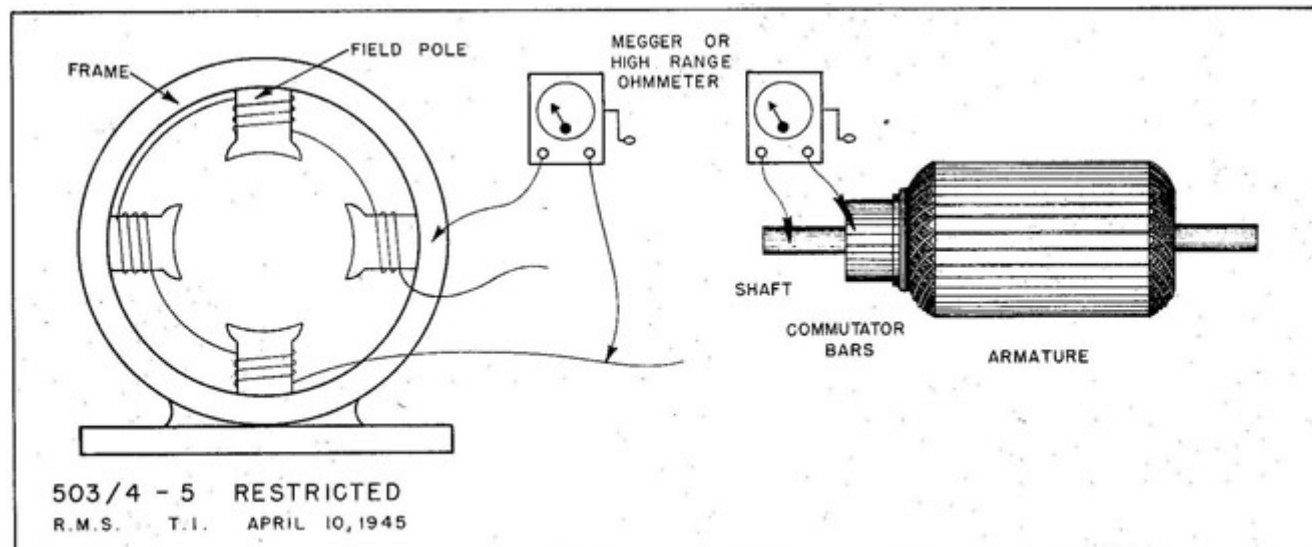


Fig. 5 Testing for leaky insulation and grounded coils.

**TRANSMITTER SERVICING**

4. **ARMATURE AND FIELD COIL FAILURES:**

- (a) Mechanical defects may be worn bearings, loose or sagged windings, exposed mica segments or otherwise rough, uneven commutators.
- (b) Electrical defects may be open coils or connections, shorted coils, or grounded coils.

5. **TESTING FOR OPEN OR SHORTED FIELD COILS:**

- (a) Remove brushes and other connections from field coil leads to avoid parallel circuits in testing.
- (b) Test with an ohmmeter as shown in Fig. 6.
- (c) No continuity indicates an open coil. Isolate the defective coil by testing each coil individually.
- (d) Continuity, even with approximately correct resistance, for all coils in series does not eliminate the possibility of a shorted coil. Test each coil individually. One reading appreciably less than the others indicates a shorted or partially shorted coil. Visual inspection usually reveals signs of overheating.
- (e) Spare field coils are often supplied With the equipment, and may be installed by the technician without special tools.

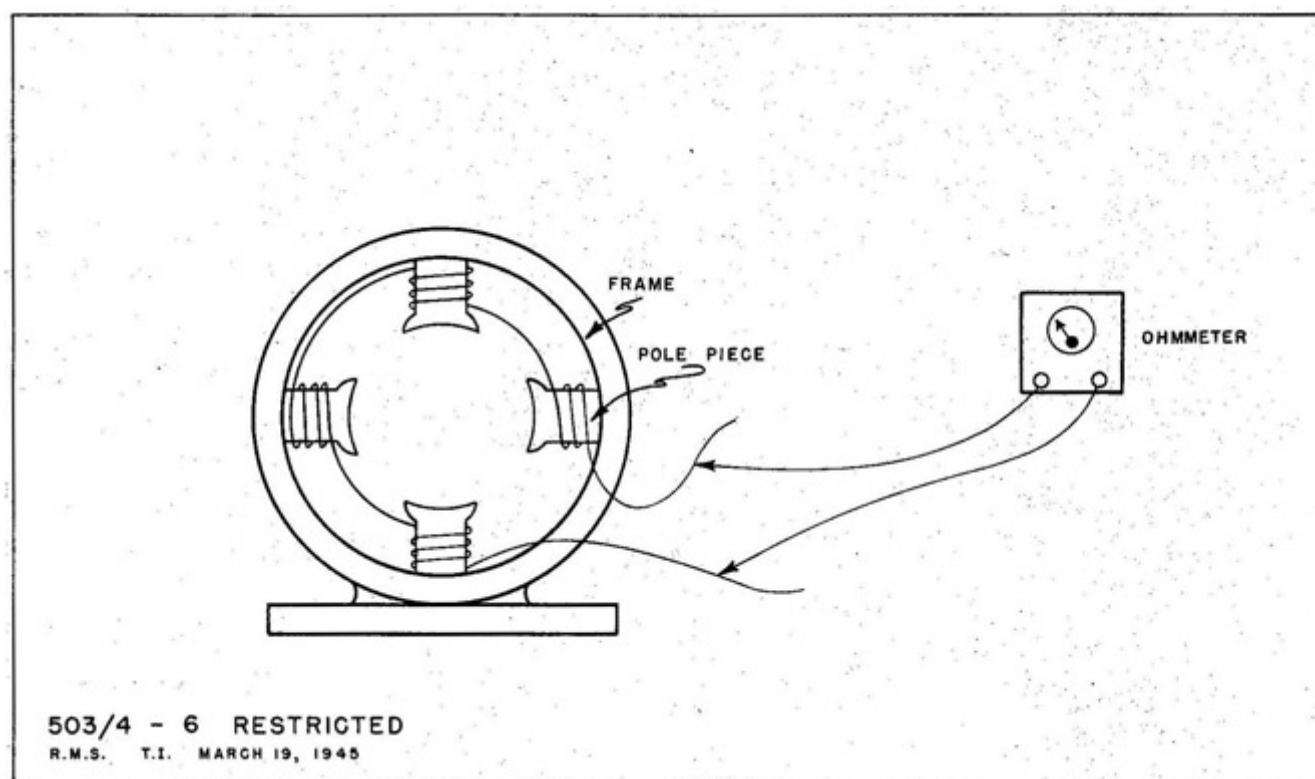


Fig. 6 Testing for open or shorted field coils.

## MOTOR-GENERATOR SERVICING

### 6. TESTING FOR OPEN OR SHORTED ARMATURE COILS:

- (a) Lift all but one set of brushes free of the commutator.
- (b) Apply DC through a current limiting lamp as shown in Fig. 7. The test current divides into two parallel paths, one through coils A, B and C; the other through coils E, F, G, H, I, J, K, L and M (coil D in Fig. 7 is shorted by the negative brush).
- (c) The test meter should be a milliammeter with a range appropriate for the test current.
- (d) All bar to bar measurements between adjacent commutator bars in the current path including coils E to M should give practically identical readings. To obtain similar readings on coils A to D, rotate the armature to bring these coils into the same current path.
  - (1) An open coil causes a high reading across that coil, but zero across all others in the same current path
  - (2) A short in a coil or between commutator bars causes a low or zero reading across the defect, and slightly higher than normal readings across all other test points in the same current path.
- (e) If the resistance of individual armature coils is high enough to give satisfactory readings on an ohmmeter, similar bar to bar measurements may be made without an external source of DC
- (f) Armature repairs are difficult to make, and should be done by a repair ship or Navy yard shop if possible.

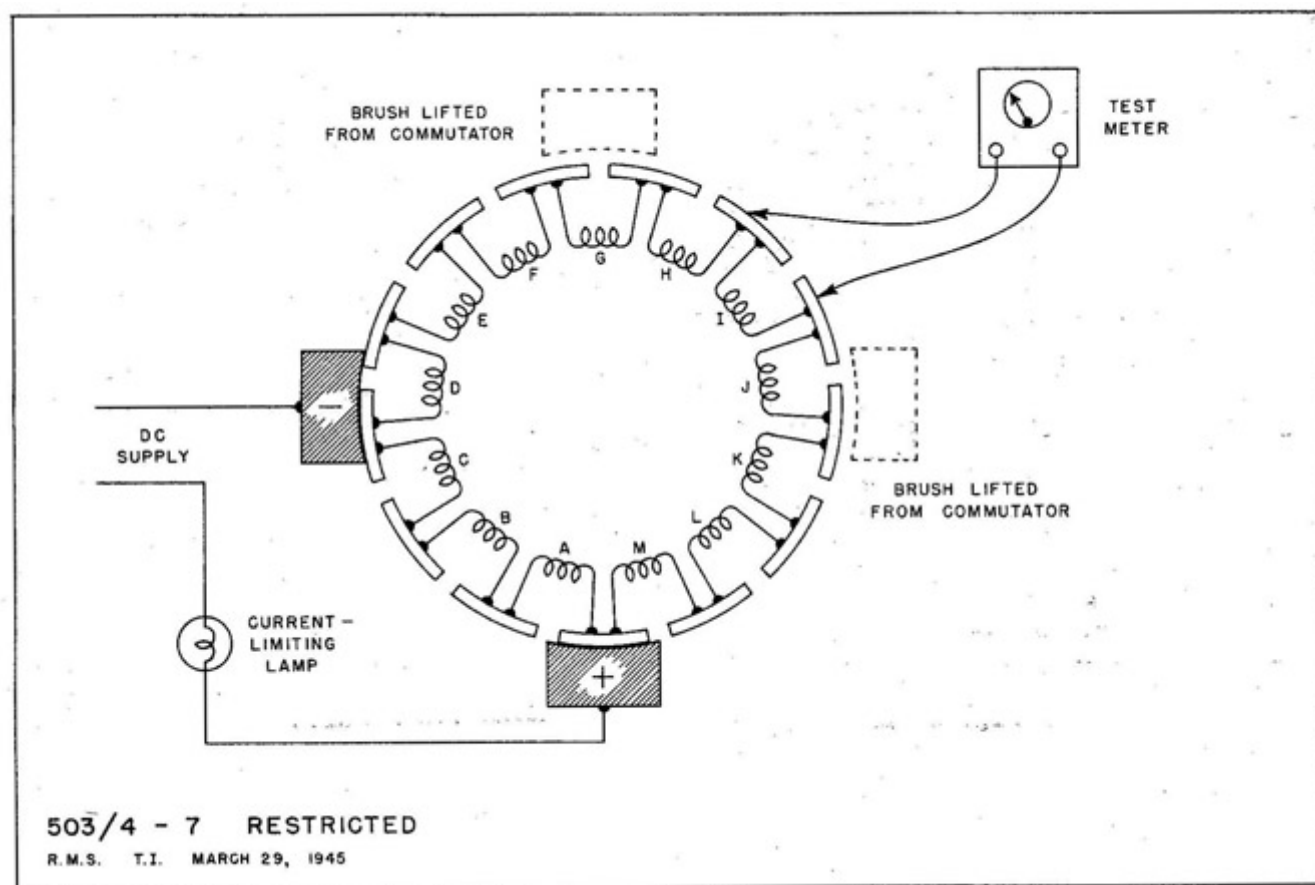


Fig. 7 Testing for open or shorted armature coils.



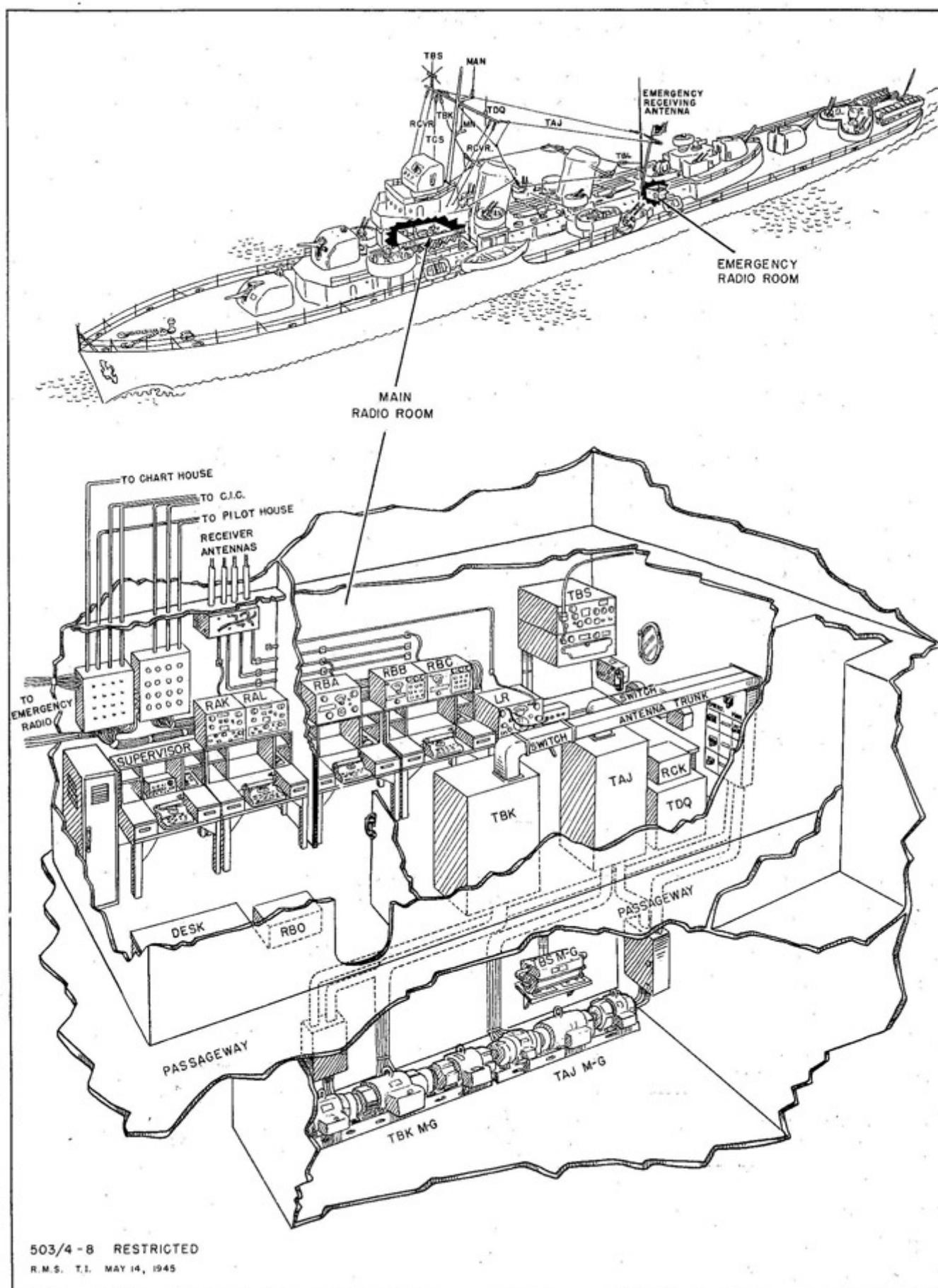


Fig. 8 A typical shipboard installation of communication transmitting equipment.

### A TYPICAL SHIPBOARD INSTALLATION OF COMMUNICATION TRANSMITTING EQUIPMENT

The installation described here is based on that of a large destroyer. The details of individual installations vary widely, especially in older ships where electronic equipment has outgrown the original construction plans. Therefore the following typical arrangement applies only in general.

	MAIN RADIO ROOM	EMERGENCY RADIO ROOM	CIC	PILOT HOUSE
TRANSMITTERS	TAJ TBK TBS TDQ	TBL with modulator and speech input eq.	TCS MN	MAN
RECEIVERS	TBS, RCK RBA-RBB-RBC RAK-RAL RBO	RAK-RAL	ICS MN RBH	MAN
REMOTE CONTROL	3 Navy STANDARD	1 Navy STANDARD	2 Navy STANDARD	1 Navy STANDARD

UNITS	1 TBS	1 TBL Phone	1 TBL phone 1 TBS 1 TDQ	1 TBL phone 1 TBS 1 TDQ, 1 MN
TRANSFER PANELS	Transmitter Receiver	Transmitter Receiver		
FREQUENCY METER	1 LR			

**MOTOR GENERATORS:** If the transmitter motor generators cannot be located as shown, they should be as near the transmitters as possible without being in the same room.

**POWER PANEL:** A changeover switch in the main radio room permits operation of all equipment from either the main generators or the emergency diesel power plant.

**ANTENNAS:** The large transmitting antennas enter the radio rooms through protective trunks, with an antenna disconnect and grounding switch at the transmitter end. The TBS, TDQ, MN and MAN antennas are mounted on the foremast and are connected to the transceivers with coaxial transmission line. Four receiving antennas, two port and two starboard, are suspended from the foremast yard arm. A 30-foot whip antenna serves the emergency radio receivers.

**TRANSFER PANELS:** Except for the small transceivers intended primarily for voice communication, all transmitters, receivers and Navy standard remote control units are wired to transfer panels. Patch cords may be plugged so any control unit can operate any transmitter, and any receiver output can be connected to any operating position.

## TRANSMITTER SERVICING

### NAVY STANDARD REMOTE CONTROL UNITS

1. **PURPOSE:** To start, key and stop transmitters from a remote operating position.

2. **4-WIRE SYSTEM:**

- (a) Toggle type start-stop switch.
- (b) One wire is common to start-stop and keying circuits.

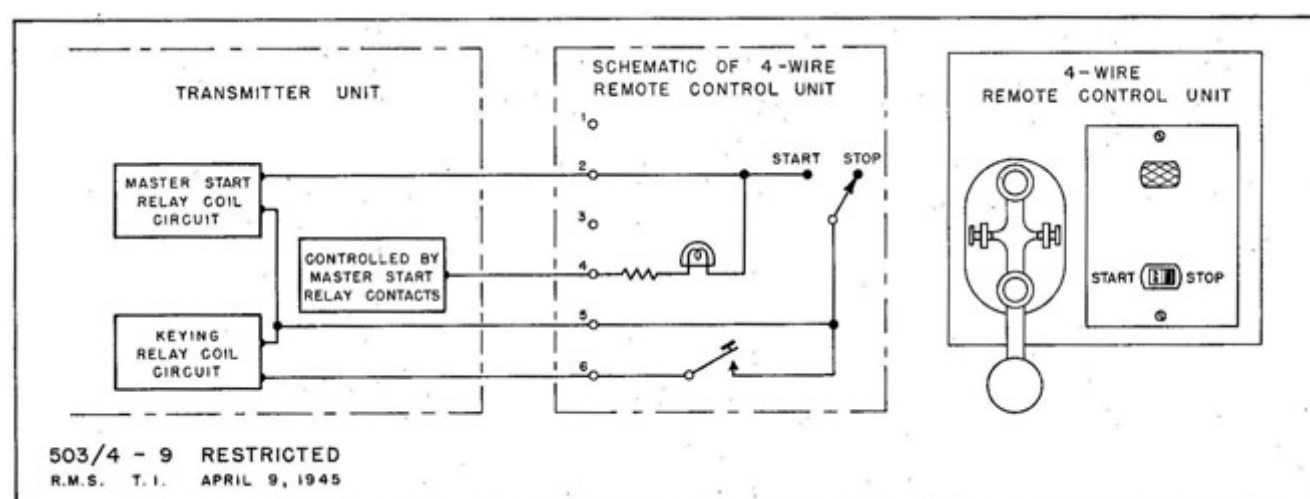


Fig. 9 Navy Standard 4-Wire Remote Control Unit.

3. **6-WIRE SYSTEM:**

- (a) Momentary push-button type start-stop switches.
- (b) Start-stop and keying circuits are isolated from each other.
- (c) Additional control units in parallel on same line provide complete control at any unit.

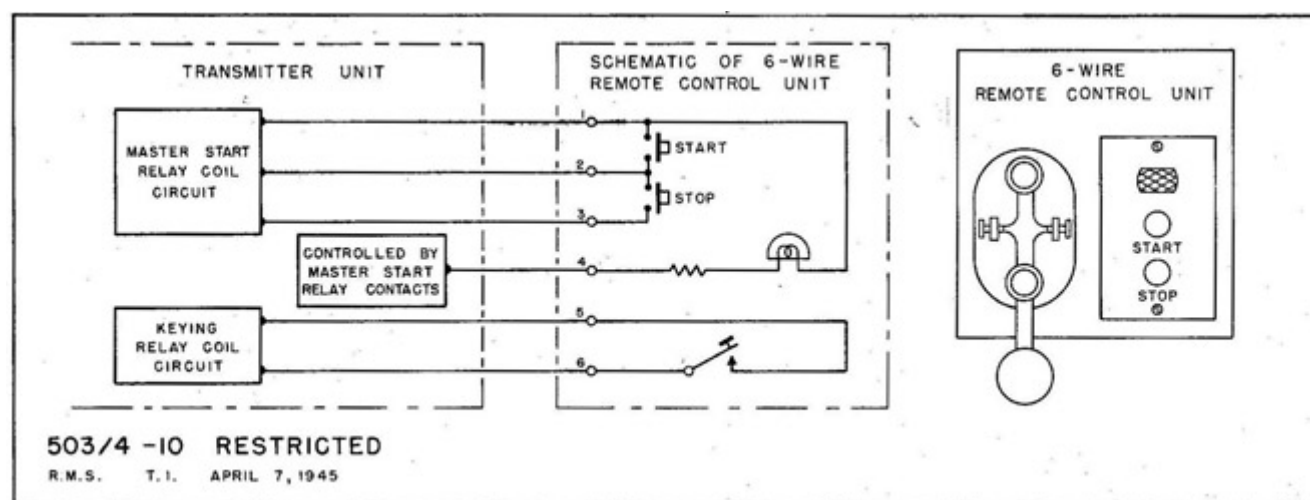


Fig. 10 Navy Standard 6-Wire Remote Control Unit.

4. **CONVERSION FROM ONE SYSTEM TO THE OTHER:** Any one ship uses either all 4-wire or all 6-wire controls. Transmitters may be converted by changing link connections according to the instruction book.

### TAJ-18 TRANSMITTER

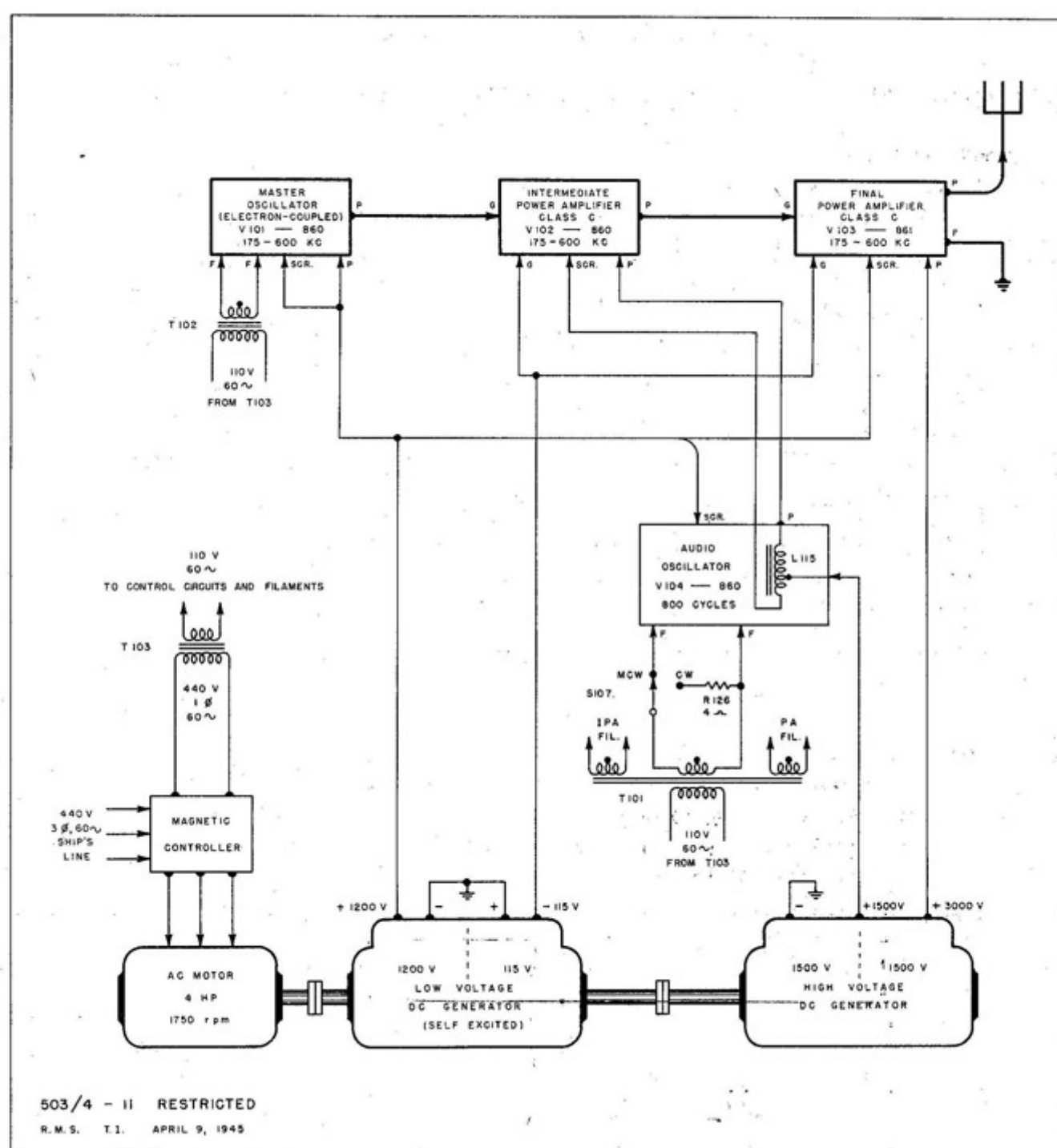


Fig. 11 TAJ-18 Transmitter (AC Model) Block Diagram.

1. **FREQUENCY RANGE:** 175 to 600 kilocycles.
2. **EMISSION:**
  - (a) A-1 or CW up to 100 words per minute.
  - (b) A-2 or MCW up to 50 words per minute.
3. **POWER OUTPUT:**
  - (a) 500 watts CW.

## TRANSMITTER SERVICING

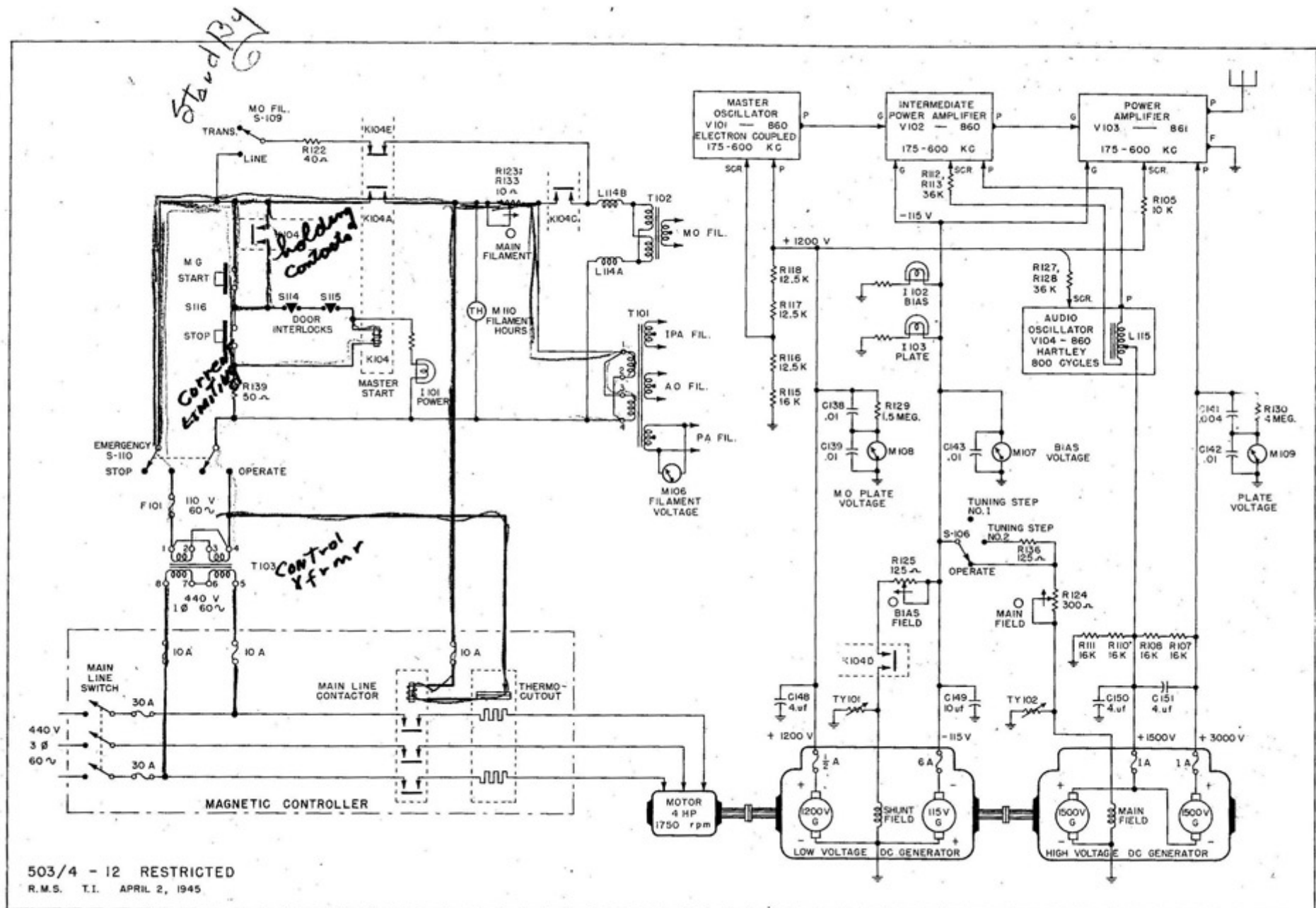


Fig. 12 TAJ-18 Transmitter (AC Model) Simplified Control and Power Circuits.

## TAJ-18 CONTROL AND POWER CIRCUITS

1. **PURPOSE:** To simplify starting and stopping the transmitter, and to convert the line supply to the types of power required by the transmitter.

2. **STARTING THE TRANSMITTER:**

- (a) When the main line switch is closed, 440 v 1 Φ AC is connected to the primary of the line transformer (T-103).
- (b) When the EMERGENCY switch (S-110) is closed, 110 v AC from the secondary of T-103 is available to the control circuits.
- (c) Press MG START button (S-116) to energize master start relay (K-104).
- (d) The holding contacts (K-104B) keep the master start relay energized after the START button is released.
- (e) The POWER indicator lamp (I-101) remains on as long as K-104 is energized.
- (f) The master start contacts K-104A energize the main line contactor, which closes the main line contacts to connect 440 v 3 Φ AC to the motor.

- (g) The motor drives both the LV and the HV DC generators.
- (h) The master start contacts K-104C energize the filament transformers (T-101 and T-102) from the line transformer (T-103).
- (i) The master start contacts K-104D allow the shunt field of the LV DC generator to be self-excited from the 115-v DC armature.

### **3. ADJUSTING THE TRANSMITTER SUPPLY VOLTAGES:**

- (a) Filament voltage should be adjusted with MAIN FILAMENT control (R-123; R-133) for 11 v on FILAMENT VOLTAGE meter (M-106). -
- (b) Bias voltage should be adjusted with BIAS FIELD control (R-125) for 115 v on BIAS VOLTAGE meter (M-107).
- (c) High plate voltage should be adjusted with MAIN FIELD control (R-124) for 3000 v on PLATE VOLT-AGE meter (M-109), with the TUNE-OPERATE switch (S-106) in OPERATE position.

### **4. STOPPING THE TRANSMITTER:**

- (a) Press MG STOP button (S-116) to de-energize master start relay (K-104).
- (b) The holding contacts (K-104B) open, to keep the master start relay de-energized.
- (c) Contacts K-104A de-energize the main line contactor, to disconnect the motor.
- (d) Contacts K-104C disconnect the filament transformers (T-101 and T-102).
- (e) Contacts K-104D disconnect the shunt field of the LV DC generator.

### **5. MASTER OSCILLATOR FILAMENT STANDBY:**

- (a) With MO FIL. standby switch (S-109) in TRANS. position, the MO filament is on only when the transmitter is on.
- (b) With S-109 in LINE position, the MO filament transformer (T-102) is energized through R-122 and the normally closed contacts K-104E while all other operating voltages are disconnected.



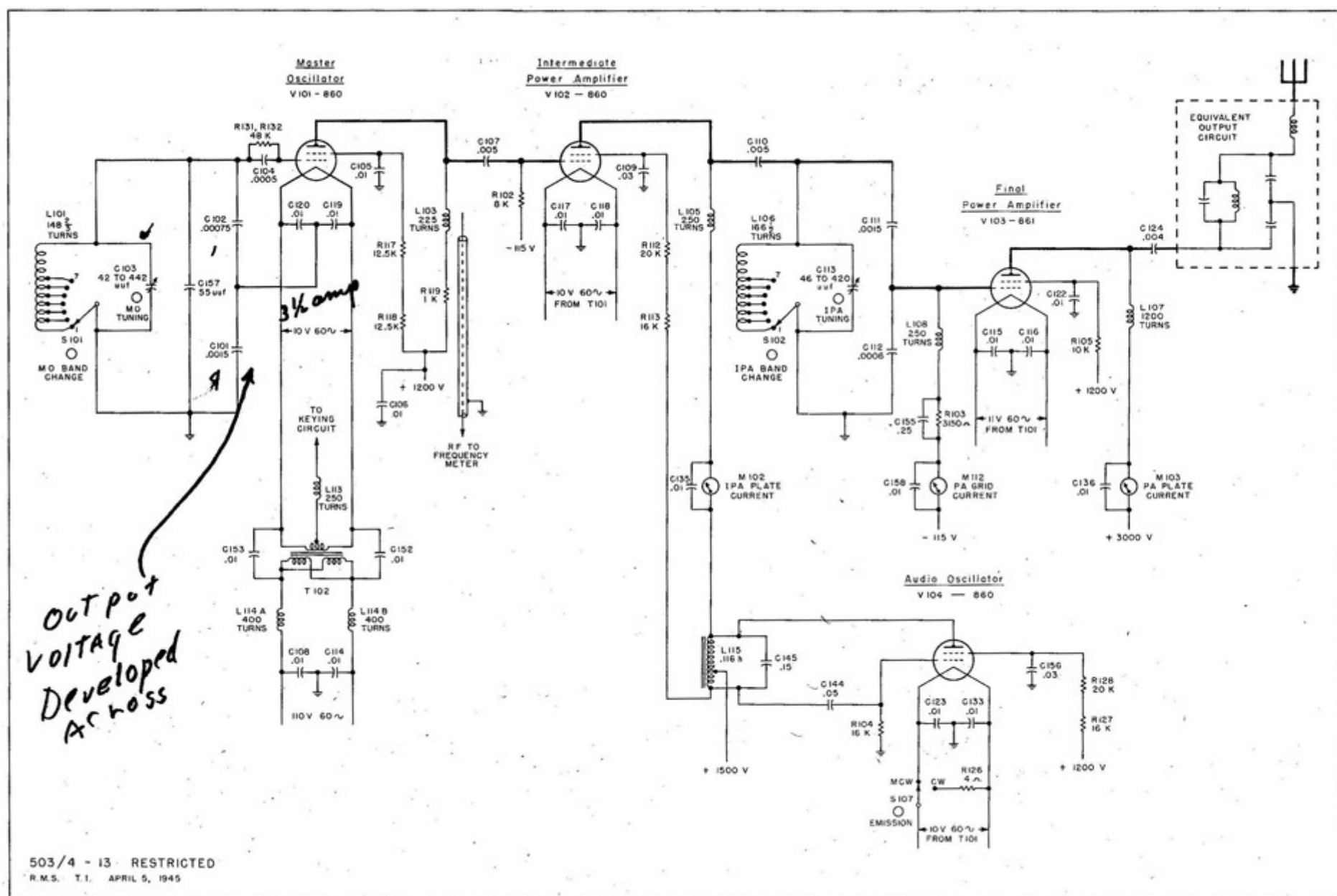


Fig. 13 TAJ-18 Transmitter RF and AF Circuits.

## TAJ-18 RF AND AF CIRCUITS

### RF STAGES (ALL CLASS C)

#### 1. MASTER OSCILLATOR (MO):

- Electron coupled type.
- Tuning range from 175 to 600 kilocycles.
  - Coarse tuning in 7 steps with MO BAND CHANGE switch (S-101).
  - Fine tuning with MO TUNING control (C-103).
- Frequency drift with changes in room temperature is compensated for by the negative temperature coefficient capacitor (C-157).
- The untuned plate circuit has a practically uniform frequency response over the entire 175 to 600 kc operating range.

#### 2. INTERMEDIATE POWER AMPLIFIER (IPA):

- Tuning range from 175 to 600 kilocycles.
  - Coarse tuning in seven steps with IPA, BAND CHANGE switch (S-102).
  - Fine tuning with IPA TUNING control (C-113).
- For MCW operation, the IPA is plate modulated by the AUDIO OSCILLATOR (V7104).

### 3. FINAL POWER AMPLIFIER (PA):

- (a) Tuning range from 175 to 600 kilocycles in the same manner as the IPA. The details omitted from the equivalent output circuit in Fig. 13 are shown in Fig. 14.
- (b) For MCW operation, the negative grid bias is held constant over the audio cycle by the AF bypass capacitor (C-155).

### AUDIO OSCILLATOR (AO)

- (a) Hartley type.
- (b) Frequency 800 cycles.
- (c) For CW operation, the EMISSION selector switch (S-107) turns off the AO filament and substitutes R-126.

16

### TRANSMITTER SERVICING

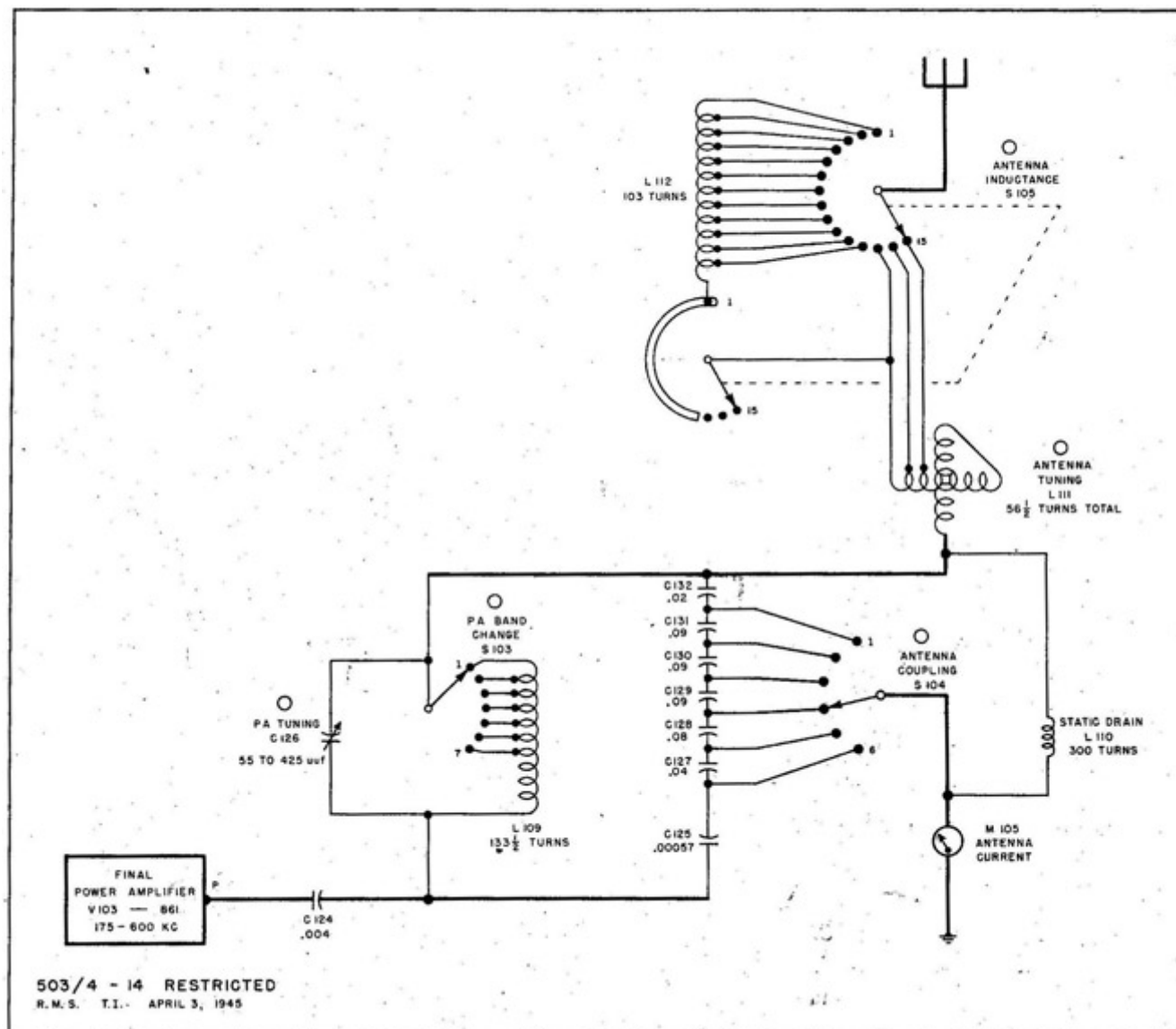


Fig. 14 TAJ-18 Transmitter Antenna Circuit.

1. **PURPOSE:** To match the impedance of the antenna to the impedance of the final RF power amplifier (V-103), and to tune the antenna to resonance.
2. **COUPLING:** The degree of coupling between the antenna and the transmitter is adjusted in 6 steps with ANTENNA, COUPLING control (S-104). The degree of coupling is maximum in position 6.
3. **TUNING:**
  - (a) The ANTENNA INDUCTANCE control (S-105) varies the amount of antenna loading in 15 steps.
  - (b) ANTENNA TUNING control (variometer L-111) is the vernier adjustment.
  - (c) Exact resonance at a quarter wavelength is indicated by a rise on ANTENNA CURRENT meter (M-105).



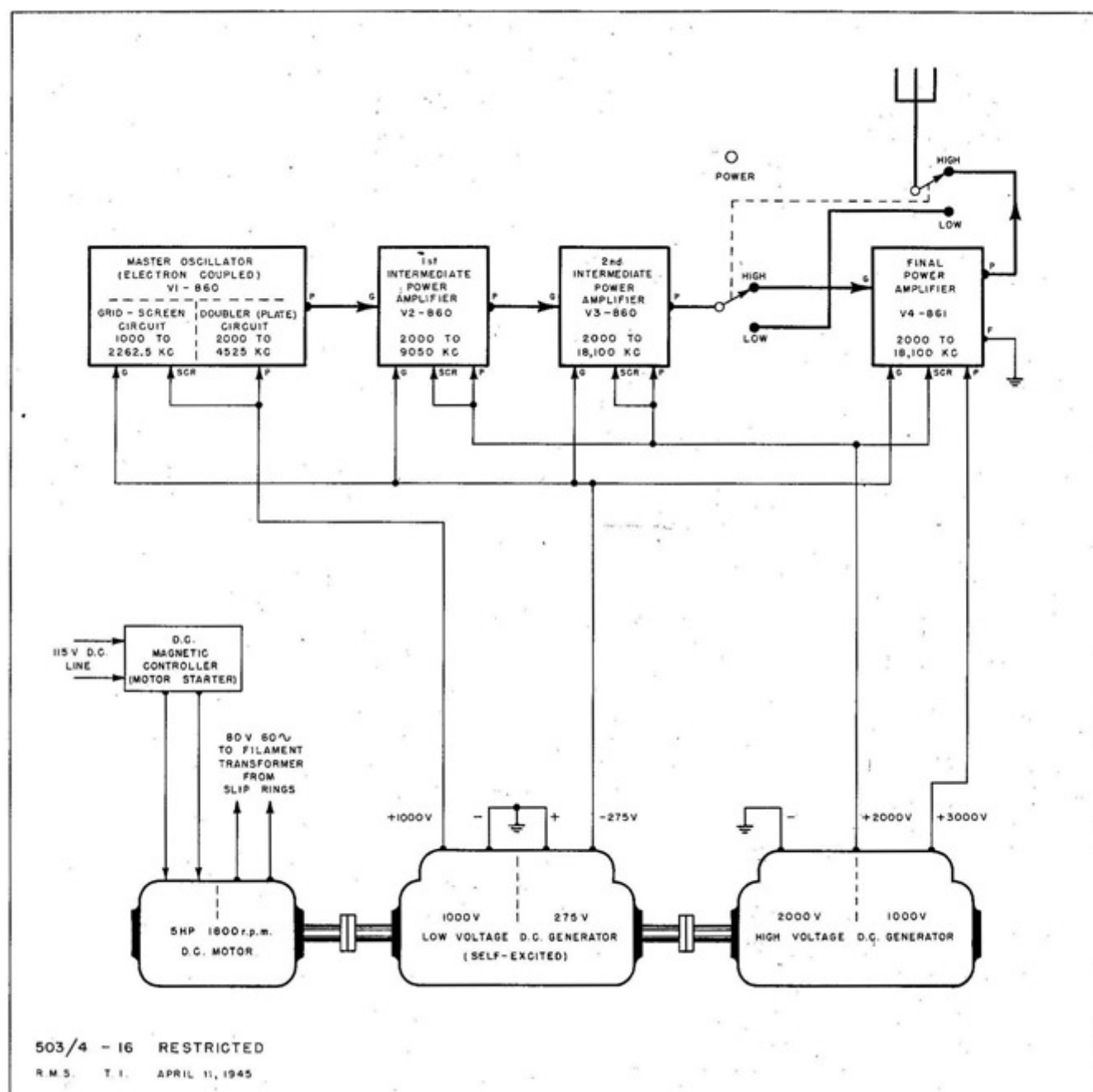


Fig. 16 TBK-13 Transmitter (DC Model) Block Diagram.

1. **FREQUENCY RANGE:** 2,000 to 18,100 kilocycles.
2. **EMISSION:** A-1 or CW only.
3. **POWER OUTPUT:**
  - (a) HIGH POWER 500 watts over the entire frequency range.
  - (b) LOW POWER 75 watts, using the 2nd IPA as the final power amplifier.  
Available only from 2,000 to 9,050 kc because doubling is not permissible in the final stage.

[Doc Home](#)   [Next Part](#)  
[Page](#)

## TBK-13 TRANSMITTER

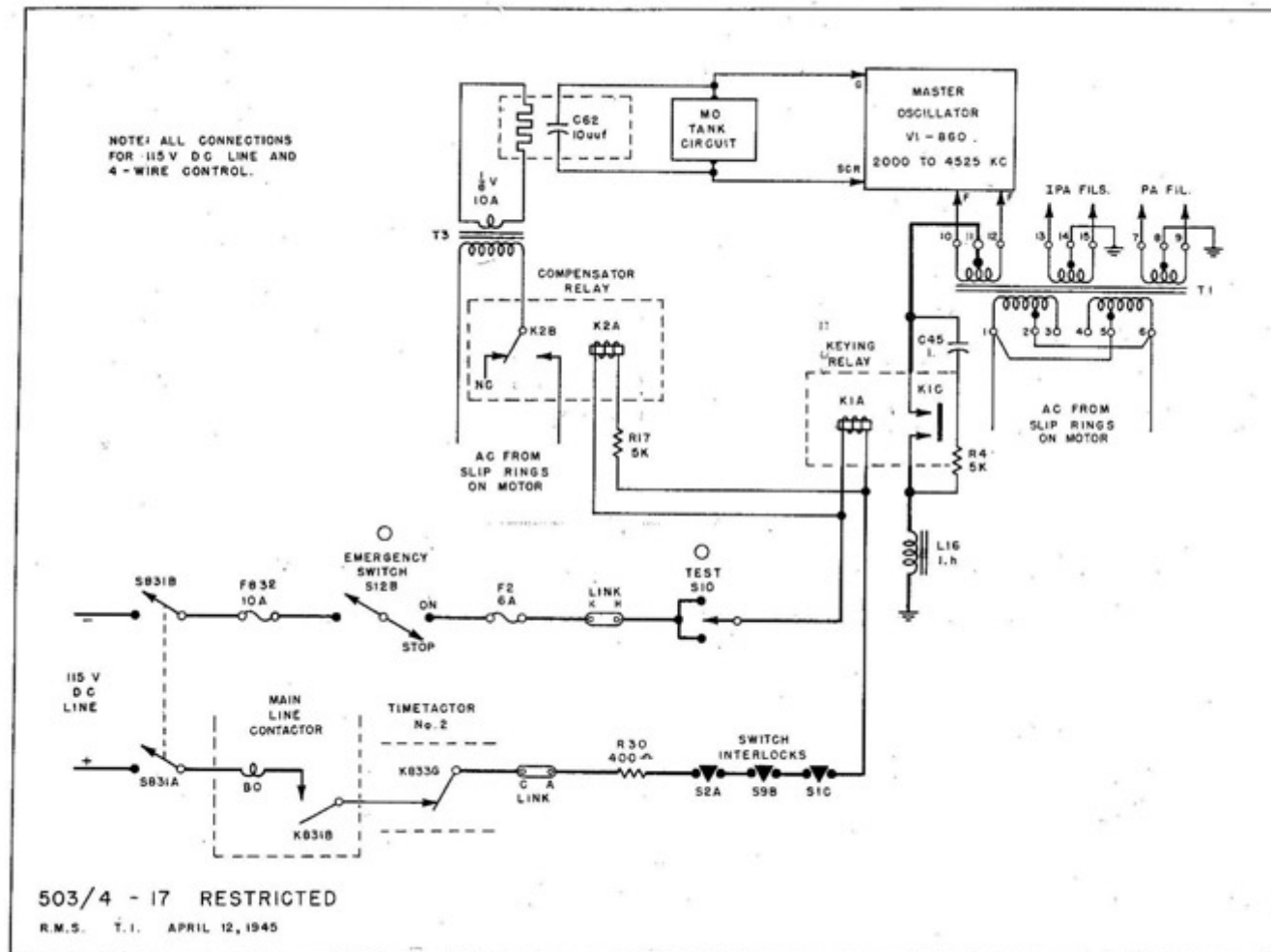


Fig. 17 TBK-13 Transmitter (DC Model) Keying Circuit.

### 1. GENERAL CIRCUIT CONDITIONS:

- All stages use protective fixed bias.
- Only the MO stage is keyed.
- With the equipment ready for operation, the main line switch (S-831), the EMERGENCY SWITCH (S-12) and the main line contactor contacts K-831B all are closed.

### 2. OPERATION:

- When the TEST key (S-10) is closed, the keying relay coil (K-1A) will be energized.
  - The keying relay main contacts (K-1C) ground the center tap of the MO filament secondary of T-1 to complete the DC return path to the filament and allow the MO to oscillate.
- The compensator relay coil (K-2A) in parallel with K-1A will also be energized whenever the TEST key (S-10) is closed.
  - Contacts K-2B connect the AC supply to the compensator transformer (T-3) to heat the compensating capacitor (C-62). This capacitor is a bi-metallic device which compensates for the changes in MD circuit capacity due to the expansion of tube elements under key-down conditions.
- When the key is open, both relays (K-1 and K-2) are de-energized.



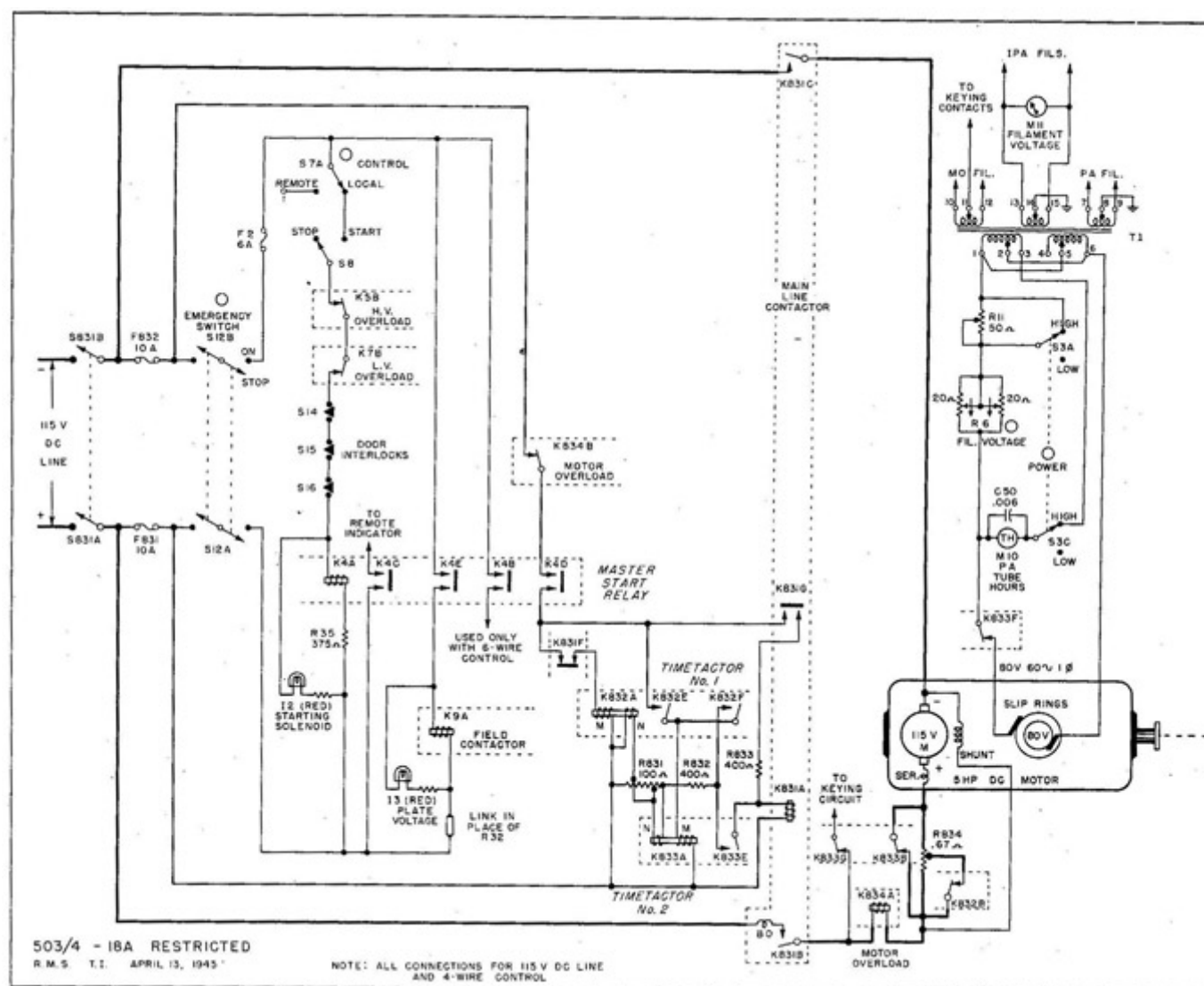
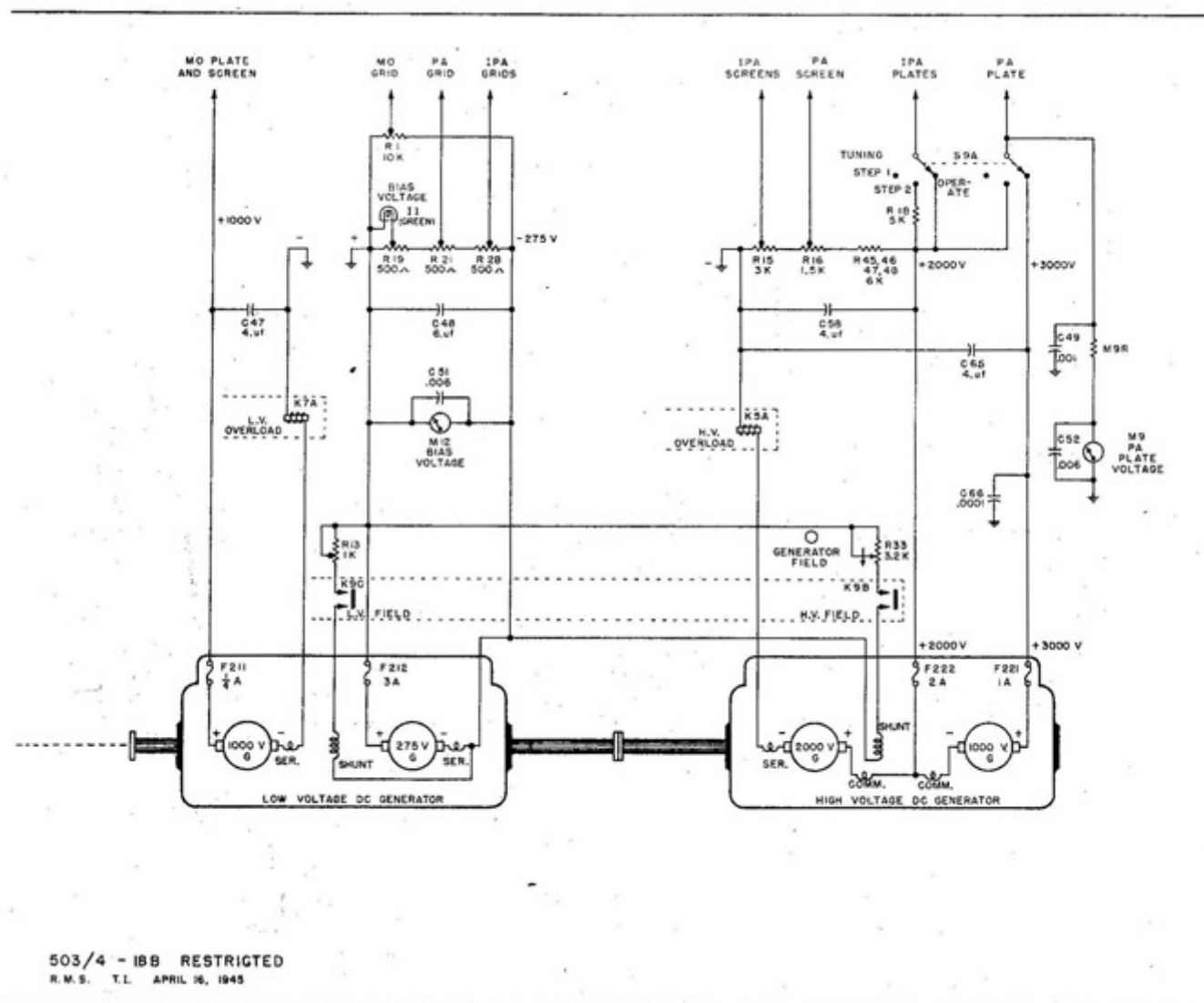


Fig. 18 TBK-13 Transmitter (DC Model) Control and Power Circuits.

### STARTING THE TRANSMITTER

1. Main line switch (S-831) and EMERGENCY SWITCH (S-12) both closed.
2. Closing START-STOP switch (S-8) energizes master start relay coil (K-4A).
3. Master start contacts K-4E energize the field contactor coil (K-9A).
  - (a) Field contacts (K-9B and C) connect the HV and LV generator fields to the 275-v DC generator armature.
4. Master start contacts K-4D energize main coil (K-832A) of Timetactor No. 1.
  - (a) Timetactor No. 1 contacts K-832B (across part of the motor starting resistance R-834) open.
5. Timetactor No. 1 contacts K-832E energize main coil (K-833A) of Timetactor No. 2.
  - (a) Timetactor No. 2 contacts K-833B (across all of the starting resistance R-834) open.
6. Timetactor No. 2 contacts K-833E energize main line contactor coil (K-831A) through previously closed contacts K-832F, K-832E and K-4D.
7. Main line contacts K-831B and C connect the 115-v DC line to the motor through starting resistance (R-834).
  - (a) Holding contacts K-831G connect R-833 in series with coil K-831A.
  - (b) Contacts K-831F disconnect main coil (K-832A) of Timetactor No. 1.



8. After a few seconds delay, Timetactor No. 1 becomes de-energized.
  - (a) K-832B short out part of the starting resistance (R-834).
  - (b) K-832E disconnect the main coil (K-833A) of Timetactor No. 2.
9. After another few seconds delay, Timetactor No. 2 becomes de-energized.
  - (a) K-833B short out all of the starting resistance (R-834).
  - (b) K-833F connect the filament transformer (T-1) to 80 v AC from the slip rings on the DC motor.

### ADJUSTING THE TRANSMITTER SUPPLY VOLTAGES

1. Filament voltage should be adjusted with FILAMENT VOLTAGE control (R-6) for 10 v on FILAMENT VOLTAGE meter (M-11).
2. High plate voltage\_-should be adjusted with GENERATOR FIELD control (R-33) for 3,000 v on PA PLATE VOLTAGE meter (M-9), with the TUNE-OPERATE switch (S-9A) in OPERATE position.

### STOPPING THE TRANSMITTER

1. Opening the START-STOP switch (S-8) disconnects master start relay coil (K-4A).
  - (a) K-4D disconnect the main line contactor coil (K-831A).
  - (b) K-831B and C disconnect the motor from the line.

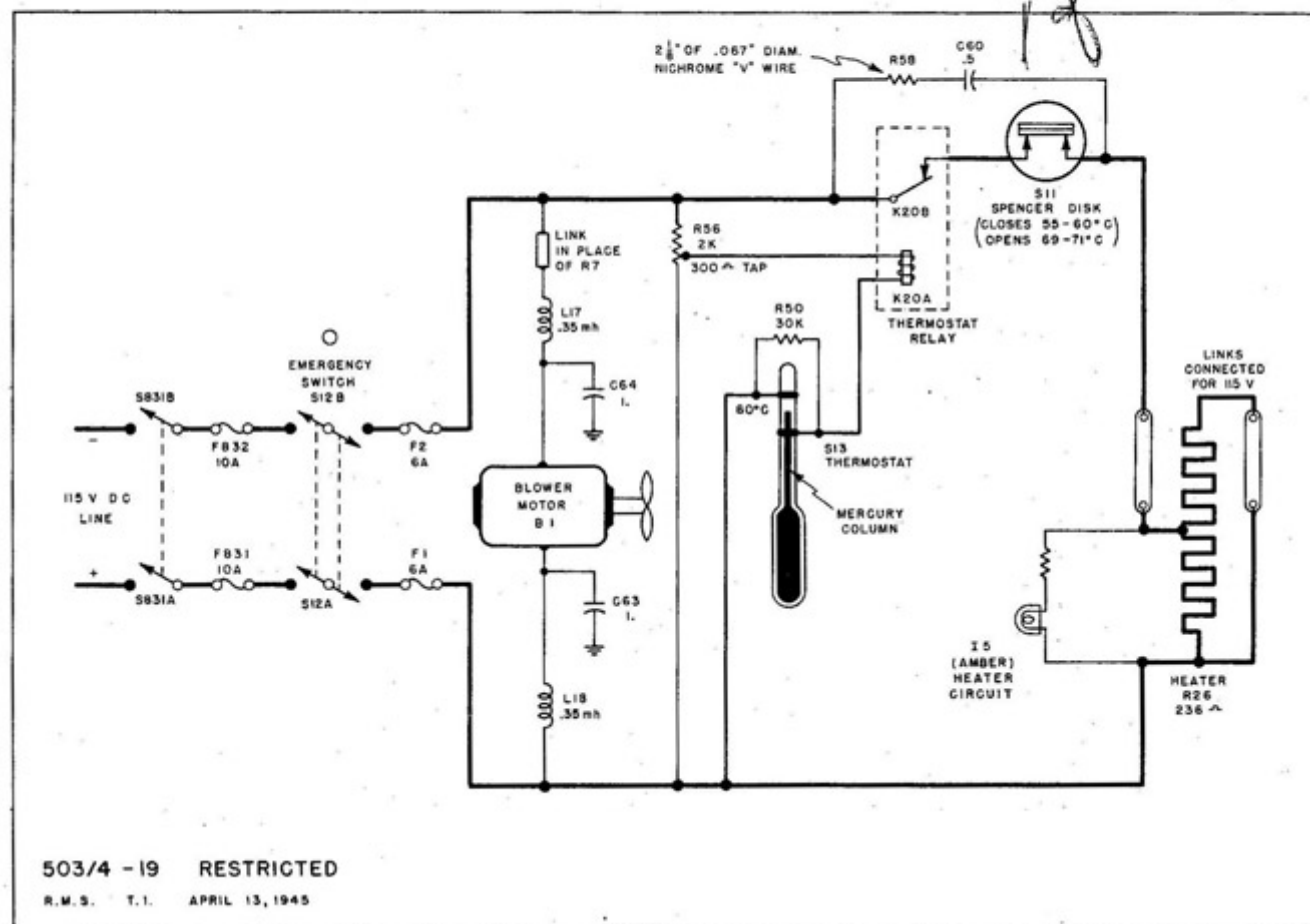


Fig. 19 TBK-13 Transmitter (DC Model) MO Temperature Compartment.

1. **PURPOSE:** To improve the MO frequency stability by maintaining critical MO circuit elements at a practically constant temperature.

2. **OPERATION:**

(a) Closing main line switch (S-831) and EMERGENCY SWITCH (S-12) starts the blower motor (B-1), to circulate the air within the compartment.

(1) RF hash interference to radio equipment nearby is eliminated by the two filters (L-17, C-64 and L-18, C-63).

(b) If the temperature in the compartment is below 60° C, the thermostat (S-13) contacts are open, preventing the thermostat relay (K-20) from being energized. The heating element (R-26) is energized through the normally closed contacts (K-20B) of the thermostat relay.

(c) When the temperature in the compartment reaches 60° C, the mercury column of the thermostat (S-13) completes the circuit to the thermostat relay coil (K-20A).

(1) Contacts K-20B open to turn off the heating element (R-26).

(d) As soon as the temperature within the compartment falls a small fraction of a degree below 60° C, the heating cycle is repeated.

(e) If either S-13 or K-20 fail to operate, the temperature protection switch (bi-metallic Spencer Disk S-11) will turn the heating element (R-26) off and on within the limits of 71° and 55° C.

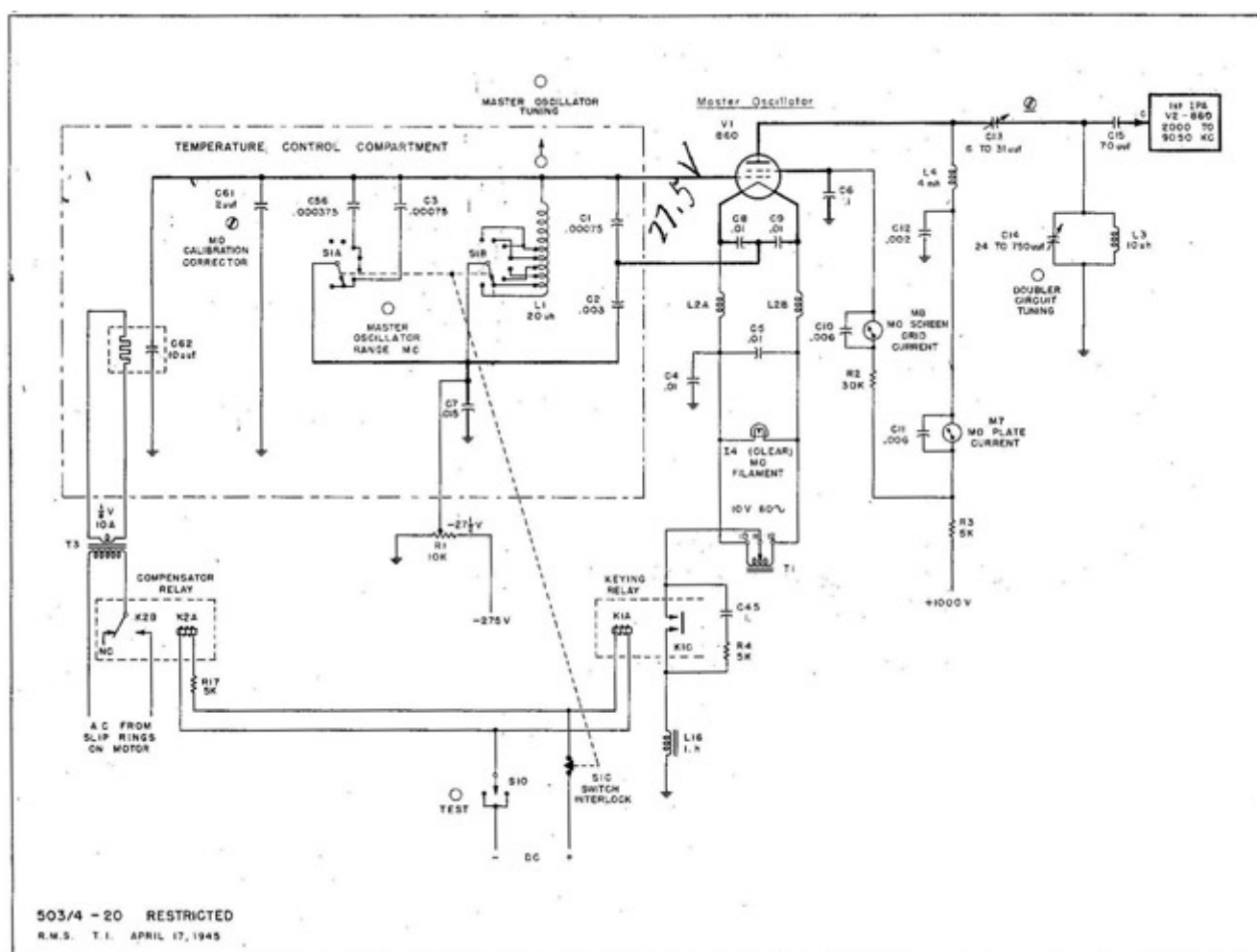


Fig. 20 TBK-13 Transmitter, (DC Model) Master Oscillator Circuit.

1. **PURPOSE:** To provide a signal of 2,000 to 4,525 kc with excellent frequency stability and sufficient power to drive the first IPA.

2. **GENERAL CIRCUIT CONDITIONS:** An electron coupled circuit, Class C, with plate circuit always tuned to the second harmonic of the grid - screen grid circuit.

### 3. OPERATION:

(a) MO frequency is controlled by the grid - screen grid circuit L-1; C-1, C-2, C-3, C-56, C-61 and C-62.

(1) Coarse tuning in 8 steps with MASTER OSCILLATOR RANGE MC control (S-1). Switch interlock contacts S-1C break the keying circuit while S-1A and B are between steps.

(2) Vernier tuning with MASTER OSCILLATOR TUNING control (a - copper cylinder on a threaded shaft inside L-1L).

(b) MO CALIBRATION CORRECTOR capacitor (C-61) should be set half open before the transmitter is calibrated. When MO tubes or parts are changed, C-61 may be adjusted to make the MO frequency correspond to the previously calibrated settings.

(c) Bi-metallic compensating capacitor (C-62), heated by current from T-3 whenever the key is closed, compensates for changes in MO circuit capacity due to expansion of tube elements under operating conditions.

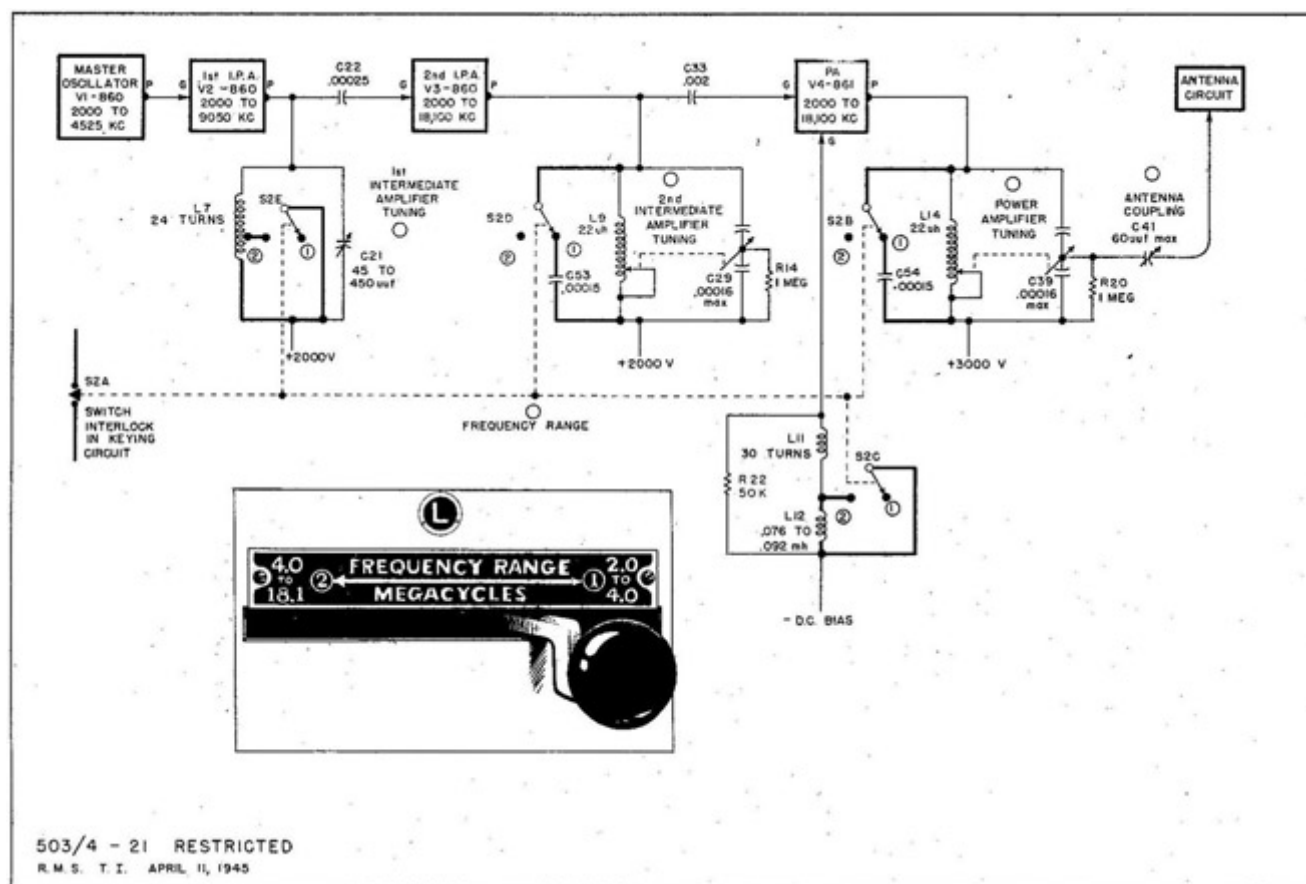


Fig. 21 TBK-13 Transmitter FREQUENCY RANGE Control

1. **PURPOSE:** To provide two tuning ranges, (1) from 2.0 to 4.0 mc, and (2) from 4.0 to 18.1 mc.
2. **OPERATION WITH FREQUENCY RANGE** control (S72) in position (1) 2.0 to 4.0 mc;
  - (a) S-2E connects all of the inductance (L-7) into the 1st IPA plate tank circuit for the lower frequency range.
  - (b) S-2D connects a fixed capacitor (C-53) across the 2nd IPA tank.
  - (c) S-2B connects a fixed capacitor (C-54) across the FA tank.
  - (d) S-2C connects an additional RF choke (L-12) in the grid circuit of the PA to provide sufficient impedance at the lower frequencies.
  - (e) S-2A (switch interlock) opens the keying relay coil circuit while the main contacts (S-2B, C, D and E) are between positions.
3. **OPERATION WITH FREQUENCY RANGE** control (S-2) in position (2) 4.0 to 18.1 mc:
  - (a) S-2E shorts out part of the 1st IPA plate tank inductance (L-7) for the higher frequency range.
  - (b) S-2D disconnects the fixed capacitor (C-53) from the 2nd IPA tank.
  - (c) S-2B disconnects the fixed capacitor (C-54) from the PA tank.
  - (d) S-2C shorts out the additional RF choke (L=12) in the PA grid circuit so L-11 will provide the correct impedance for the higher frequency range.
  - (e) S-2A (switch interlock) opens the keying relay coil circuit while the main contacts (S-2B, C, D and E) are between positions.



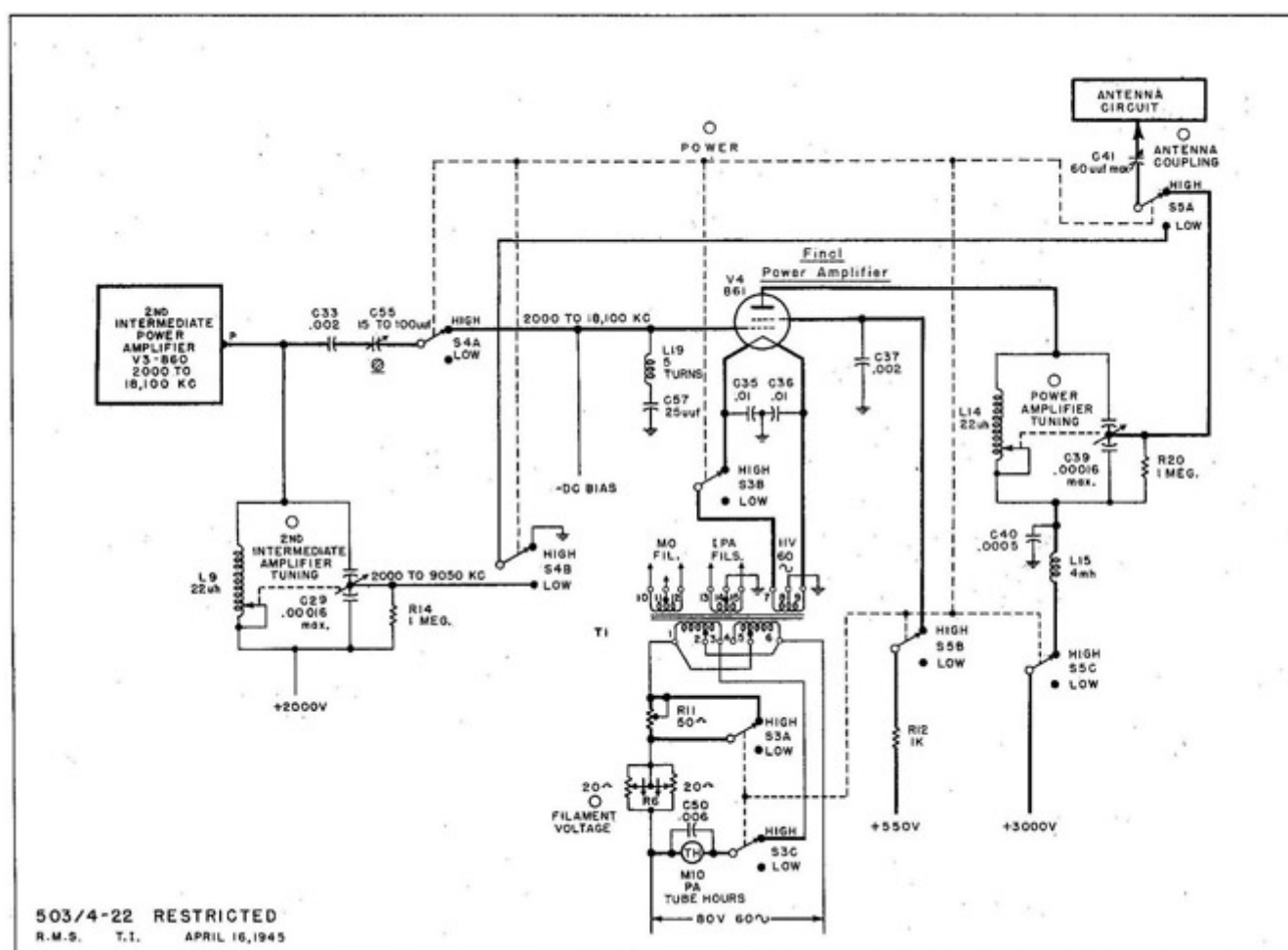


Fig. 22 TBK-13 Transmitter (DC Model) High 7 Low POWER Control

1. **PURPOSE:** To provide two power outputs, 500 watts and 75 watts.
2. **GENERAL CIRCUIT CONDITIONS:** Parts concerned only with the 2.0 to 4.0 mc range have been omitted from Fig. 22.
3. **OPERATION WITH POWER** control (S-2, S-3, S-4 and S-5) in HIGH position:
  - (a) S-3B connects the final FA filament.
  - (b) S-3A shorts out the low power filament resistor (R-11).
  - (c) S-3C connects the FA TUBE HOURS meter (M-10).
  - (d) S-4A connects the final PA grid to the output of the 2nd IPA. (e). S-5B connects the final PA screen to the DC power supply.
  - (f) S-5C connects the final FA plate to the DC power supply.
  - (g) S-5A connects the antenna to the final PA plate tank circuit.
  - (h) S-4B disconnects the antenna from the 2nd IPA plate tank circuit.
  - (i) S-2A (switch interlock) breaks the keying relay coil circuit while all the main contacts of the POWER control are between positions.
4. **OPERATION WITH POWER** control (S-2, S-3, S-4 and S-5) in LOW position:
  - (a) S-3B and S-3A disconnect the PA filament and connect the low power filament resistor (R-11) in series with the primary of filament transformer (T-1) to maintain 10 volts on the remaining filaments.,
  - (b) S-3C disconnects the FA TUBE HOURS meter (M-10).
  - (c) S-4A, S-5B and S-5C disconnect the PA grid, screen and plate.
  - (d) S-5A and S-4B transfer the antenna from the FA to the 2nd IPA.

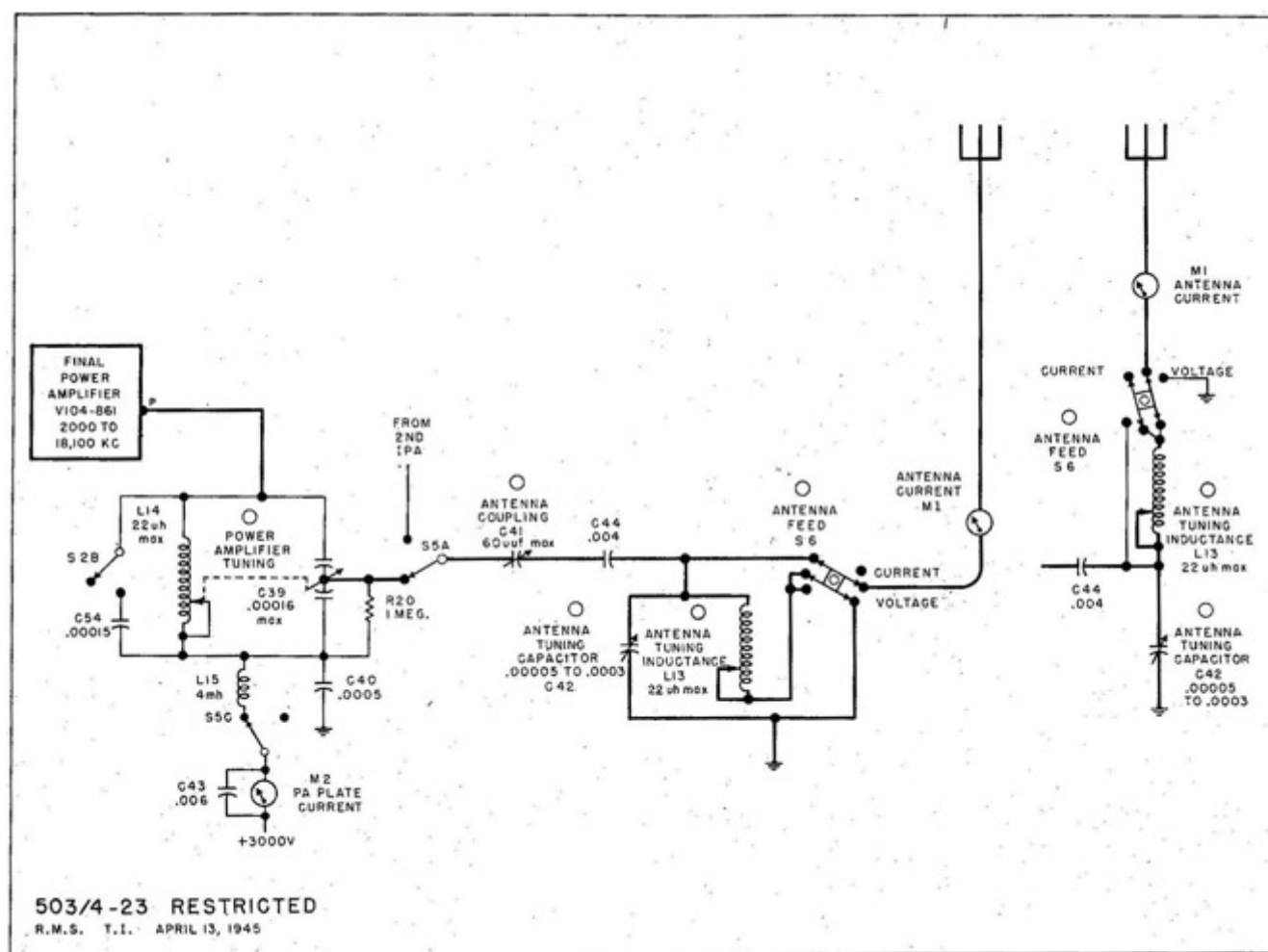


Fig. 23 TBK-13 Transmitter Antenna Circuit.

1. **PURPOSE:** To tune the antenna circuit to resonance and to couple the desired amount of RF power from the transmitter to the antenna.

(a) **CURRENT FEED:** To couple the transmitter output to an antenna that is nearest to an odd multiple of quarter wavelengths.

(b) **VOLTAGE FEED:** To couple the transmitter output to an antenna that is nearest to an even multiple of quarter wavelengths.

## 2. OPERATION:

(a) With the ANTENNA FEED switch (S-6) in CURRENT FEED position, the antenna tuning inductance (L-13) and the antenna tuning capacitor (C-42) are connected in a series circuit.

(b) With the ANTENNA FEED Switch (S-6) in VOLTAGE FEED position, L-13 and C-42 are connected in a parallel circuit.

(c) The degree of coupling between the transmitter and the antenna is adjusted with the ANTENNA COUPLING control (C-41). Increased coupling should cause an increase in PA PLATE CURRENT (M-2).

(d) Coarse antenna tuning is done with ANTENNA TUNING INDUCTANCE control (L-13), for a rise in FA PLATE CURRENT (M-2).

(e) Vernier antenna tuning is done with ANTENNA TUNING CAPACITOR control (C-42), for a peak in PA PLATE CURRENT (M-2).

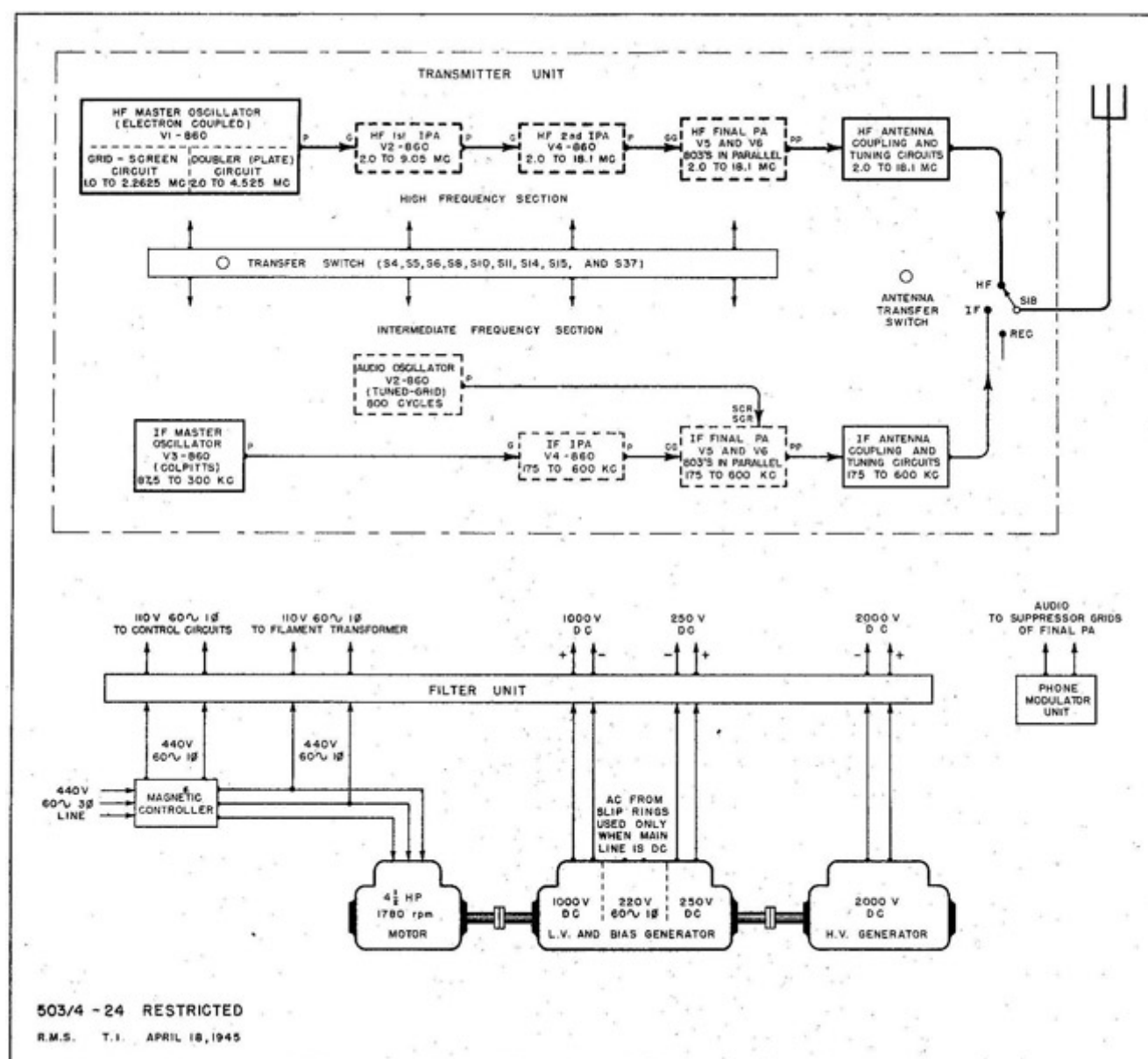


Fig. 24 TBL-7 Transmitter, Simplified Block Diagram.

1. **PURPOSE:** To provide general communication for small ships.
2. **FREQUENCY RANGES:**
  - (a) IF, 175 to 600 kc.
  - (b) HF 2,000 to 18,100 kc.
3. **EMISSION:**
  - (a) A-1 or CW up to 100 words per minute.
  - (b) A-2 or MCW on IF range only, up to 100 words per minute.
  - (c) A-3 or PHONE up to 85% modulation.
4. **POWER OUTPUTS:**
  - (a) From 50 to 200 watts variable on CW.
  - (b) 100 watts on MCW.
  - (c) 50 watts on PHONE.

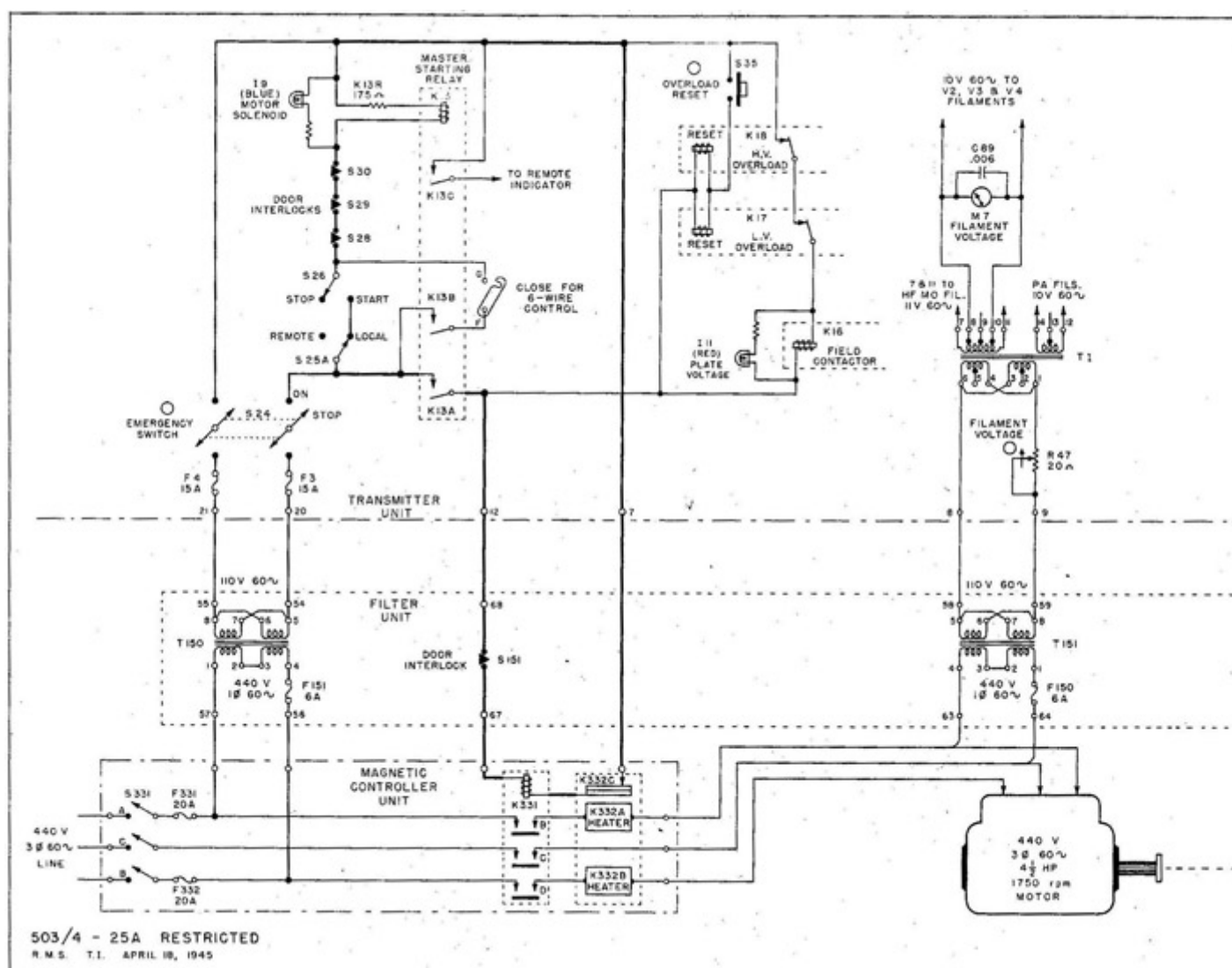


Fig. 25 TBL-7 Transmitter (AC Model) Control and Power Circuits.

1. **PURPOSE:** To simplify starting and stopping the transmitter, and to convert the line supply to the types of power required by the transmitter.

2. **GENERAL CIRCUIT CONDITIONS:**

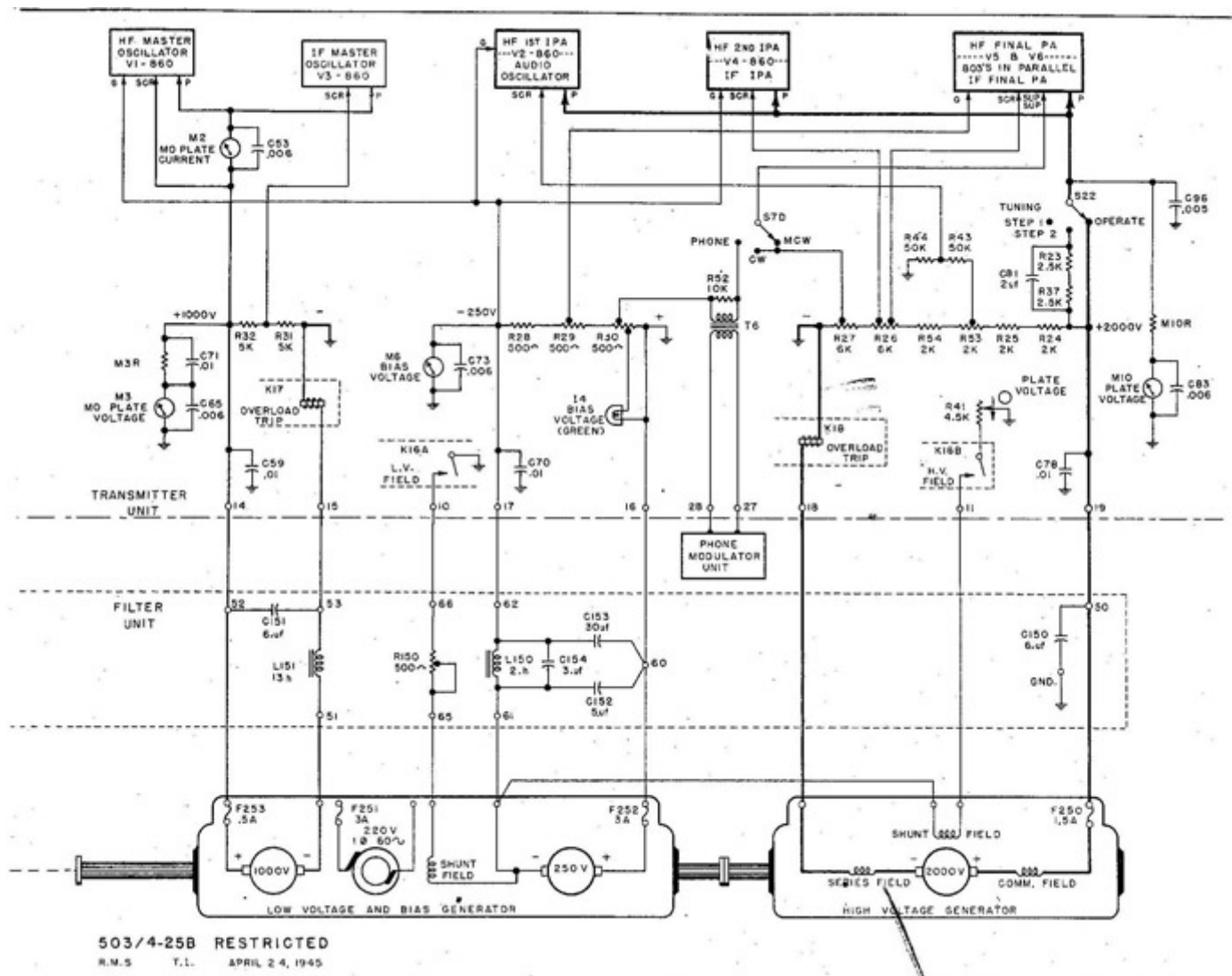
- (a) Transmitter control circuits connected for Navy 4-wire control unit.
- (b) Main line switch (S-331) and EMERGENCY SWITCH (S-24) both closed.

3. **STARTING THE TRANSMITTER:**

- (a) Close START-STOP switch (S-26) to energize master start relay (K-13).
- (b) Master start contacts K-13A energize the main line contactor (K-331).
  - (1) Main line contacts (K-331B, C and D) connect the line to the AC motor and to filament power transformer (T-151).
- (c) Master start contacts K-13A also energize field contactor (K-16).
  - (1) Field contacts (K-16A and B) connect the LV and HV generator shunt fields to the 250-v DC bias generator armature.

4. **ADJUSTING THE TRANSMITTER SUPPLY VOLTAGES:**

- (a) Filament voltage on all tubes should be correct when FILAMENT VOLTAGE



control (R-47) is adjusted for 10 v on FILAMENT VOLTAGE meter (M4).

(b) High plate voltage should be adjusted with PLATE VOLTAGE control (R-41) for 2,000 v on PLATE VOLTAGE meter (M-10) with TUNE-OPERATE-switch (S-22) in OPERATE position.

(c) Bias and MO plate voltages adjustable only with tap on R-150.

## 5. OVERLOAD PROTECTION:

(a) Momentary overload in either the 1,000-v or the 2,000-v DC generator output will trip either the LV (K-17) or the HV (K-18)-overload relay.

(1) Overload contacts (K-17 or K-18) de-energize K-16 coil.

(2) K-16A and B disconnect both generator shunt fields.

(b) Prolonged overload on the AC motor will trip thermal overload relay (K-332) in the magnetic controller unit.

(1) Thermo-cutout contacts (K-332C) disconnect K-331 coil.

(2) Main line contacts (K-331B, C and D) disconnect the motor.

## 6. STOPPING THE TRANSMITTER:

(a) Open START-STOP switch (S-26) to de-energize master start relay K713.

(1) Master start contacts K-13A de-energize K-16 and K-331.

(2) K-16A and B disconnect both generator shunt fields.

(3) K-331B, C and, D disconnect the motor And filament supply.



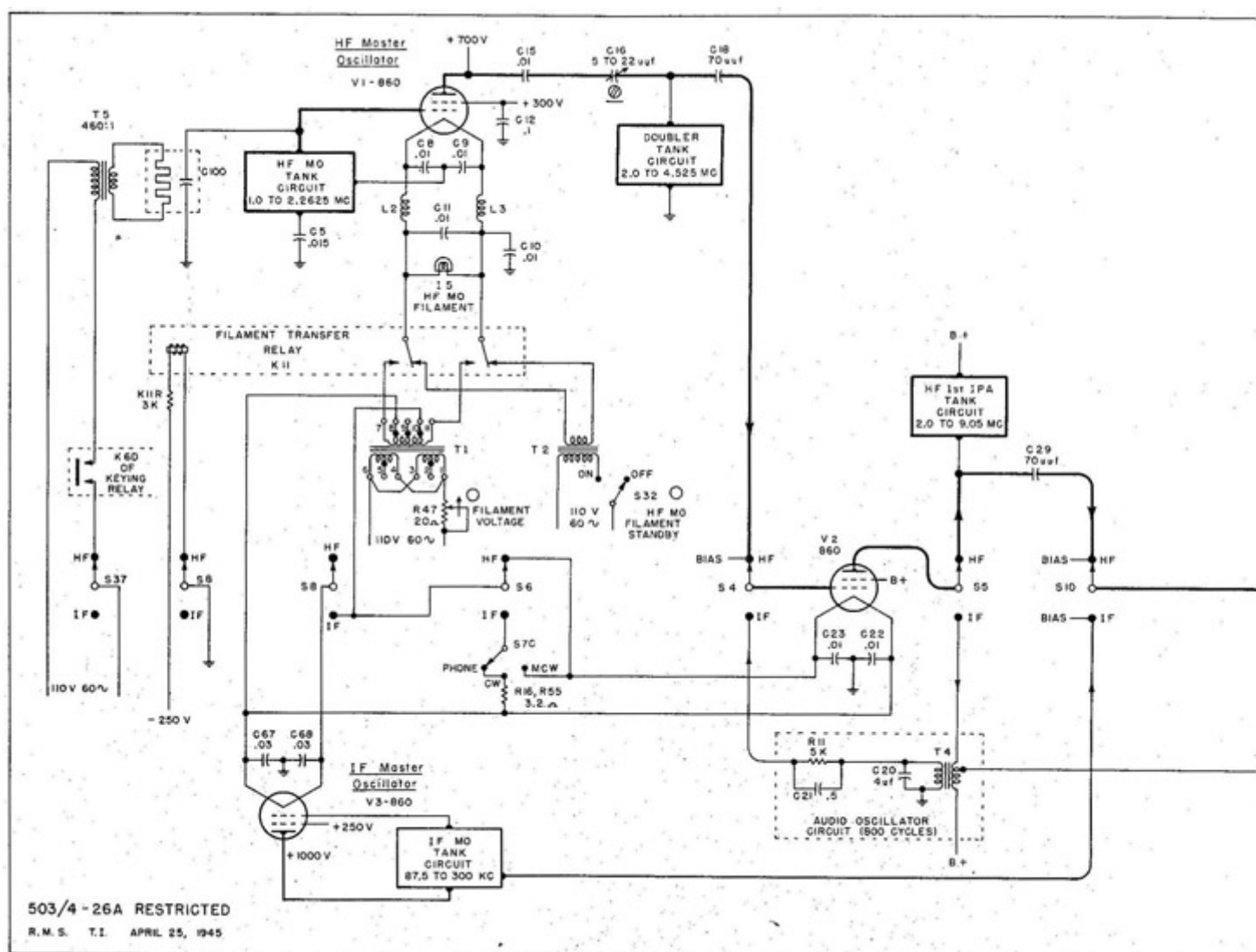


Fig. 26 TBL-7 Transmitter HF - IF TRANSFER SWITCH

1. **PURPOSE:** TO select for operation either the HF or the IF transmitter.

2. **GENERAL CIRCUIT CONDITIONS:**

(a) All tubes except the master oscillators :.(V-1 and V-3) are common to both the HF and the IF transmitters.

(b) The HF-IF TRANSFER SWITCH control operates S-4, S-5, S-6, S-8, S-10, S-11, S-14, S-15 and S-37.

3. **OPERATION-WTTH HF-IF TRANSFER SWITCH** control in HF position:

(a) S-37 connects 110 volts AC to the primary circuit of the compensator transformer (T-5).

(b) S-8 disconnects the filament of the IF master oscillator (V-3), and energizes the filament transfer relay (K-11).

(1) K-11 contacts transfer the filament of HF master oscillator (V-1) from the standby transformer (T-2) to the main filament transformer (T-1).

(c) S-6 connects the filament of V-2 to the filament transformer (T-1).

(d) S-4 transfers the grid of V-2 from the audio oscillator circuit to



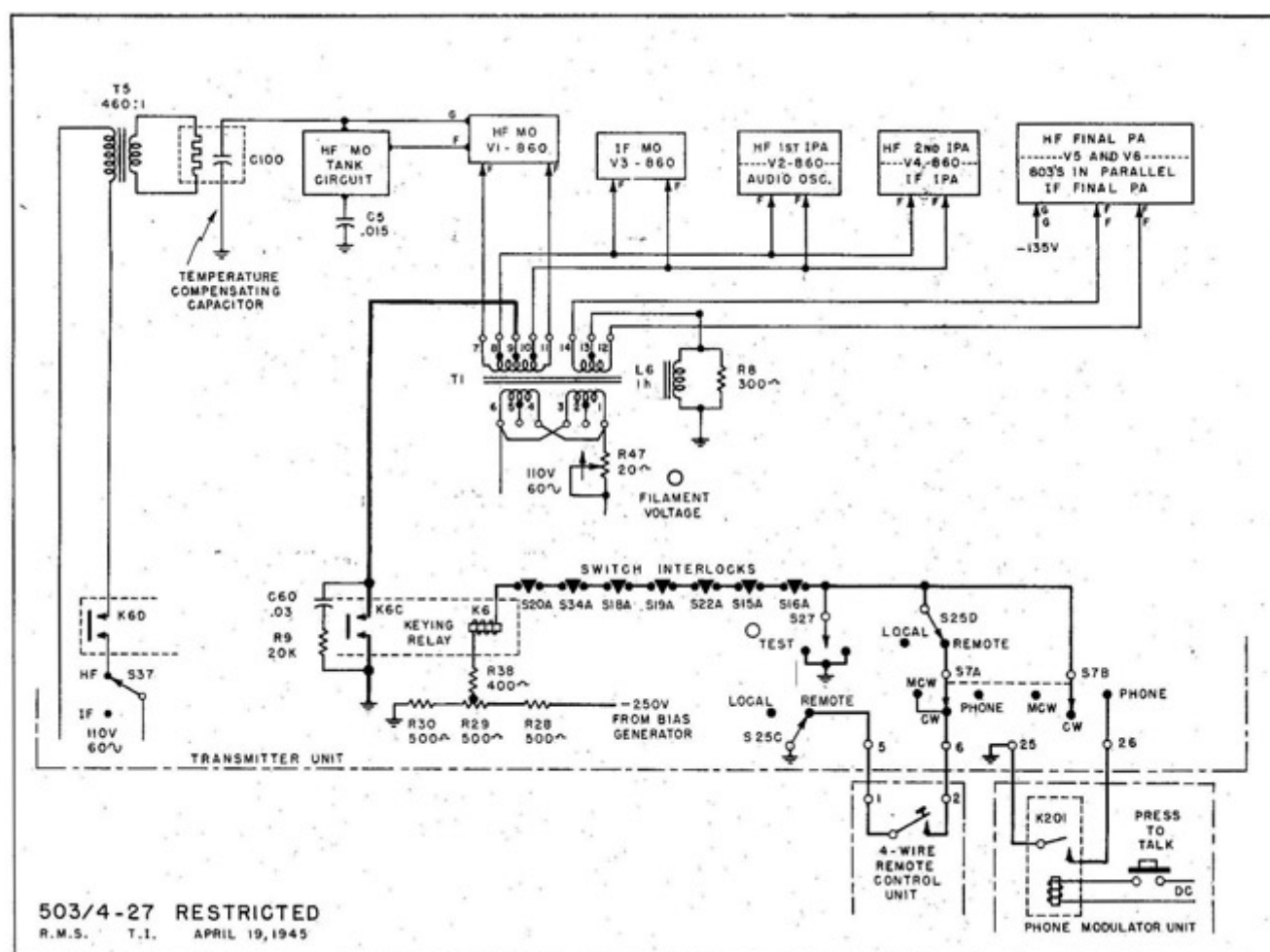


Fig. 27 TEL-7 Transmitter (AC Model) Keying Circuit.

- 1, **PURPOSE:** To control the RF output of the transmitter'.
2. **GENERAL CIRCUIT CONDITIONS:** With no signal, the final PA tubes (V-5 and V-6) are biased beyond cutoff with -135 volts of fixed bias.-
3. **OPERATION:**
  - (a) Closing any of the following energizes the keying relay (K-6):
    - (1) TEST key (S-27).
    - (2) Remote key when REMOTE - LOCAL switch (S-25) is in REMOTE and PHONE - CW - MCW switch (S-7) is in CW or MCW.
    - (3) PRESS TO TALK Switch and K-201 contacts in the phone modulator unit when PHONE - CW - MCW switch (S-7) is in PHONE.
  - (b) Keying relay contacts K-6C complete the DC return path to the filaments of all stage's except the final PA. The PA filament return is always complete through the key thump filter (L-6 and R-8).
  - (c) Keying relay contacts K-6D energize the compensator transformer (T-5) which heats bi-metallic temperature compensating capacitor (C-100).
  - (d) Opening the key or press to talk switch de-energizes K-6.
    - (1) K-6C break the filament return of all stages except the PA.
    - (2) K-6D disconnect the compensator transformer (T-5).
  - (e) C-60 and R-9 are a key click filter.

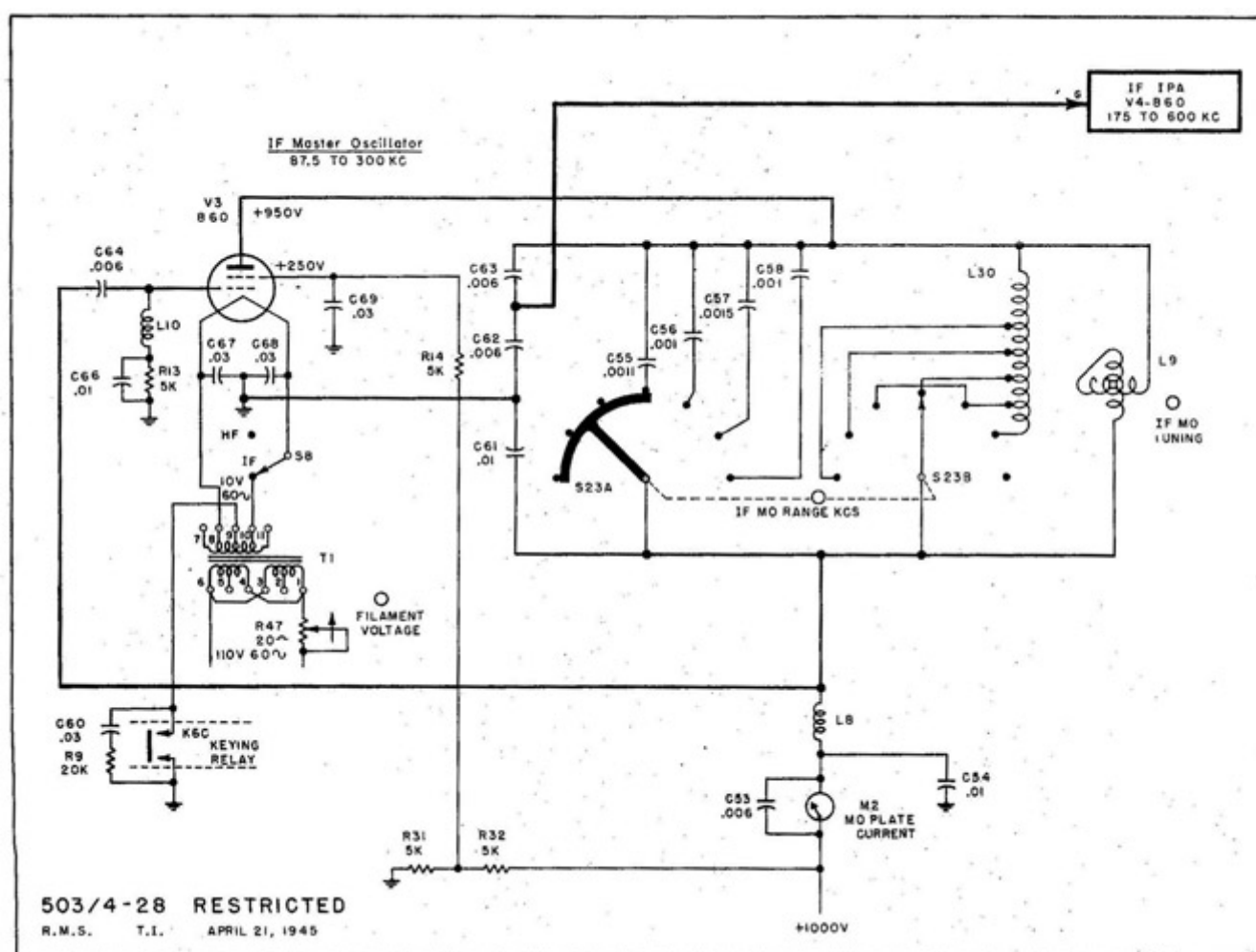


Fig. 28 TBL-7 Transmitter (AC Model) IF Master Oscillator.

#### IF MASTER OSCILLATOR (87.5 to 300 kc)

1. **PURPOSE:** To generate an RF signal at any desired frequency from 87.5 to 300 kc.
2. **GENERAL CIRCUIT CONDITIONS:** Series-fed standard Colpitts type, Class C.
  - (a) Parallel-resonant tank circuit consists of:
    - (1) Inductive branch, L-30 in parallel with L-9.
    - (2) Capacitive branch, C-55, 56, 57, 58, 61, 62, and 63.
    - (3) RF output taken from capacitive voltage divider (C-61, C-62 and C-63).
3. **OPERATION:**
  - (a) Coarse tuning in 7 steps with IF MO RANGE KCS control (S-23).
  - (b) Vernier tuning with IF MO TUNING control (variometer L-9).

#### IF INTERMEDIATE FOYER AMPLIFIER. (175 to 600 kc)

1. **PURPOSE:** To amplify the RF output of the MO, and to isolate the MO from the PA.
2. **GENERAL CIRCUIT CONDITIONS:** Class C, always operated as a frequency doubler.

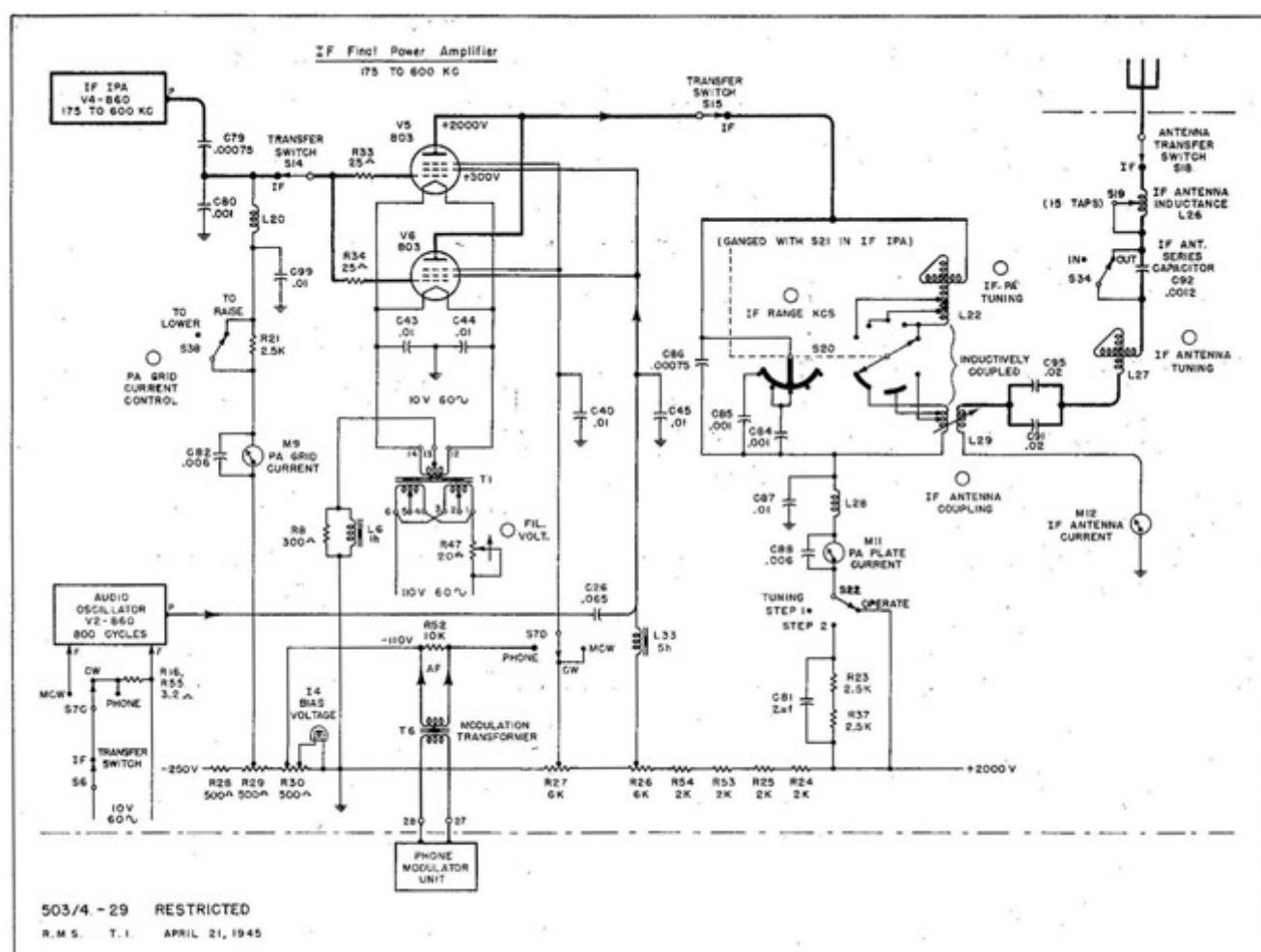


Fig. 29 TBL-7 Transmitter IF Final Power Amplifier.

### IF FINAL POWER AMPLIFIER (175 to 600 kc)

1. **PURPOSE:** To deliver a maximum of 200 watts of RF power to the antenna circuit.
2. **GENERAL CIRCUIT CONDITIONS:**
  - (a) Two 803's in parallel, Class C.
  - (b) R-33 and R-34 in the grid circuit are parasitic suppressors.
  - (c) For MCW operation, the PA tubes are screen-grid modulated by the 800-cycle audio oscillator (V-2).
  - (d) For PHONE operation, the PA tubes are suppressor-grid modulated by the output of a separate Phone modulator unit.
  - (e) The antenna circuit is always series-tuned.
3. **OPERATION:**
  - (a) Coarse tuning in 5 steps with IF RANGE RCS control (S-20).
  - (b) Vernier tuning with IF PA TUNING control (variometer L-22).
  - (c) Inductive antenna coupling with IF ANTENNA COUPLING control (L-29).

### TBL-7 HF TRANSMITTER (2.0 to 18.1 mc)

The TBL-7 HF transmitter is very similar to the TBK-13. The main differences are: 200 watts maximum output, parallel 803's in the PA, and 50 watts PHONE emission.

[TX Home Page](#)
[Next Part](#)

### TDE-2 TRANSMITTER

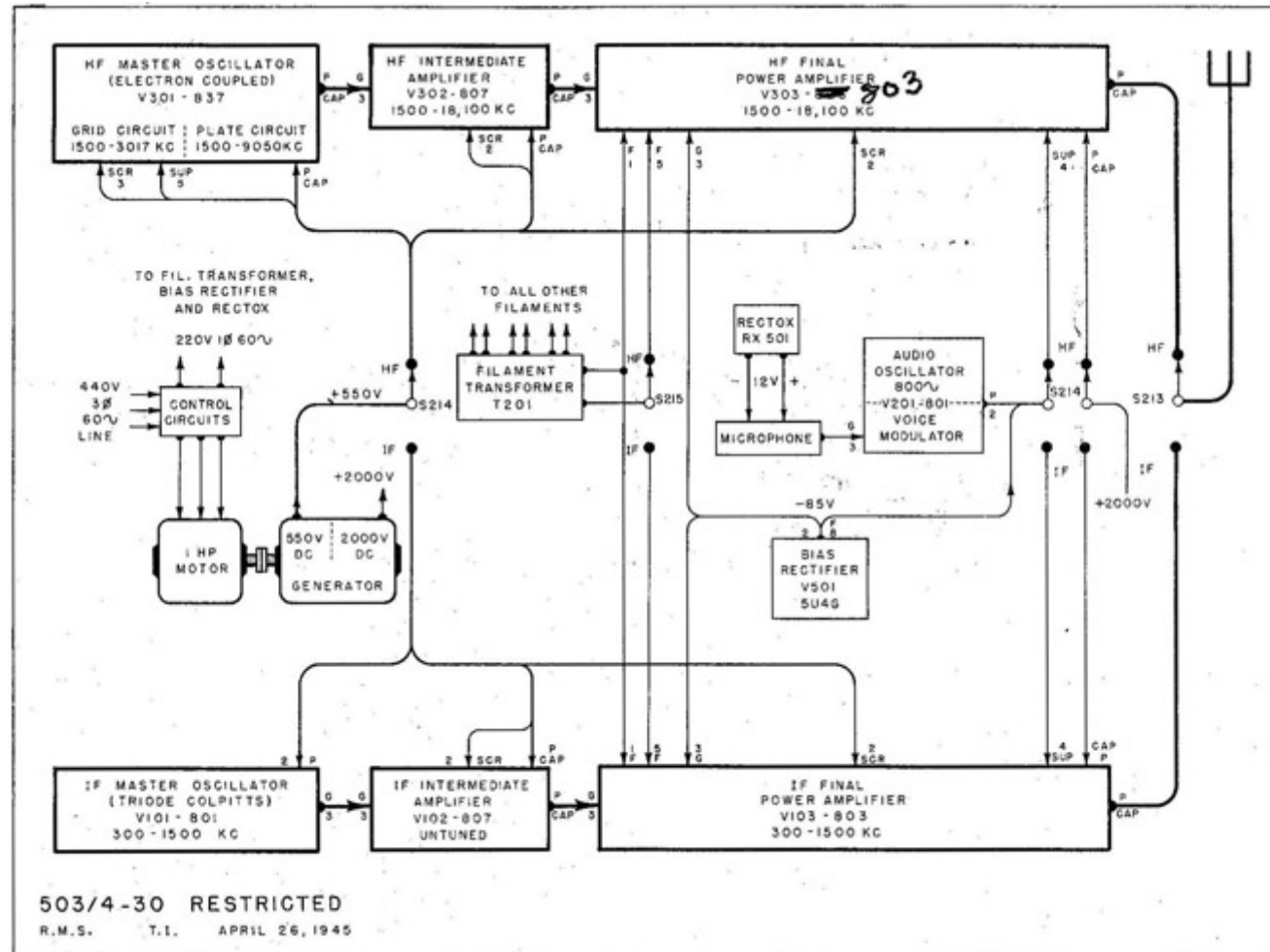


Fig. 30 TDE-2 Transmitter Block Diagram.

1. **PURPOSE:** General communication for small ships.
2. **FREQUENCY RANGES:**
  - (a) IF, 300 to 1,500 kc.
  - (b) HF, 1,500 to 18,100 kc.
3. **EMISSION:**
  - (a) A-1 or CW, up to 100 words per minute.
  - (b) A-2 or MCW, up to 100 words per minute.
  - (c) A-3 or VOICE.
4. **POWER OUTPUTS:**
  - (a) 125 watts CW.
  - (b) 35 watts MCW.
  - (c) 30 watts VOICE.
5. **HF-IF TRANSFER SWITCH (S-213, S-214 and S-215):**
  - (a) S-213 transfers the antenna to either the HF or the IF transmitter.
  - (b) S-214 transfers the DC plate and bias voltages, and the output of the audio oscillator - voice modulator (V-201) to either transmitter.
  - (c) S-215 transfers the PA filament supply to either transmitter.



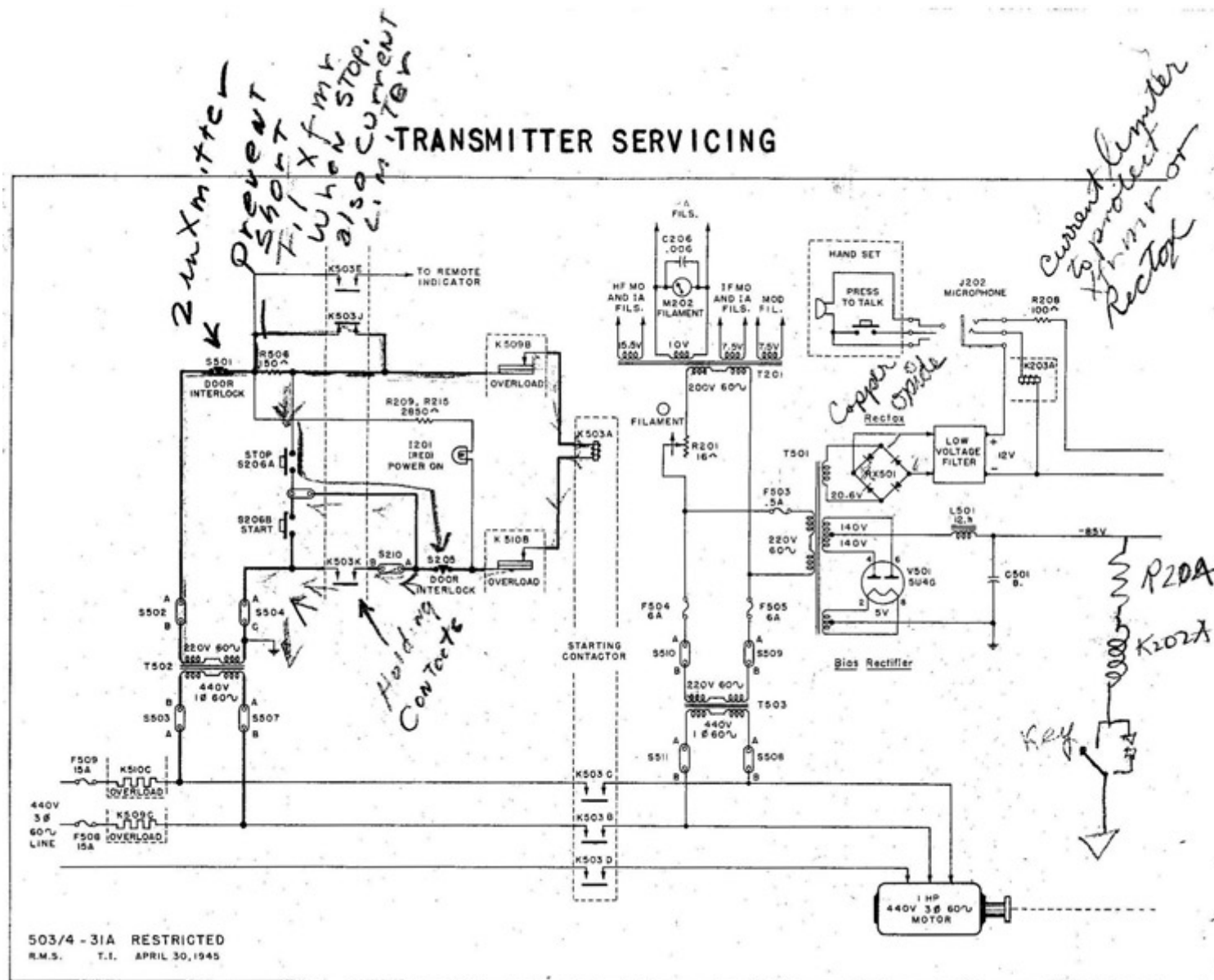


Fig. 31 TDE-2 Transmitter (AC Model) Control and Power Circuits.

1. **PURPOSE:** To simplify starting and stopping the transmitter and to convert the line supply to the types of power required by the transmitter..

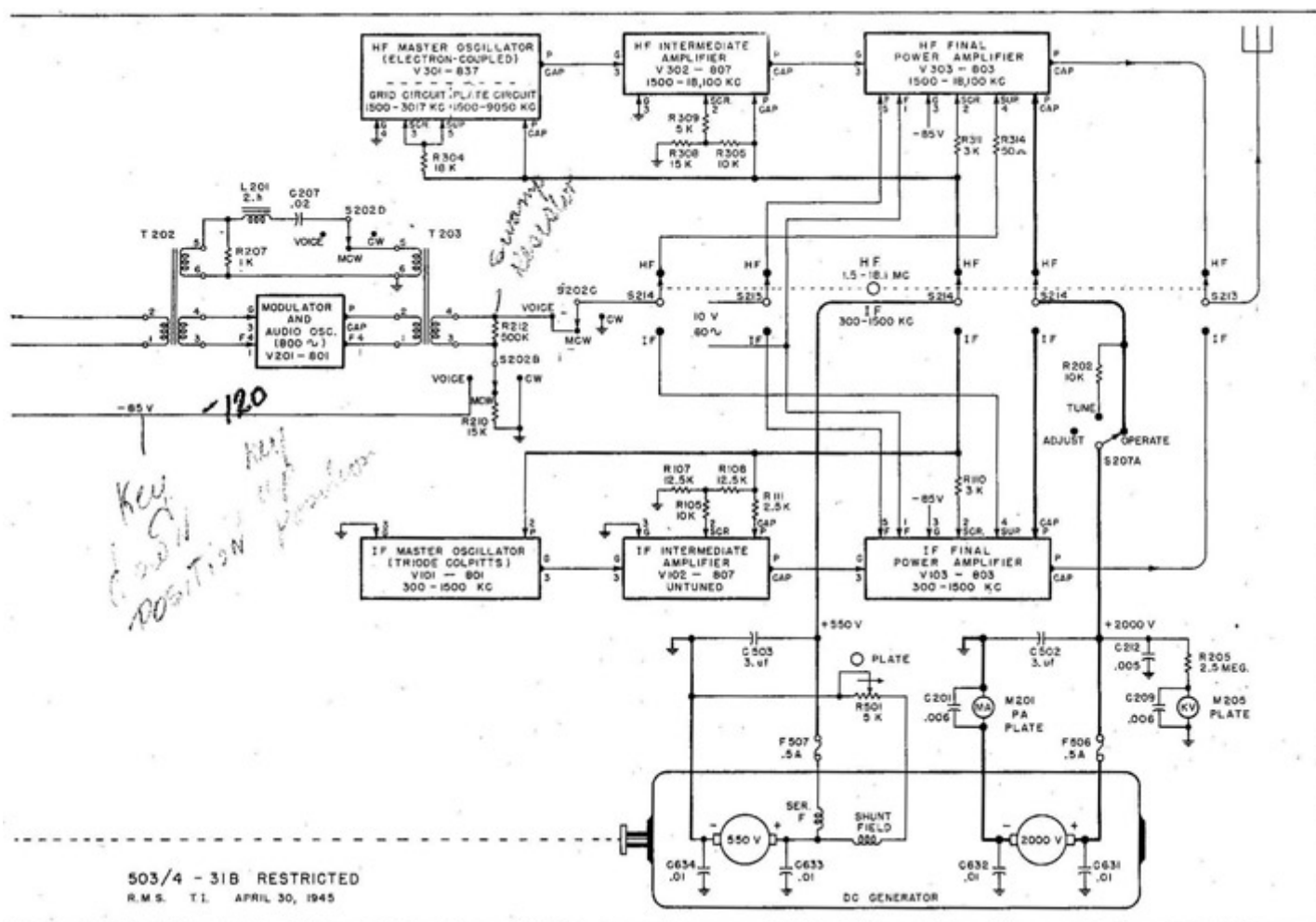
2. **GENERAL CIRCUIT CONDITIONS:**

- (a) Transmitter control circuits connected for Navy 6-wire control unit.
- (b) Control circuit power transformer (T-502) is energized from one phase of the 440-volt three phase main line.
- (c) Three main power conversion units are:
  - (1) Motor generator with 550-volt and 2,000-volt DC outputs.
  - (2) Bias rectifier (V-501) with 85-volt DC output.
  - (3) Rectox unit with 12-volt DC output for microphone.

3. **STARTING THE TRANSMITTER:**

- (a) Press START switch (S-206B) to energize starting contactor (K-503).
  - (1) Starting contacts (K-503B, C and D) connect the line to the motor and to the power transformer (T-503). The filament transformer (T-201) and the rectifier transformer (T-501) both are energized from the secondary of T-503.
  - (2) Holding contacts (K-503K) keep K-503A energized.
  - (3) Normally closed contacts (K-503J) open to leave R-506 in series with starting contactor coil (K-503A).





#### 4. ADJUSTING THE TRANSMITTER SUPPLY VOLTAGES:

- Filament voltages for all tubes should be correct when the FILAMENT control (R-201) is adjusted for 10 volts on FILAMENT meter (M-202).
- All plate voltages should be correct when PLATE control (R-501) is adjusted for 2.0 kilovolts on PLATE meter (M-205).

#### 5. PERSONNEL PROTECTION: Door interlocks (S-501 and S-205) in series with K-503A.

#### 6. OVERLOAD PROTECTION:

- Fuses in the +2,000-volt and +550-volt leads, in the primary circuits of rectifier transformer (T-501) and filament transformer (T-201). and in two of the main line leads.
- Thermal overload relays (K-509 and K-510) with heaters in two of the main line leads. Prolonged overload that fails to blow a fuse will cause thermo-cutout contacts (K-509B or K-510B) to break the starting contactor coil circuit.
  - Starting contacts (K-503B, C and D) disconnect the line from the motor and from the power transformer (T-503).

#### 7. STOPPING THE TRANSMITTER:

- Press STOP switch (S-206A) to de-energize starting contactor (K-503).
  - K-503B, C and D disconnect the motor and T-503.
  - K-503K open to keep the starting contactor de-energized.

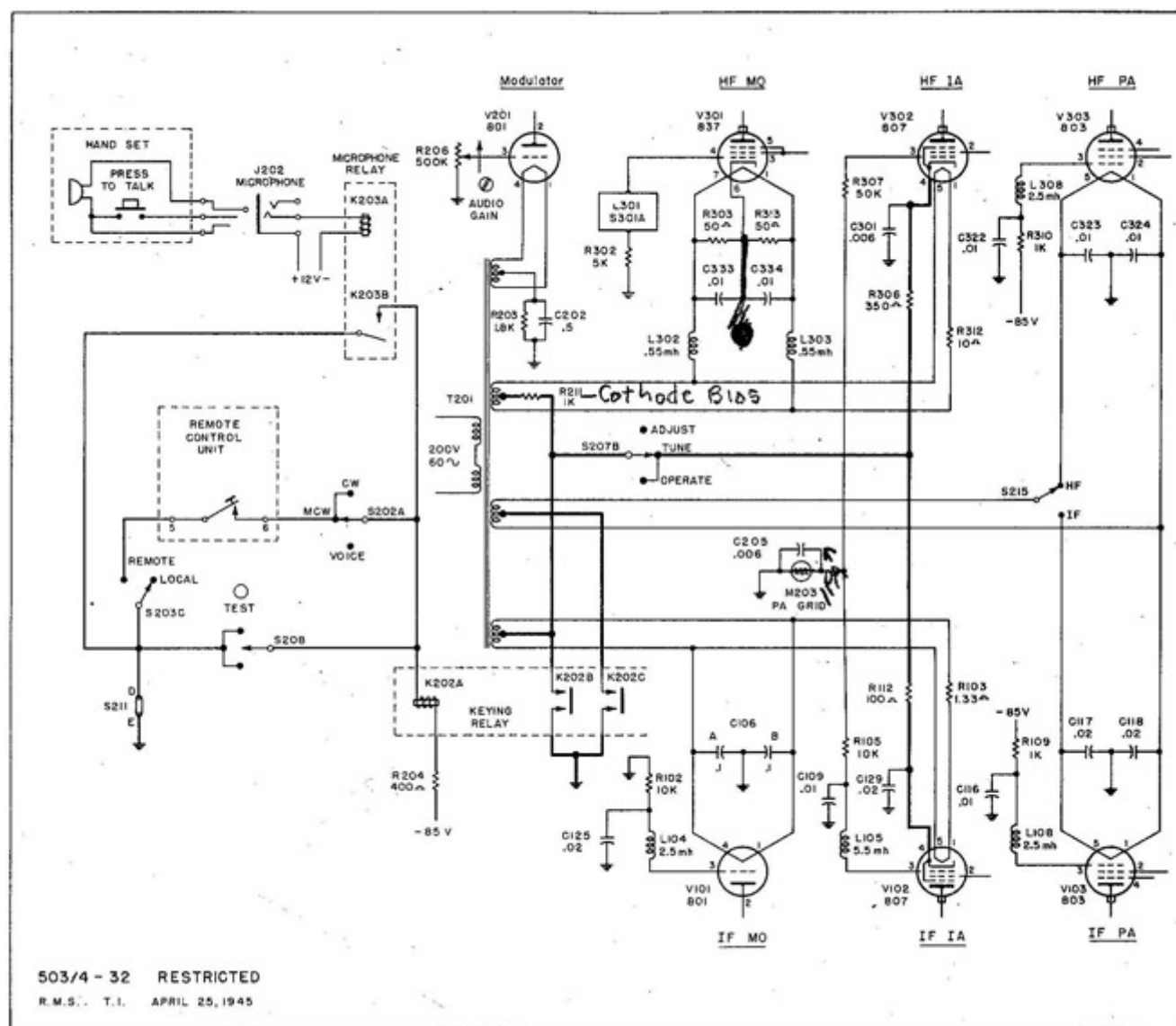


Fig. 32 TDE-2 Transmitter (AC Model) Keying Circuit.

1. **PURPOSE:** To control the RF output of the transmitter.

2. **GENERAL CIRCUIT CONDITIONS:**

(a) All RF stages are keyed.

(b) For MCW, -audio oscillator (V-201) generates 800 cycles continuously.

3. **OPERATION:**

(a) From local position, closing the TEST key (S-208) energizes the keying relay coil (K-202A) from the 85-volt DC bias supply.

(1) Keying contacts (K-202B and C) complete the DC return paths to the filaments of all RF stages.

(b) From remote position, the keying relay (K-202) may be energized either through the remote key or through the microphone relay contacts (K-203B) controlled by the PRESS TO TALK switch in the hand set.

(c) Opening the key or press to talk switch de-energizes the keying relay.

(1) K-202B and C break the DC return paths to the filaments of all RF stages.

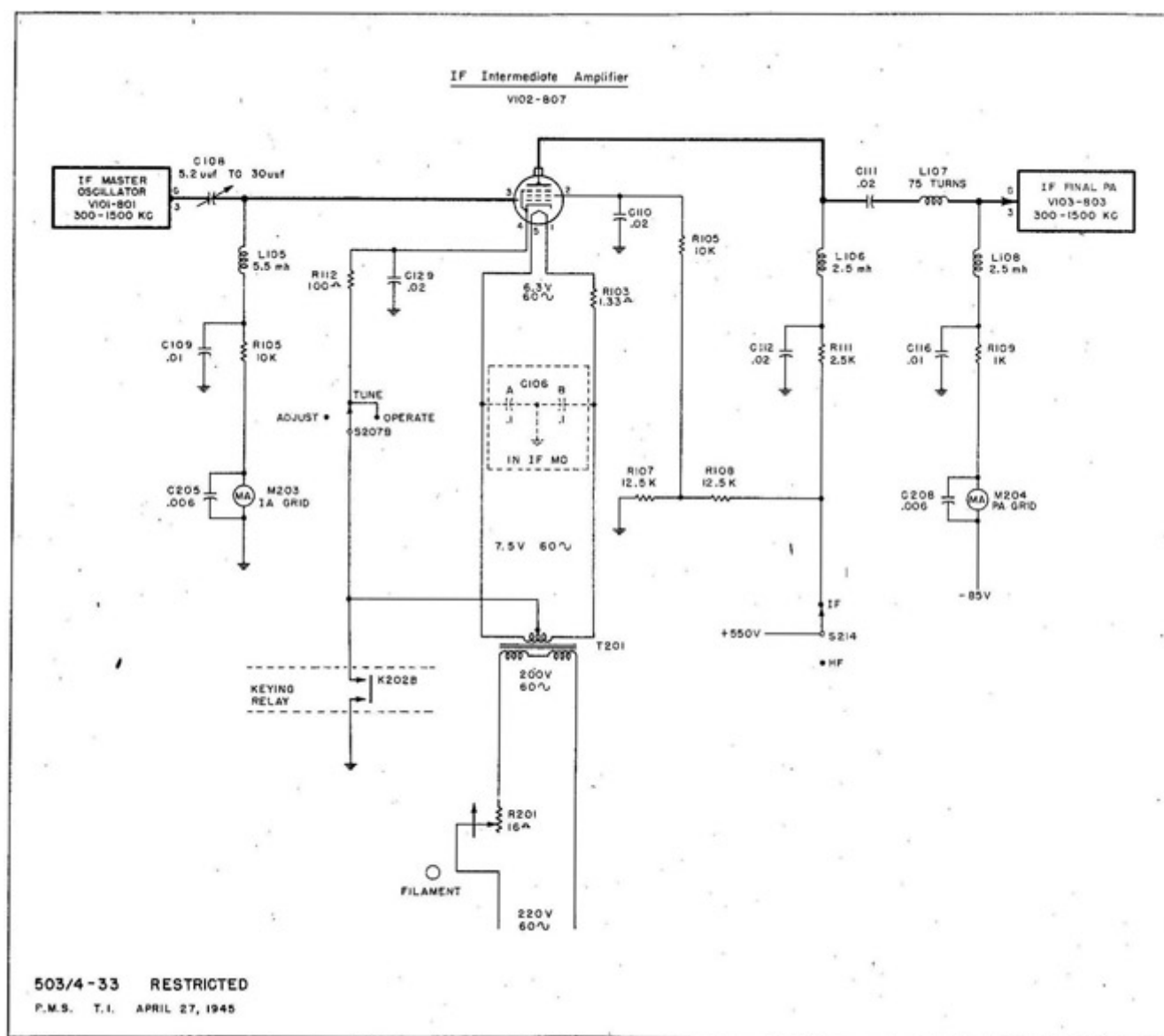


Fig. 33 TDE-2 Transmitter (AC Model) IF Intermediate Amplifier.

### TDE- 2 INTERMEDIATE FREQUENCY TRANSMITTER

#### 1. IF MASTER OSCILLATOR (300 to 1,500 kc):

- (a) An 801 (V-101) in a series-fed Colpitts circuit, Class C.

#### 2. IF INTERMEDIATE AMPLIFIER (300 to 1,500 kc):

- (a) An 807 (V-102) in an un-tuned circuit, Class AB.

(1) L-106 is the untuned plate load.

- (b) The coupling circuit (C-111 and L-107) will pass all frequencies between 300 and 1,500 kc.

#### 3. IF FINAL POWER AMPLIFIER (300 to 1,500 kc):

- (a) An 803 (V-103) in a conventional Class C amplifier circuit.

### TDE-2 HIGH FREQUENCY TRANSMITTER

An electron coupled master oscillator and two Class C amplifiers, all conventional.

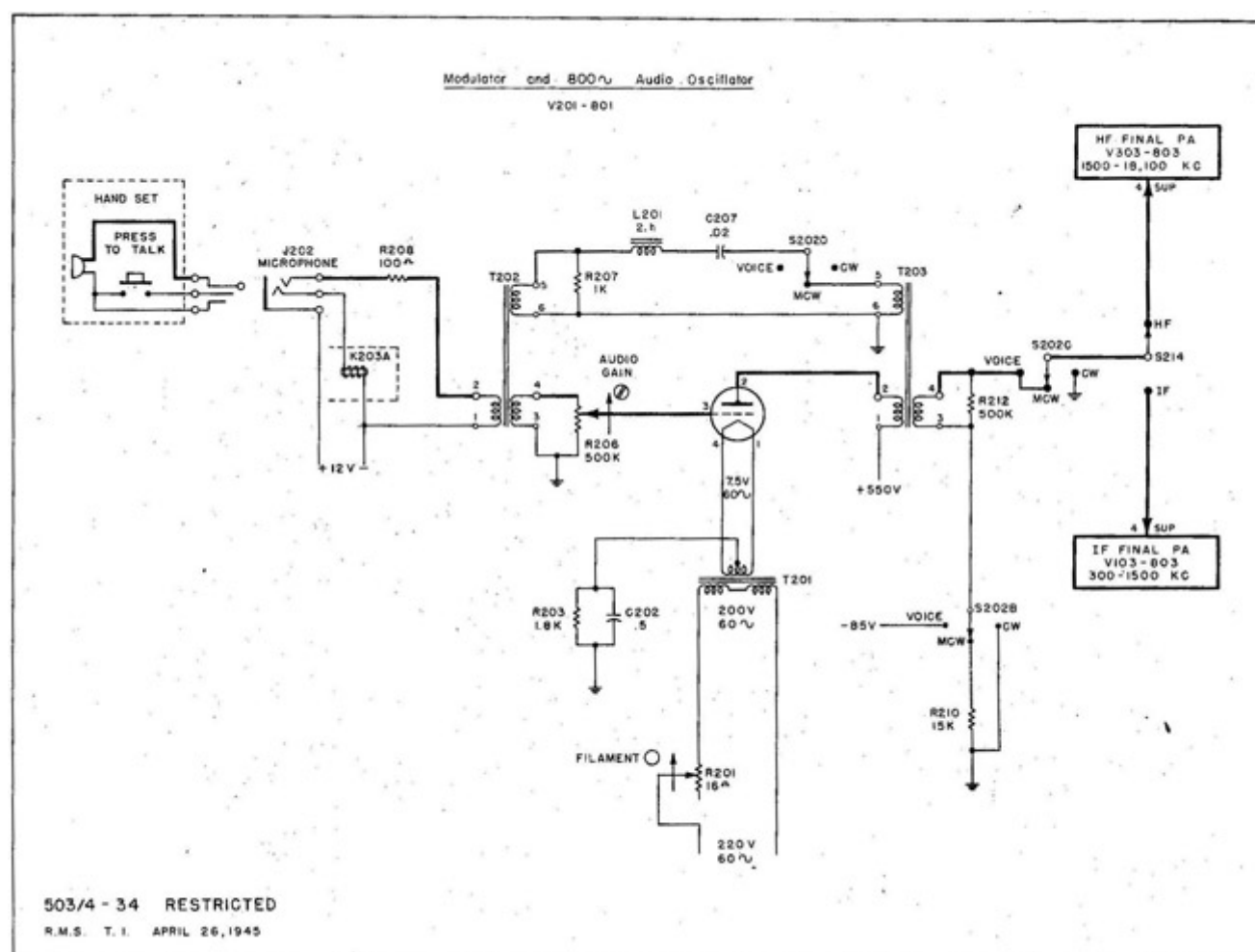


Fig. 34 TDE-2 Modulator and 800-cycle Audio Oscillator.

## 1. PURPOSES:

- (a) For VOICE operation, to amplify the AF signal from the microphone.
- (b) For MCW operation, to generate an 800-cycle signal.

**2. GENERAL CIRCUIT CONDITIONS:** An 801 (V-201) Class A amplifier.

### 3. VOICE OPERATION:

- (a) The VOICE position of S-202B connects -85 volts bias to the suppressor grid of the PA being used (either V-103 or V-303).
- (b) The modulator (V-201) amplifies the AF signal from the microphone transformer (T-202).
- (c) The AF output of V-201 delivered to the modulation transformer (T-203) modulates the suppressor grid of the PA being used.
- (d) Swamping resistor (R-212) reduces distortion due to the flow of suppressor grid current on positive signal peaks.

#### 4. MCW OPERATION:

- (a) The MCW position of S-202D connects an 800-cycle feedback circuit (L-201 and C-207) between the grid and plate circuits of V-201.
- (b) The 800-cycle output of V-201 delivered to the modulation transformer (T-203) modulates the suppressor grid of the PA being used.

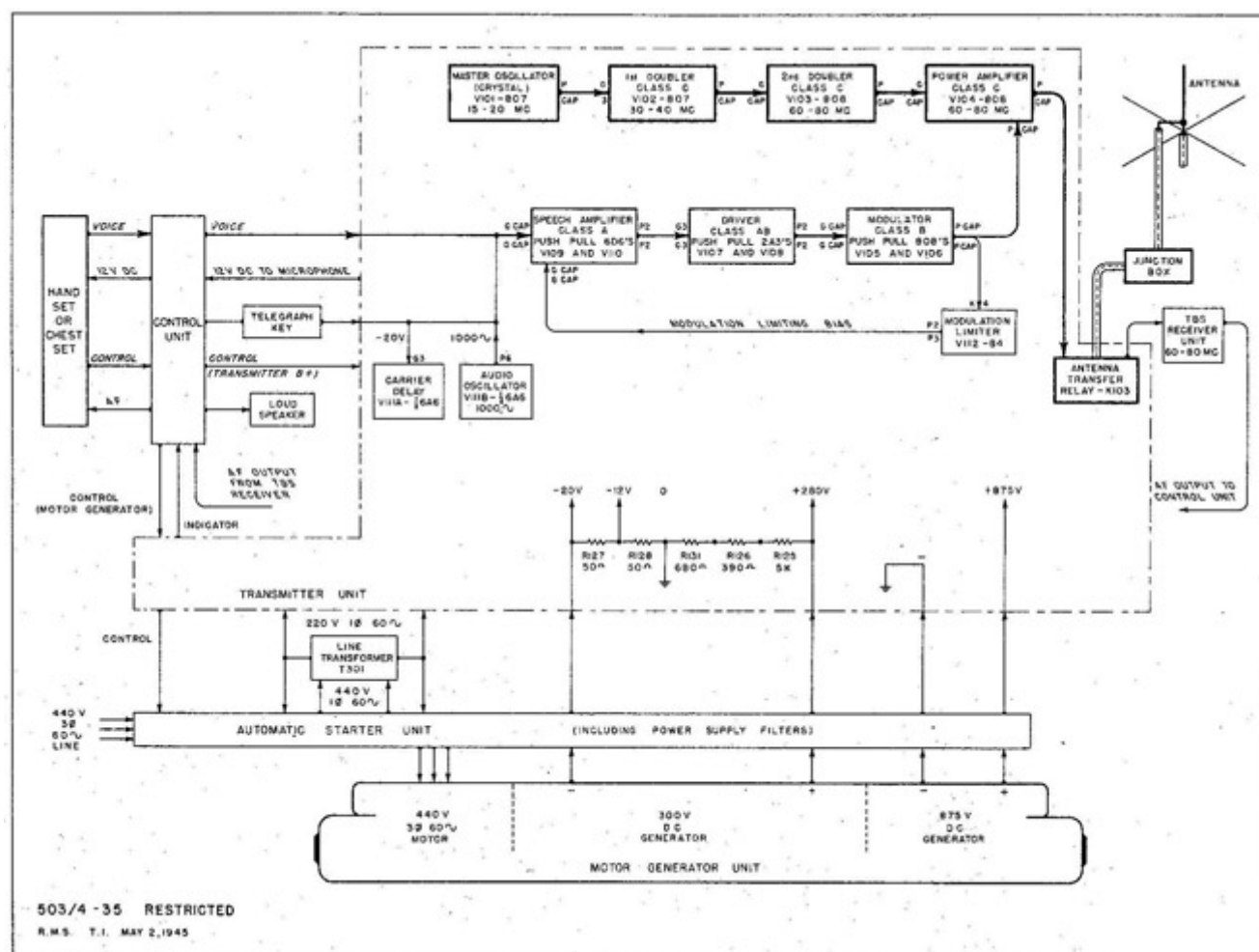
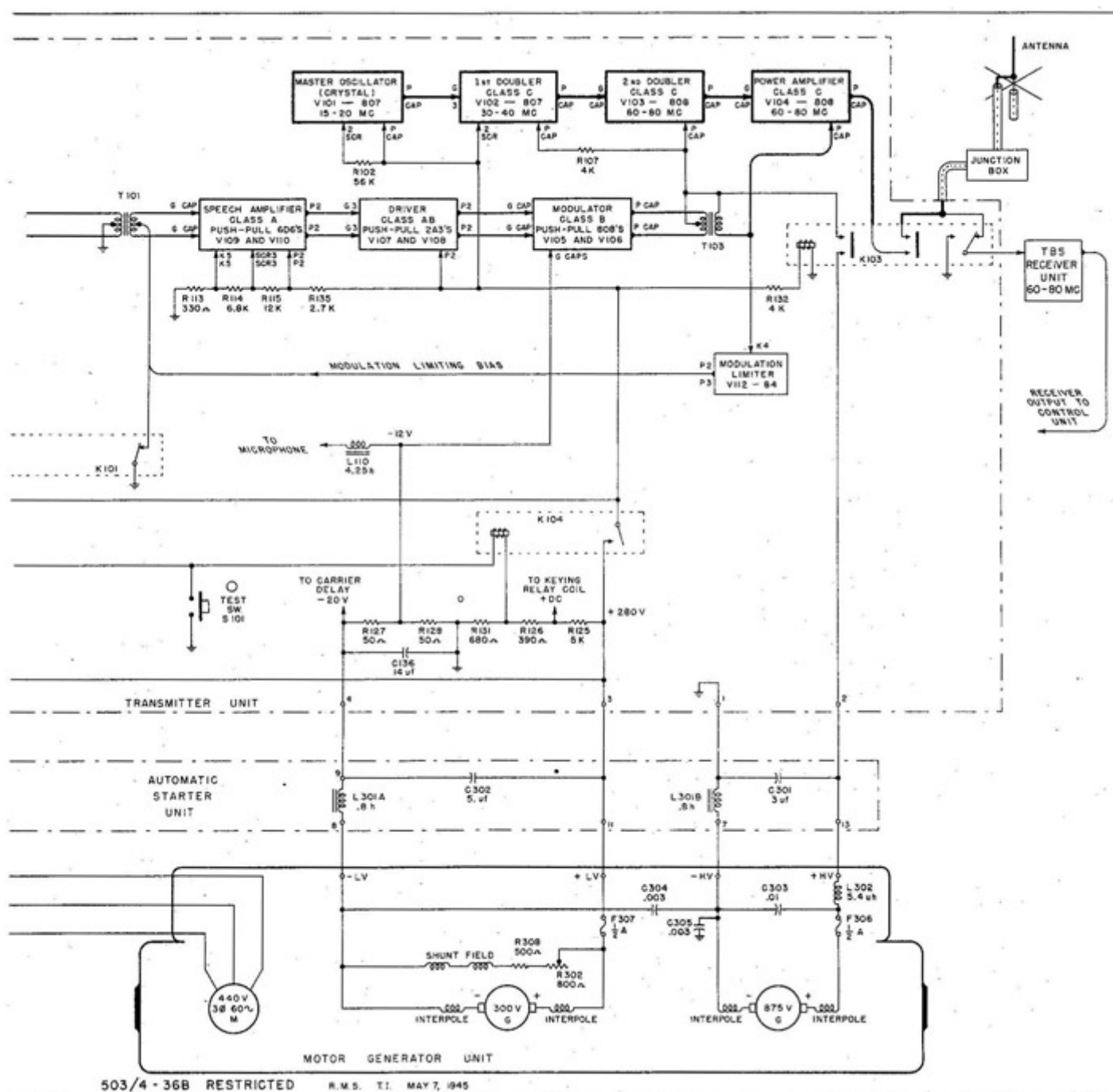


Fig. 35 TBS-6 Transmitter (AC Model) Block Diagram.

1. **PURPOSE:** To provide ship to ship communication over short distances.
2. **FREQUENCY RANGE:** 60 to 80 megacycles in crystal controlled channels.
3. **EMISSION:** Primarily or VOICE. A-2 or MCW also available if desired.
4. **POWER OUTPUT:** 50 watts for either VOICE or MCW.
5. **RF STAGES:** Crystal type master oscillator (15 to 20 mc), two frequency doublers and a power amplifier, all Class C. RF output to antenna through 72-ohm coax.
6. **AF STAGES:** Class A speech amplifier, Class AB driver and Class 13-modulator, all push pull. Armstrong type audio oscillator (1,000 cycles).
7. **MODULATION LIMITER:** An 84 rectifier (V412) used as an automatic gain control.
8. **CARRIER DELAY:** Keeps RF carrier on for about one second after MCW output stops.
9. **POWER SUPPLY:** Single unit motor generator set with 300-v and 875-v DC outputs.
10. **CONTROL UNITS:** Each has motor generator start-stop switch; AF volume control; hand jet switch; speaker relay and jack, for hand set, chest set and phones.





(c) RF carrier is transmitted continuously, voice modulated during speech.

(d) Releasing TALK switch returns all equipment to receive condition.

### 3. MCW OPERATION:

(a) Close telegraph key to energize keying relay K-102.

(1) K-102 opens the short across audio oscillator output, and connects -20 v to the grid of V-111A to de-energize K-101.

(b) K-101 shorts out the modulation limiting bias, connects plate voltage to the audio oscillator and energizes K-104 (but not K-201).

(c) K-104 and K-103 put the transmitter, antenna and receiver in transmit condition, but the receiver and loud-speaker still serve as monitor.

(d) The RF carrier remains on while the audio oscillator is keyed.

(e) If the key is left open for more than one second, C-134A discharges through R-119 enough to allow V-111A plate current to energize K-101. The equipment then returns to receive condition



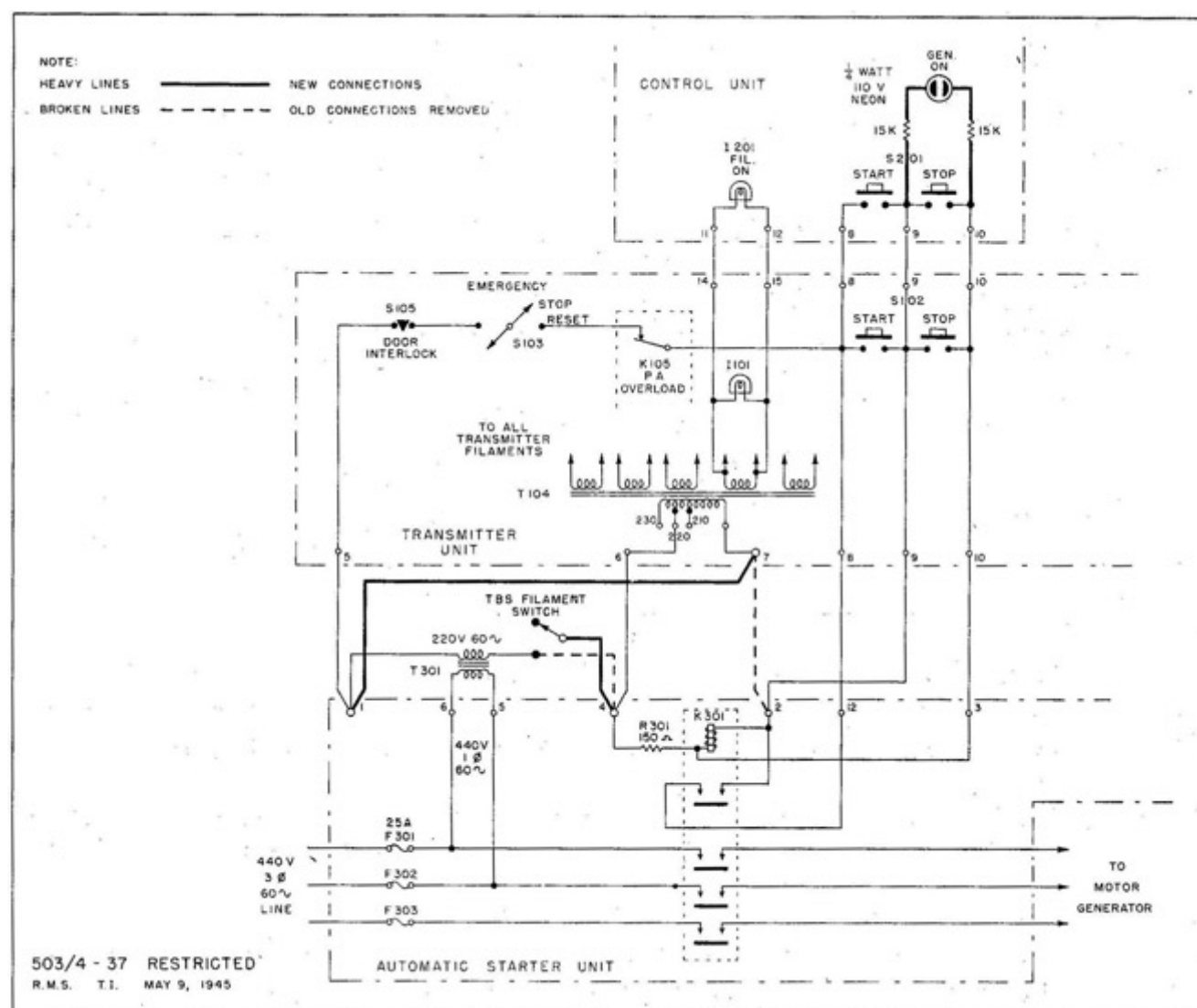


Fig. 37 TBS-6 Transmitter (AC Model) Modification to Filament Circuit.

1. **AUTHORITY:** C.E.M.B. - 8, 4-15-44.

2. **PURPOSE:** To reduce the warm-up time of the transmitter, and to avoid interrupting reception until V-111A conducts.

3. **CHANGES:**

- Remove old connections shown in broken lines in Fig. 37.
- Make new connections shown in heavy solid lines in Fig. 37.
- Mount switch in box, name plate TBS FILAMENT SWITCH, by transmitter.
- Drill control unit panel, install GEN. ON illuminated name plate with 1/4-watt, 110-volt neon lamp and 15-K, 2-watt resistors behind it.
- Change illuminated name plate on 1-201 from TRANS. ON to FIL. ON.

4. **RESULTS:**

- TBS FILAMENT SWITCH has complete control of transmitter filaments.
- Motor generator can not be started with TBS FILAMENT SWITCH open.
- The control unit lamps indicate both FIL. ON and GEN. ON, but the transmitter panel lamp (I-101) indicates only that filaments are on.

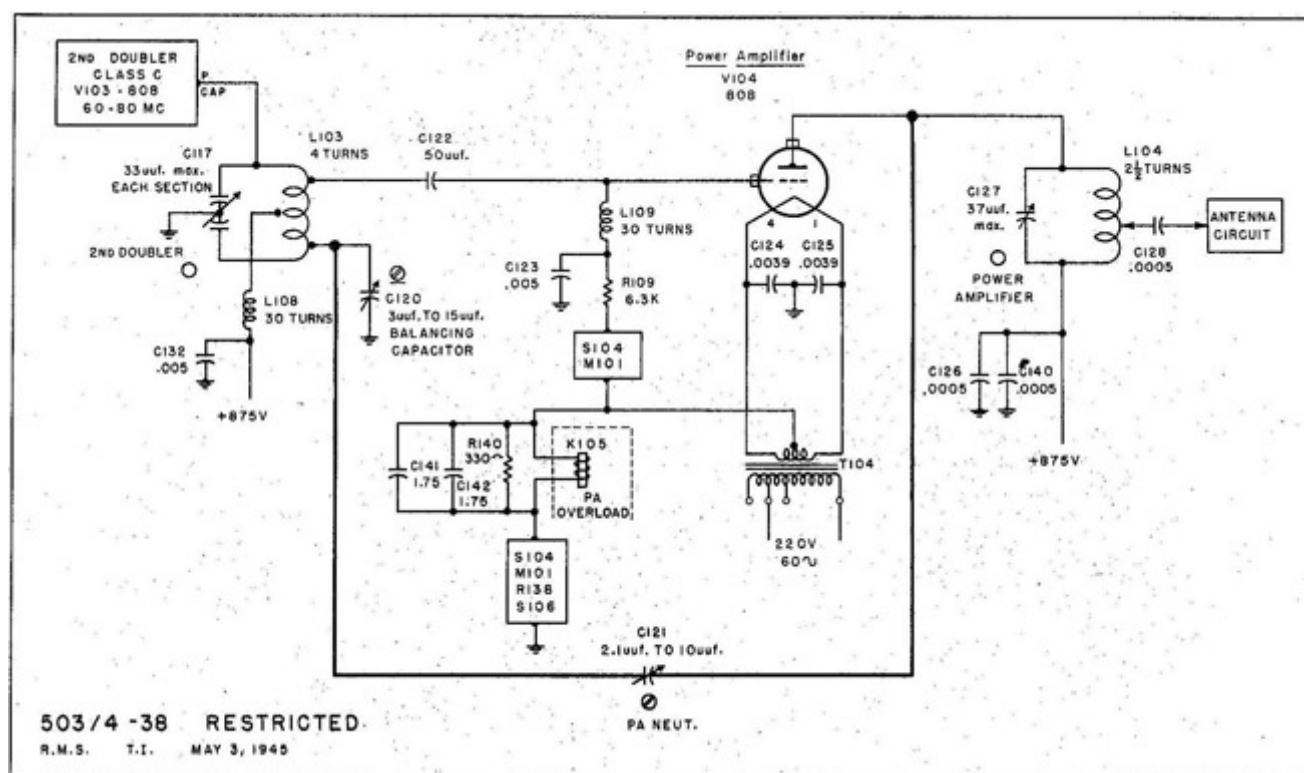


Fig. 38 TBS-6 Transmitter Power Amplifier Neutralizing Circuit.

1. **PURPOSE:** To cancel the effect of undesired feedback of RF voltage from plate to grid through the interelectrode capacity of a triode amplifier tube.

## 2. GENERAL CIRCUIT CONDITIONS:

- (a) Grid neutralization of Class C.RF amplifier using type 808 tube.
- (b) The PA grid connection and the neutralizing connection are made across equal and opposite portions of the coil in the balanced tank circuit (C-117 and L-103).
- (c) The RF voltage fed back from the PA plate through the neutralizing capacitor (C-121) cancels the undesired voltage fed back from plate to grid through the interelectrode capacity of the PA tube (V-104).
- (d) The balancing capacitor (C-120) compensates for the total capacity between the grid connection and ground, so one neutralizing adjustment will serve for the entire tuning range from 60 to 80 mc. The manufacturer specifies that C-120 should be set exactly half open and locked.

## 3. NEUTRALIZING ADJUSTMENT:

- (a) Disconnect plate voltage from the PA (V-104).
- (b) Set the meter switch to Ig PA and tune the transmitter for normal PA grid drive.
- (c) Unlock and adjust PA NEUT. screwdriver control (C-121) for minimum, change in Ig PA when POWER AMPLIFIER tuning control (C-127) is tuned through resonance.
- (d) Lock the adjustment of C-121 and replace PA plate voltage connection.

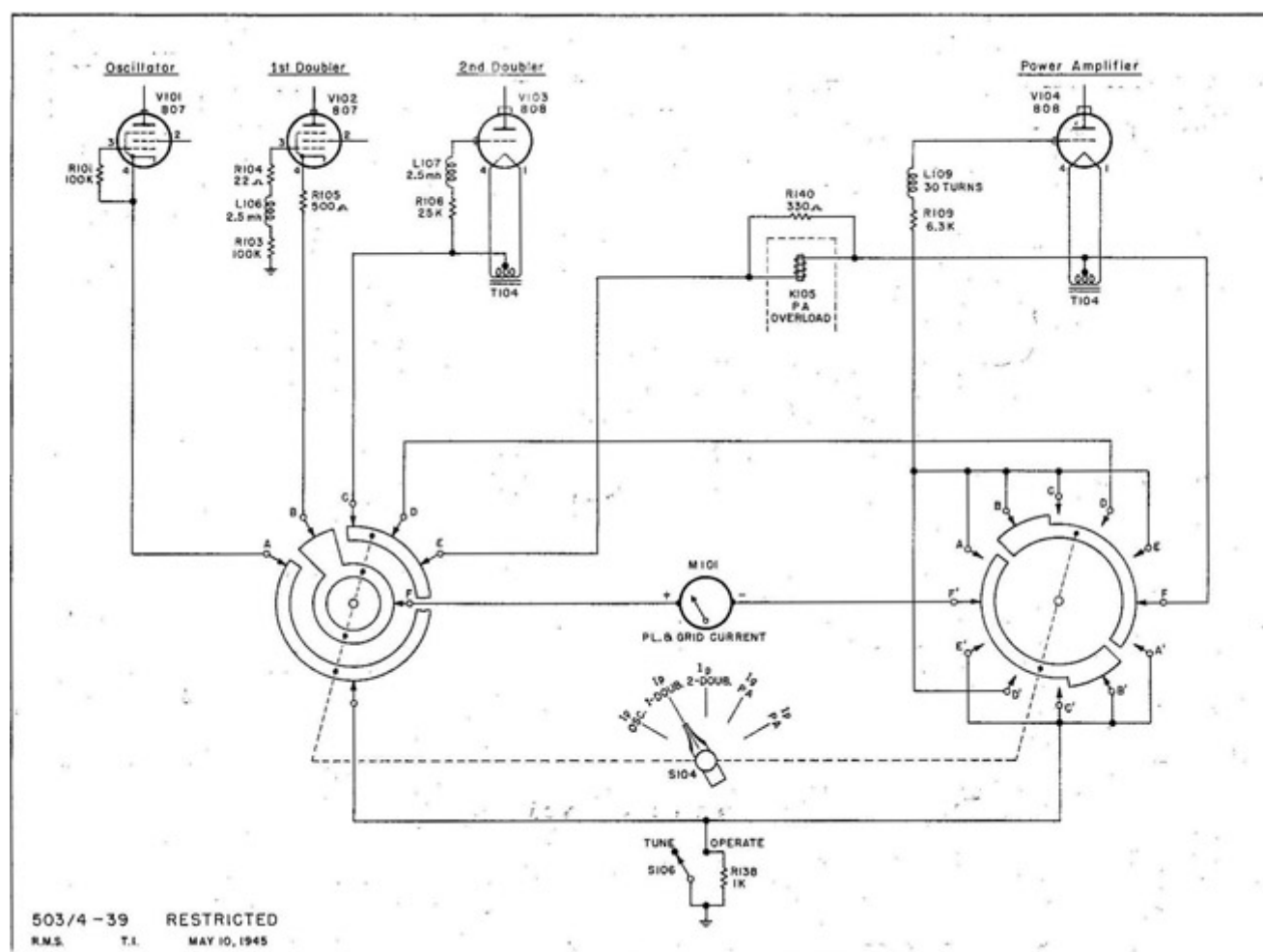


Fig. 39 TBS-6 Transmitter Meter Switching Circuit.

1. **PURPOSE:** To use one Meter (M-101) for measuring current in any one of five different circuits.

2. **GENERAL CIRCUIT CONDITIONS:**

- (a) All metering is done in the cathode or filament DC return circuits.
- (b) The meter switch (S-104) is a three-gang wafer switch.
- (c) The meter (M-101) has a 0-200 ma movement.

3. **OPERATION:** The actual currents measured in each switch position are:

- $I_p$  OSC. Plate and screen current of the RF Oscillator (V-101).
- $I_p$  1-DOUB. Plate, screen and grid current of the 1st Doubler (V-102).
- $I_p$  2-DOUB. Plate current of the 2nd Doubler (V-103).
- $I_g$  PA Grid current of the Power Amplifier (V-104).
- $I_p$  PA Plate current of the Power Amplifier (V-104).

47

## TBS-6 TRANSMITTER

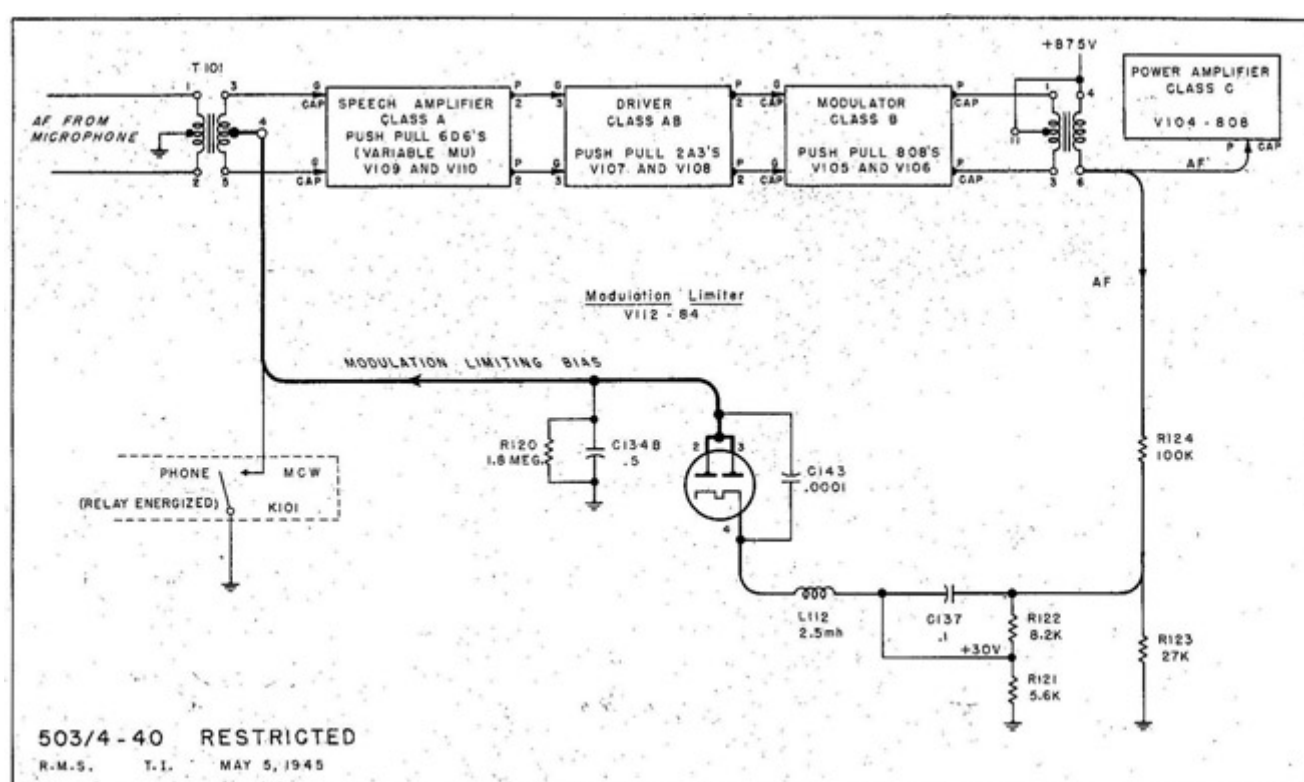


Fig. 40 TBS-6 Transmitter Modulation Limiter.

1. **PURPOSE:** To prevent over-modulation with high level voice signal input.

## 2. GENERAL CIRCUIT CONDITIONS:

- (a) Variable-mu tubes (6D6's) are used in the Speech Amplifier.
- (b) For PHONE operation, the MIME MCW relay (K-101) contacts are open.
- (c) With no AF signal, the cathode of the Modulation Limiter (V-112) is biased about 30 volts positive with respect to the plate.

## 3. OPERATION BELOW 75% MODULATION:

- (a) The AF voltage fed from the modulation transformer to the cathode of the Modulation Limiter (V-112) is less than the DC bias.
  - (1) V-112 does not conduct, so has no effect on the modulation.

## 4. OPERATION ABOVE 75% MODULATION:

- (a) The AF voltage fed to the cathode of V-112 exceeds the DC bias.
  - (1) V-112 conducts on negative signal peaks when the cathode becomes negative with respect to the plate.
  - (2) The pulses of DC Plate current from V-112 charge the filter capacitor (C-134B) negative with respect to ground.
  - (3) This negative voltage is applied to the grids of V-109 and V-110 to reduce the gain of the Speech Amplifier.
- (b) With an AF signal input 10 db greater than that required to produce 75% modulation, V-110 develops enough bias for the Speech Amplifier to limit the modulation to less than 95%.
- (c) Limiting of increasing signal levels is practically instantaneous.
- (d) Loss of limiting bias after the signal decreases is delayed by the slow discharge of C-134B through R-120 (90% recovery in 3 seconds).



[Previous  
Part](#)



[TX Home  
Page](#)