INSTRUCTION BOOK

FOR

MODEL G-187 SPECIAL PURPOSE RECEIVER

LTV - Electrosystems, Inc.
(A Subsidiary of Ling-Temco-Vought)
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WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised while working with this equipment with any of the protective covers removed.

NOTICE

This is not the original Istruction Manual of the LTV G-187 Receiver, it is only an attempt to write one from scratch (but for sure it is very close to the original manual however). It is based upon visual inspection and visual circuit tracing on an existing and unmodified LTV G-187 Receiver that has survived and upon the Instruction Manuals of some Nems-Clarke units using similar components.

The work is dated 2010-2011 and the author is Paolo Viappiani of La Spezia, Italy (pviappiani@tin.it), a radio collector whose only purpose was to share information on this particular unit.

It is a no-profit work and consequently in no way this manual may be sold and/or made object of commercial transactions.

The work is still in progress, so any contribution and suggestion is very welcome. The author also apologizes for eventual ad unwanted mistakes, misprints or omissions of which he cannot be held as responsible.

La Spezia, Italy, March 2011

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Figure 1-1. Model G-187 Special Purpose Receiver, Front View

PERFORMANCE SPECIFICATIONS

Model G-187 Receiver

Tuning Range	55-260 Mc.
IF Rejection	70 dB, minimum
Image Rejection	58 dB, minimum
Noise Figure	6 dB, maximum
Absolute Sensitivity	4 uV produces at least 23 db S/N with 100 kc deviation, 1 kc modulation frequency.
IF Frequencies	21.4 Mc. and 2.5 Mc.
IF Bandwidth	200 Kc and 40 Kc
FM Output	0.10 Volt per Kc, approximately
AM Outputs, 200 Kc and 40 Kc strips	Approx. 10V RMS for 500 uV input modulated 50% at 1 Kc.
FM Output Stability	Varies less than 2 dB for inputs above 1 uV.
AM Output Stability 200 kc and 40 kc strips	7 dB maximum variation for 40 dB variation in input.
Input (Ant.) Impedance	Approx. 50 Ohms.
Video Response	10 Cps to 300 Kc
Power Input	115 VAC, 50-60 Cps (400 Cps on special order); 28 V (DC or AC) for front panel lamps.
Power Consumption	170 Watts
Weight	40 lbs.

Power Input connector: 12-pole round male DEUTSCH, “DS” Series (12-0), J-106;

Output connector: 19-pole round female DEUTSCH, “DS” Series (19-0), J-108.

Table 1-1. Performance Specifications

LTV G-187 Semiconductor & Tube Complement

Symbol	Type	Functions
CR-101	1N457	AGC Delay Voltage
CR-102	1N458	COR Delay
CR-103	1N1695	Bridge Rectifier
CR-104	1N1695	Bridge Rectifier
CR-105	1N1695	Bridge Rectifier
CR-106	1N1695	Bridge Rectifier
CR-107	10M150Z5	150 VDC – 10 W Zener Voltage Regulator
CR-108	10M150Z5	150 VDC – 10 W Zener Voltage Regulator
CR-301		Detector (200 Kc IF Slave Subchassis)
CR-601		Detector (40 Kc IF Slave Subchassis)
CR-602		Discriminator (40 Kc IF Master Subchassis)
CR-603		Discriminator (40 Kc IF Master Subchassis)
V-101	12AU7A	1st Video Amplifier & Tuning Meter Bridge
V-102	12AU7A	Video Cathode Follower Output
V-103	12AU7A	Squelch
V-104	12AU7A	Audio Amplifier
V-105	6C4	COR Amplifier
V-106	12AU7A	COR Amplifier & Relay Driver
V-201(m)	416B/6280	1st Grounded-Grid RF Amplifier (Master Tuner)
V-202(m)	6J4	2nd Grounded-Grid RF Amplifier (Master Tuner)
V-203(m)	6AK5	Mixer, 21.4 Mc (Master Tuner)
V-204(m)	6AF4A	1st Local Oscillator (Master Tuner)
V-201(s)	416B/6280	1st Grounded-Grid RF Amplifier (Slave Tuner)
V-202(s)	6J4	2nd Grounded-Grid RF Amplifier (Slave Tuner)
V-203(s)	6AK5	Mixer, 21.4 Mc (Slave Tuner)
V-204(s)	6AK5	Oscillator Buffer (Slave Tuner)
V-301	6DC6	1st 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-302	6DC6	2nd 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-303	6CB6	3rd 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-501	6DC6	1st 21.4 Mc IF Amplifier (200 Kc BW Master Subch.)
V-502	6DC6	2nd 21.4 Mc IF Amplifier (200 Kc BW Master Subch.)
V-503	6CB6	3rd 21.4 Mc IF Amplifier , AM – 1st Limiter, FM (200 Kc BW Master Subchassis)
V-504	6AK5	AM Detector, AM; 2nd Limiter, FM (200 Kc BW Master Subch.)
V-505	6AL5	Discriminator (200 Kc BW Master Subchassis)

Table 1-2. Semiconductor and Tube Complement.

LTV G-187 Semiconductor & Tube Complement (continued)

Symbol	Type	Functions
V-301	6DC6	1st 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-302	6DC6	2nd 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-303	6CB6	3rd 21.4 Mc IF Amplifier (200 Kc BW Slave Subch.)
V-501	6DC6	1st 21.4 Mc IF Amplifier (200 Kc BW Master Subch.)
V-502	6DC6	2nd 21.4 Mc IF Amplifier (200 Kc BW Master Subch.)
V-503	6CB6	3rd 21.4 Mc IF Amplifier , AM – 1st Limiter, FM (200 Kc BW Master Subchassis)
V-504	6AK5	AM Detector, AM; 2nd Limiter, FM (200 Kc BW Master Subch.)
V-505	6AL5	Discriminator (200 Kc BW Master Subchassis)
V-601	6CW4	Mixer, 2.5 Mc (40 Kc BW Slave Subch.)
V-602	6CW4	1st 2.5 Mc IF Amplifier (40 Kc BW Slave Subch.)
V-603	6CW4	18.900 Kc Oscillator (40 Kc BW Slave Subch.)
V-604	7587	2nd 2.5 Mc IF Amplifier (40 Kc BW Slave Subch.)
V-605	7587	3rd 2.5 Mc IF Amplifier (40 Kc BW Slave Subch.)
V-606	6CW4	Mixer, 2.5 Mc (40 Kc BW Master Subch.)
V-607	6CW4	1st 2.5 Mc IF Amplifier (40 Kc BW Master Subch.)
V-608	6CW4	18.900 Kc Oscillator (40 Kc BW Master Subch.)
V-609	7587	2nd 2.5 Mc IF Amplifier (40 Kc BW Master Subch.)
V-610	7587	3rd 2.5 Mc IF Amplifier, AM – 1st Limiter, FM (40 Kc BW Master Subchassis)
V-611	7587	AM Detector, AM; 2nd Limiter, FM (40 Kc BW Master Subch)

Table 1-2. Semiconductor and Tube Complement (continued).

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT

The Model G-187 Special Purpose Receiver has been specifically designed to meet the requirements of a highly stable, extremely sensitive AM-FM receiver for critical application in the 55 to 260 Mc. range and for Direction Finding purposes specifically.

The receiver has a self-contained power supply and is capable of operation from a power source of 115 Volts +/- 10%, 50 to 60 cycles +/- 5%**,** single phase, alternating current.

The particular features of the G-187 receiver include the following: a dual-tuner and dual-IF channel system; a carrier operated relay (COR) which may be used to control auxiliary equipment; an audio squelch with adjustable threshold; FM and AM reception with very low distortion with selective IF bandwidths of 200 or 40 Kc; a separate high-quality 600 ohm audio output; a video output and a special control signal output (for direction-finding purposes).

For further details concerning the capabilities and special features of the Model G-187 receiver, see table 1-1, Performance Specifications.

2. DESCRIPTION OF EQUIPMENT

The Model G-187 receiver is 7 inches high by 19 inches wide by 19-7/8 inches deep and it weighs approximately 40 pounds.

Panel and chassis are of aluminum construction, and the front panel has a black plexiglass outer covering with aeronautical-style grazing light lamps mounted on it.

The panel is designed for standard 19 inch relay rack mounting, although the receiver is equipped with dust covers and side panels, and may be used independently on a shelf or table.

The receiver uses single-conversion (with an IF value of 21.4 Mc) for the 200 Kc. bandwidth (AM or FM modes) and double-conversion (IF values: 21.4 Mc. and 2.5 Mc.) for the 40 Kc. bandwidth (AM of FM modes).

The two bandwidth values are obtained through separate IF channels (the 21.4 Mc. - 200 KHz one using conventional miniature vacuum tubes, the 2.5 Mc. - 40 Kc. one using nuvistors instead), by properly switching the H.V. supply to the involved subchassis.

Both the IF amplifiers are "doubled units" (one section is fed by the "Master" RF Tuner and the other one by the "Slave" RF Tuner, so there are four IF channels total in the receiver).

For each mode and bandwidth, the "Master" RF-IF channel provides to the signal treatment and intelligence, while the "Slave" RF-IF Channel produces special outputs (suitable for direction finding purposes) and is also used for driving the signal strength meter and for AGC.

The two RF Tuners are identical each other but as for the oscillator circuit (a common oscillator stage is employed for both the mixers and it is allocated in the "Master Tuner"); both of them make use of a 4-Section Mallory "Inductuner" each.

The RF Tuners employed in the G-187 receiver derive directly from the ones that Nems-Clarke Co. used in their "1302" and "1502" receivers.

Inductuners are mechanically tuned variable inductors for VHF and UHF applications that are tuned using a common rotary shaft moving contacts along single turn or spiral silver coils. This is a product Mallory has been making since the 1940s and it is still used in military communications equipment and precision test instruments.

The advantage of the Inductuner over other variable inductance devices is its stability and repeatability; it operates on the principle that inductance of two lines, shorted at one end, is proportional to the area that these lines enclose. Two such lines are laid concentrically on a coil form and a shorting contactor, connected to the tuning shaft, is allowed to be moved along their length, changing the inductance.

The tuning dial on the G-187 receiver series is a spiral scale printed on 1/8" thick translucent plastic disk illuminated from behind. A small crescent-shaped window mask, sliding vertically, tracks each spiral showing on the relevant part as the radio is tuned. This dial mechanism is a common item in some Nems-Clarke and CEI equipments. All the receiver circuits are built as completely shielded subassemblies with most of the audio and video components mounted on a single terminal board on the underside of the main chassis.

The G-187 receiver is not intended for CW reception and so it is not equipped with a BFO.

It is also worth to say that the audio output of the G-187 receiver is at a very low level; for sure this receiver requires an external audio amplifier associated to a good speaker for a comfortable listening.

Figure 1-1 shows a front view of the Model G-187 receiver, and table 1-2 shows the semiconductor and tube complement.

As shown by the various pictures of the manual, the two RF Tuners are located in the center of the G-187 chassis, while the 200 Kc. "Double- Channel" 21.4 Mc. strip is placed near the left side of the receiver. The 40 Kc. "Double-Channel" nuvistor 2.5 Mc. IF subchassis is directly fastened just to the left side panel by three 1/2"-turn screws.

Near the rear panel of the unit are located the video, audio, squelch and COR circuits, while the power supply circuits are located in the right side of the main chassis instead.

All the connections between subchassis are made by coaxial cables or color-coded single wires.

It's also useful to notice that the components employed in the various sections of the receiver are identified by different "prefixes" according to the section itself, i.e.:

Prefix:	Receiver Section:
1xx	Main Chassis;
2xx	Both the RF Tuners;
3xx	200 Kc. - 21.4 Mc. IF "Slave Channel"
5xx	200 Kc. - 21.4 Mc. IF "Master Channel"
6xx	40 Kc. - 2.5 Mc. IF Channels (Both "Master" and "Slave").

This means that, as an example, R-101 identifies a resistor located in the Main Chassis, L-203 an inductor placed in one of the two RF Tuners, T-305 a trasformer located in the 200 Kc. - 21.4 Mc. IF subchassis ("Slave Channel") and so on.

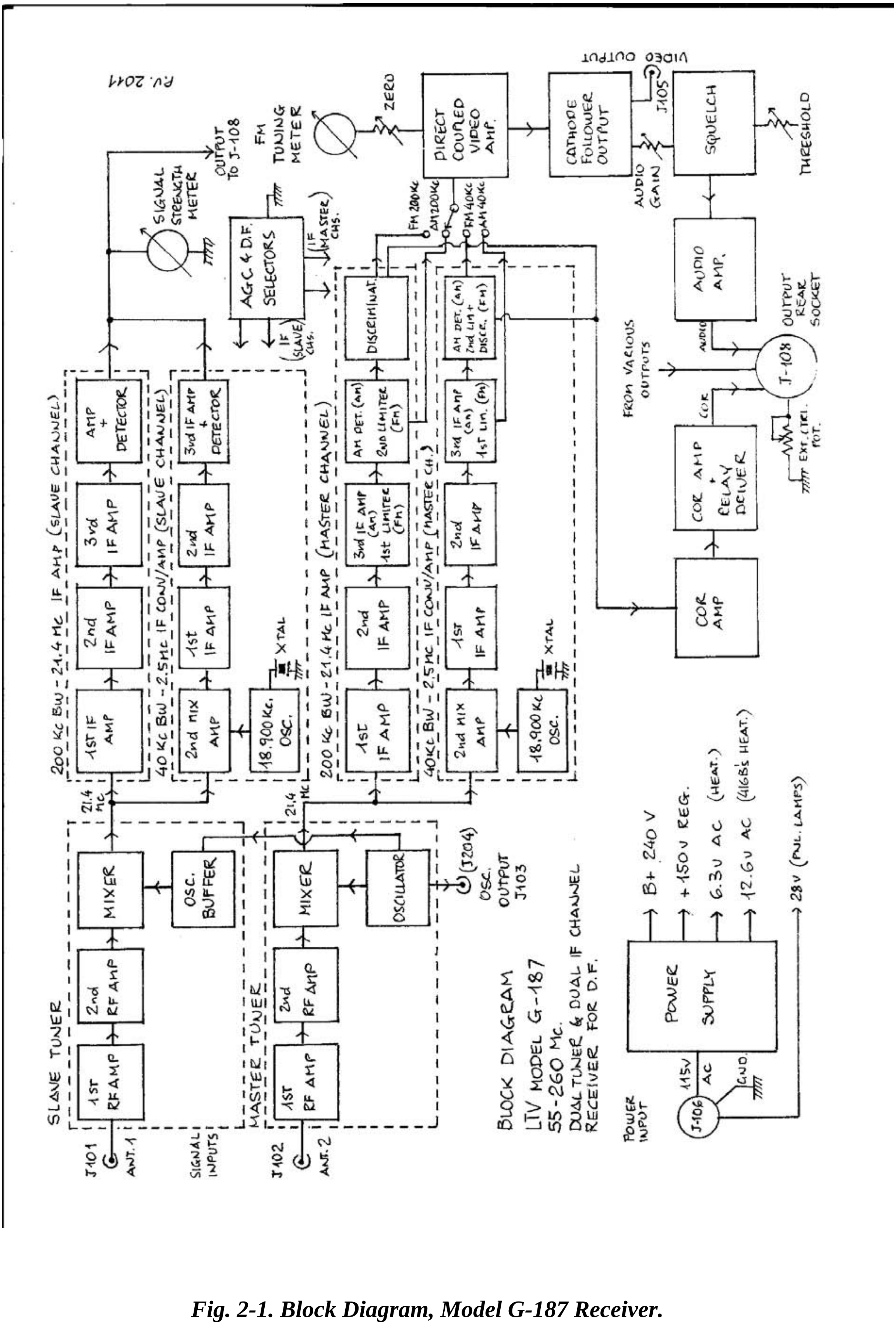

Fig. 2-1. Block Diagram, Model G-187 Receiver.

SECTION 2

THEORY OF OPERATION

1. ANALYSIS, MODEL G-187 RECEIVER

a. A block diagram of the Model G-187 receiver is shown in Figure 2-1.

The circuit, with the function switch in the 200 Kc AM or FM position is a single superheterodyne with an IF of 21.4 Mc. With the function switch in the 40 Kc AM or FM position, a dual-conversion circuit is used, with a 21.4 Mc first IF, followed by a 2.5 Mc second IF.

Each of the separate IF channels used for the available bandwidths has been built in a two-section arrangement: one section is fed from the “Master Tuner” output and the other from the “Slave Tuner” output. The “Master” section is used for FM and AM signal demodulation, while the “Slave” section produces special outputs for AGC and Direction Finding purposes and is not directly involved with signal intelligence.

The 2.5 Mc IF strips and double-conversion are used for the 40 Kc bandwidth only and make use of a special kind of tubes (called “Nuvistor”) in a separate subchassis that is fastened to the left side of the receiver. Such a subchassis is the “FM-75J-100 IF strip” that was built by CEI.

The two RF tuners are designed to produce the lowest possible noise figure consistent with the type tube used (a 416B first RF amplifier} and a practical tuning structure capable of tuning 55 to 260 mc, with reasonably uniform performance over the band.

The basic tuning element in both the tuners is a Mallory type S-4 spiral inductuner. The input circuit is broadly tuned by the first section of the inductuner. The second and third sections double tune a bandpass filter to produce a high gain with a minimum response to spurious signals. Adjustable coupling is provided by a capacitive "tee" section between the input and output sections of the bandpass filter. The remaining inductuner section is used as the oscillator tank inductance in the “Master” tuner and as a simple tuning device in the plate circuit of the oscillator buffer in the “Slave” tuner.

The IF amplifiers, with the function switch in the 200 Kc. FM position, use two stages of amplification, cascade limiters and a phase-shift discriminator. With the function switch in the 200 Kc. AM position, AGC voltage is applied to the first two stages, and the second limiter becomes the AM detector. With the function switch in the 40 Kc. FM or AM position, plate voltage is removed from the 21.4 Mc IF amplifiers and applied to the 2.5 Mc dual conversion mixer and IF amplifier channels.

The output signal of the two “Master” IF strips (200 Kc. AM and FM or 40 Kc. AM and FM) drives a two-stage direct-coupled video amplifier with cathode follower output. A portion of the follower output drives a four-stage squelch-audio amplifier circuit whose output is fed to the J-108 connector (a 19-pole round female connector of the Deutsch “DS” Series) placed in the rear apron of the receiver.

During either AM or FM operation the carrier operated relay (COR) is actuated by AGC voltage from the stage which functions as either a detector or second limiter. The COR controls a light and two sets of DT contacts (in the above mentioned J-108 connector) to which auxiliary equipment can be connected.

To the same connector is also fed the output signal of the two “Slave” IF strips (200 Kc. AM and FM or 40 Kc. AM and FM); it can be used for direction-finding purposes and is also employed for the AGC circuits and for driving the signal strength meter.

2. "MASTER" AND "SLAVE" RF TUNERS

a. ANTENNA INPUTS

The main and auxiliary antenna inputs are two N-type connectors mounted on the chassis rear apron, from which the signal is applied to each RF Tuner (“Master” and “Slave”).

The input impedance of each tuner is approximately 50 ohms over the frequency range of 55 to 260 Mc.

b. FIRST RF STAGE (“MASTER” OR “SLAVE” TUNER)

The input signal is applied to the cathode of the 416B low noise planar triode.

To prevent loss of input signal due to cathode-to-filament capacity, the filaments are kept above RF ground with broad-band chokes. The input resistance of the 416B is approximately equal to 2/Gm when RL = RP, and in this case is 40 Ohms.

The cathode circuit is not tuned, due to the extreme bandwidth produced by the 40-Ohm shunt load and the low cathode-to-ground capacity.

The plate tank circuit takes the form of a modified pi network and is used to couple the high impedance plate circuit of the 416B tube to the low input impedance of the 6J4 grounded grid second RF amplifier.

c. SECOND RF STAGE (“MASTER” OR “SLAVE” TUNER)

The output of the pi-network drives the cathode of the 6J4 grounded-grid second RF amplifier. A low-noise second stage is used so that the system noise figure (first RF, second RF, and mixer) is essentially that of the first stage.

The plate of the 6J4 is coupled to the grid of the 6AK5 pentode mixer by a double-tuned over-coupled band-pass filter. A capacity "T" is used to provide coupling between the primary and secondary tuned circuits. The shunt element of the "T" is adjustable, thus providing a control over the interstage bandwidth.

A small iron-core inductor across the shunt element of the "T" network approaches parallel resonance at 55 Mc, thus increasing the coupling at the low end and providing a more uniform coupling over the tuning range of 55 to 260 Mc.

The single-tuned high Q plate circuit of the 416B tube is used to "fill in" the dip in the over-coupled interstage network. The overall RF response when viewed at the mixer grid test point is essentially flat over the band.

A convenient means for measuring the plate current of the 416B tube is made possible by TP-201 at the junction of R-201 and R-202, the cathode bias resistors. A VTVM at TP-201 will read the voltage drop across 100 Ohms. Thus 2V equals 20 mA, 5V equals 30 mA, etc.

The filament of the 416B is operated from a 12.6 volt winding of T-101 through a total series dropping resistor of 5.1 Ohms. This produces a self-regulating effect, which extends the tube life.

A blower motor mounted on the front end assembly is used to cool the 416B tube. The motor plugs into the main chassis with a Jones plug. A jumper between two of the pins of the Jones plug removes plate voltage from the 416B when the motor is disconnected, thus protecting the tube.

Positive grid bias of 8 Volts is applied from a voltage divider from the 150 Volt regulated B+. This voltage is necessary to cancel the cathode self-bias voitage of 8.2 Volts so that the tube will operate with approximately 0.2 Volts bias. The D-C degeneration due to the large cathode resistor has a considerable stabilizing effect on the 416B tube and minimizes performance variations from one tube to the next if replacement becomes necessary.

If, for any reason, the grid bias voltage is shorted or removed, the plate current is reduced and the tube will not be damaged.

d. MIXER (“MASTER” OR “SLAVE” TUNER)

A 6AK5 pentode is used as a converter. The oscillator signal is injected into the grid circuit, developing an operating bias proportional to the amplitude of the local oscillator signal. This causes a minimum effect on the receiver operation due to variations in local oscillator amplitude. A de-coupled test point (TP-202) from a tap on the mixer grid resistors provides a convenient means for observing the response of the RF circuits.

The output signals from the mixers (IF signals) have a frequency of 21.4 Mc.

e. LOCAL OSCILLATOR (“MASTER” TUNER ONLY)

The local oscillator utilizes a 6AF4A tube in a modified Colpitts configuration. The end inductors are made of heavy straps to insure frequency stability. The frequency stability of the oscillator is very high due to the use of a high Gm tube which is loosely coupled to the high Q tank circuit.

The Local Oscillator is present in the “Master” Tuner only and its signal is fed to the mixer stages of both the tuners (directly in the “Master” Tuner and through a buffer stage in the “Slave” Tuner). The oscillator signal is also fed (via the J-204 socket) to J-103, a BNC socket in the rear apron of the receiver, so that the oscillator frequency can be precisely measured or the signal used for other purposes.

f. OSCILLATOR BUFFER (“SLAVE” TUNER ONLY)

A 6AK5 pentode is used in this stage as “oscillator buffer”, in order to avoid any loading effect to the oscillator itself.

3. IF STAGES

The first 21.4 Mc IF transformers, located on the 200 Kc. IF subassembly (T-302 in the “Master” channel and T-301 in the “Slave” channel) are connected to the respective mixer plates through short lengths of RG-62/U coaxial cable that also carry the regulated voltage (+150 V DC) to the mixer plates.

In addition the 21.4 Mc signal from the mixers is applied to the two channels of the “Nuvistor” IF strip (via coaxial cables plugged into proper SMA sockets in the subchassis) and reachs the 2.5 Mc mixer tubes (V-606/V-607 and V-601/V-602 for the “Master” and the “Slave” channels respectively, all 6CW4’s).

The four-position “Function” switch also provides to apply the H.V. to the proper pair of IF subchassis (200 Kc or 40 Kc IF subassemblies) depending upon the selected mode and bandwidth.

a. FUNCTION SWITCH IN 200 Kc FM POSITION, MASTER IF CHANNEL

Two high gain stages (V-501, V-502) using 6DC6 tubes are followed by a 6CB6 (V-503) first limiter and a 6AK5 (V-504) second limiter. A 6AL5 (V-505) is used in a discriminator circuit of the phase-shift type. Accurate balance is obtained by using a bifilar winding for the secondary. An automatic gain control voltage is derived from the first limiter grid circuit and applied to the first IF amplifier stage. The first IF amplifier and the first limiter do not have their cathode resistors bypassed, thus causing cathode degeneration which practically eliminates the detuning caused by changes in tube input capacitance resulting from a change in the bias voltage. Such circuitry is not necessary in the second limiter due to the different tube structure and smaller change in grid bias. A minimum of approximately one volt bias is on the second limiter due to grid rectification of noise signals, A self-resonant choke is connected in the output lead of the discriminator to prevent IF signals from leaving the IF subassembly.

b. FUNCTION SWITCH IN 200 Kc AM POSITION, MASTER IF CHANNEL

The first two high-gain 6DC6 remote cutoff amplifiers (V-501, V-502) receive an AGC voltage developed at the grid of the 6AK5 (V-504) AM detector. The third IF amplifier (V-503) which drives the AM detector is not gain controlled but its signal handling capabilities have been improved by increasing the screen voltage. A self-resonant choke is connected in the AM output lead from the 6AK5 AM detector (V-504) to prevent IF signals from leaving the IF subassembly.

With the AGC switch in the manual position the AGC voltage is shorted to ground, and the IF gain control in the cathode circuit of the two 6DC6 IF amplifiers is unshorted and becomes operative. The gain-controlled stages use cathode compensation of input capacity variation with bias change. The zero center tuning meter operates only in the FM position. Correct tuning of an AM signal may be accomplished by first tuning in the signal with the selector switch in the FM position and then switching to the AM 200kc position.

c. FUNCTION SWITCH IN 200 Kc FM OR AM POSITION, SLAVE IF CHANNEL

Also the “Slave” 21.54 Mc IF channel has two high-gain stages (V-301, V-302) using 6DC6 remote cutoff amplifiers that can receive an AGC voltage The third IF amplifier (V-303) drives a solid-state AM detector (CR-301) whose output is used for various purposes (AGC, signal strength meter M-101, direction finding) .

The M-101 meter has a logarithmic characteristic and it is not calibrated, though it may be used for a relative indication of signal strength.

d. FUNCTION SWITCH IN 40 Kc FM POSITION, MASTER IF CHANNEL

Plate and screen voltage are removed from both the channels of the 21.4 Mc IF amplifier subchassis and a 21.4 Mc signal is coupled from T-602 to the grid of V-606 (6CW4), that together with V-607 (6CW4) forms a 2.5 Mc cascode mixer. V-608 (6CW4) is the 18.9 Mc crystal controlled 2nd conversion oscillator, that is capacitively coupled to the above mentioned cascode circuit.

The output of the 2.5 Mc mixer is coupled to V-609 (7587), a 2.5 Mc amplifier, and then is fed to V-610 (7587) through L-606 and L-607, which, together, comprise a 2.5 Mc double-tuned 40 Kc. Pass-Band filter.

In FM mode, V-610 (7587) acts as the first limiter and V-611 (7587) as the second limiter, while two solid-state diodes (CR-602 and CR-603) form the discriminator circuit.

e. FUNCTION SWITCH IN 40 Kc AM POSITION, MASTER IF CHANNEL

Plate and screen voltage are removed from both the channels of the 21.4 Mc IF amplifier subchassis and a 21.4 Mc signal is coupled from T-602 to the grid of V-606 (6CW4), that together with V-607 (6CW4) forms a 2.5 Mc cascode mixer. V-608 (6CW4) is the 18.9 Mc crystal controlled 2nd conversion oscillator, that is capacitively coupled to the above mentioned cascode circuit.

The output of the 2.5 Mc mixer is coupled to V-609 (7587), a 2.5 Mc amplifier, and then is fed to V-610 (7587) through L-606 and L-607, which, together, comprise a 2.5 Mc double-tuned 40 Kc. Pass-Band filter.

In AM mode, V-610 (7587) acts as a further 2.5 Mc IF amplifier and V-611 (7587) as an AM detector. A self-resonant choke is connected in the AM output lead to prevent IF signals from leaving the IF subassembly.

f. FUNCTION SWITCH IN 40 Kc FM OR AM POSITION, SLAVE IF CHANNEL

Again, plate and screen voltage are removed from both the channels of the 21.4 Mc IF amplifier subchassis and a 21.4 Mc signal is here coupled from T-601 to the grid of V-601 (6CW4), that together with V-602 (6CW4) forms a 2.5 Mc cascode mixer. V-603 (6CW4) is the 18.9 Mc crystal controlled 2nd conversion oscillator, that is capacitively coupled to the above mentioned cascode circuit.

The output of the 2.5 Mc mixer is coupled to V-604 (7587), a 2.5 Mc amplifier, and then is fed to V-605 (7587) through L-602 and L-603, which, together, comprise a 2.5 Mc double-tuned 40 Kc. Pass-Band filter.

V-605 (7587) acts as a further 2.5 Mc IF amplifier and a solid-state diode (CR-601) acts as a detector.

Also the output of the “Slave” 40 Kc IF channel is used for various purposes (AGC, signal strength meter M-101, direction finding) whose output is used for various purposes (AGC, signal strength meter M-101, direction finding) .

4. OTHER CIRCUITS

a. VIDEO

The output of the “Master” channel of the IF strips (200 or 40 Kc) drives one half of a 12AU7A direct-coupled video amplifier (V-101A). A zero center scale meter (M-102) is used as a tuning indicator and is connected in a bridge circuit consisting of the video amplifier and the other half of the 12AU7A (V-101B). A partial bypass of the cathode of the first video amplifier extends the high frequency response. The output video amplifier is a 12AU7A tube (V-102) connected as a direct-coupled cathode follower. A potentiometer (R-122) in series with the cathode resistor of the output video amplifier provides the signal source to drive the monitor audio amplifier, V-104.

b. SQUELCH

The squelch circuit is best described with the aid of the simplified schematic of Fig. 2-2.

V-103B (1/2 12AU7A) acts as a gated audio amplifier stage, while V-103A (1/2 12AU7A) serves as a d-c amplifier and gate generator. The circuit is connected in such a manner that V-103A has zero grid voltage when no signal is being received and has a negative signal applied when a carrier is being received. The audio amplifier stage, V-103B, will pass an audio signal when the d-c amplifier, V-103A, is nonconducting, and will not pass an audio signal when V-103A is in a conducting condition. In this manner the audio circuit is disabled when no carrier is being received. The carrier strength necessary to make the audio section operative is adjusted by the threshold (squelch) control R-107.

The operation of this circuit is detailed in the following paragraph.

The DC amplifier tube, V-103A, is connected between the 150V supply and ground. The fixed bias on this stage is adjusted by R-107. The audio section, V-103B, is connected between the 250 volt supply and the 150 volt supply. The bias on this stage is the voltage drop across the cathode resistor, R-131, plus the voltage drop, if any, in the plate load resistor, R-129, in V-103A. Assuming no signal is being received, the grid of the DC amplifier tube is zero, or at most has a very small negative voltage on it.

R-107 is adjusted until the noise just disappears from the output. In this condition the DC amplifier tube is drawing plate current, and the drop across its plate load, R-129, appears as a bias to V-103B. This voltage drop is sufficient to cut off V-103B and disable the audio signal.- When a carrier is tuned in, a negative voltage is supplied from the second limiter in the IF strip through an isolation resistor, R-126, to the grid of V-103A. This voltage is sufficient to cut off V-103A, causing the voltage to drop to zero across the V-103A plate load resistor, R-129. V-103B receives only its normal cathode bias generated in its cathode bias resistor, R-131, and audio signals are passed through to the output.

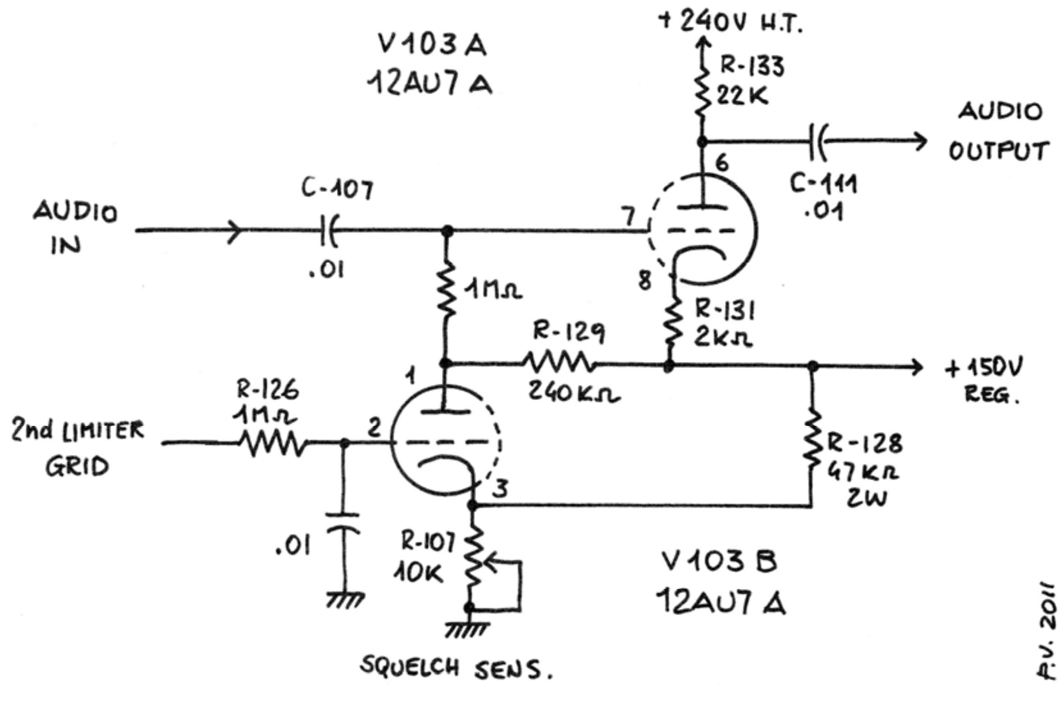

Fig. 2-2. Model G-187 Receiver Squelch Circuit, Simplified Schematic.

When receiving amplitude-modulated signals with a high percentage of modulation, the squelch circuit may be cut off on negative modulation peaks when the envelope amplitude becomes zero. To prevent this, a filter consisting of R-126 and the .01 uF cap is placed between the limiter and the grid of the d-c amplifier. This filter has a long enough time constant to reject the lowest audio frequency likely to be received, but not long enough to noticeably delay operation of the squelch.

c. AUDIO AMPLIFIER

The output of V-103B is used to drive a two-stage resistance coupled audio amplifier. The output amplifier drives an independent 600-ohm balanced output placed in the J-108 rear socket.

d. CARRIER OPERATED RELAY (COR)

The Carrier Operated Relay (COR) circuit is best described with the aid of the simplified schematic of Fig. 2-3. This circuit provides carrier-on, carrier-off control of a panel light and auxiliary equipment, provided such equipment is connected to the two available sets of relay contacts through their terminating points on J-108, a socket on the chassis rear apron.

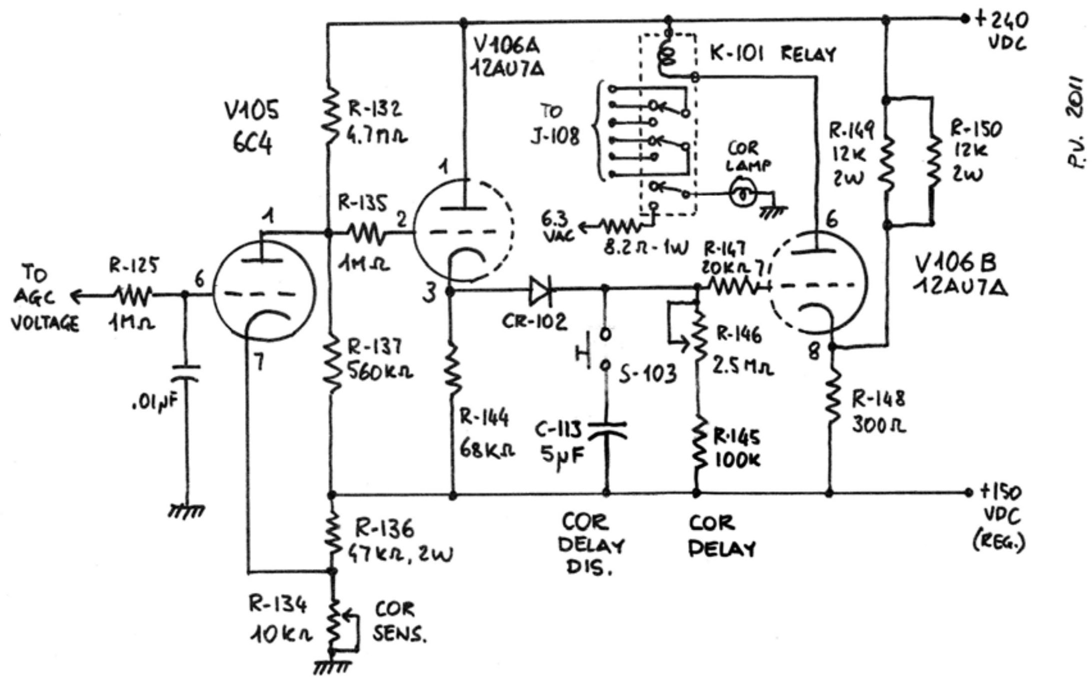

Fig. 2-3. Model G-187 Receiver COR Circuit, Simplified Schematic.

The relay is actuated when a carrier of adequate strength is received. When the carrier disappears, the relay transfers to its unactuated position within 3 to 13 seconds. A chassis rear-apron mounted COR DELAY ADJUST control (R-146) may be used to vary the delay period of the carrier-off functioning within those limits of time.

The sensitivity of the circuit to varying levels of carrier strength is adjustable by means of a panel mounted COR SENS control and a panel mounted COR DELAY DISABLE control is available to remove the delay of the carrier-off action while adjusting sensitivity. The circuit accomplishes control of the relay by the carrier through the use of three stages of DC amplification, the first being voltage-controlled by AGC and the last actuating the relay.

The presence of a carrier causes the AGC voltage to block the first stage and this in turn causes the next two stages to conduct.

The AGC voltage is applied through resistor R-125 to the control grid of a triode section of a type 6C4 tube, V-105. The stage is cathode biased by COR SENS potentiometer R-134 to a point such that it is cut off by the AGC voltage and the potentiometer may be used to vary the AGC voltage level (and hence carrier level) required to block the tube.

With the second stage directly coupled to the first stage, the second stage grid is swung in a positive or negative direction by the voltage drop across the first stage plate-load resistor, R-132. The connection of the second stage between 240 VDC and 150 VDC, and the use of a cathode resistor, R-144, biases the second stage to a level such that the amount of positive or negative grid swing it receives from the first stage is enough to either block the second stage or allow it to conduct. Therefore, the second stage conducts when AGC voltage blocks the first stage. Conduction through the second stage causes a positive voltage, developed across the second stage cathode resistor, R-144, to be applied through the forward resistance of diode CR-102 to the grid of the third stage, V-106B. A cathode follower configuration is used in the second stage so that capacitor C-113 is charged through a low impedance and therefore charges rapidly. Such rapid charging action is necessary to avoid delaying the carrier-on action because the voltage applied to the third stage grid does not reach the full value of that developed across resistor, R-144 until capacitor C-113 has fully charged.

The third stage is connected between 240 VDC and 150 VDC and receives a fixed bias from a voltage divider made up of resistors R-149 and R-150 in parallel and in series with resistor R-148 between 240 VDC and 150 VDC.

This bias is enough to keep the third stage blocked until its grid receives a positive charge from the second stage The carrier operated relay, K-101, is connected in the third stage plate circuit and is closed when the tube conducts. Thus the presence of AGC voltage, by causing the first stage to block and the second stage to conduct, ultimately causes the third stage to conduct and the relay to close.

When the carrier disappears, causing the second stage to cease conduction, the relay is held closed for a period of 3 to 13 seconds due to third stage conduction which results from the fact that capacitor C-113 holds a positive charge on the third stage grid. Since the presence of diode CR-102 necessitates that this capacitor discharge only through resistor R-145 and COR DELAY potentiometer R-146, adjustment of this control provides variation of the length of the time between the loss of the carrier and the transferring of the relay to the carrier-off position.

The relay has three sets of contacts, two of which are made available for use in the carrier control of auxiliary equipment by their connection to J-108 on the chassis rear apron.

The third set of relay contact controls the COR panel light so that it is on when a carrier is present and off when there is no carrier.

The COR light is physically combined with a pushbutton switch, the COR DELAY DISABLE control, DS-103. When depressed, this switch disconnects one side of capacitor C-113 from the circuit, no longer permitting the capacitor to delay the carrier-off functioning of the circuit. This is desirable during sensitivity adjustment of the circuit.

e. POWER SUPPLY

A conventional two-section capacitive input filter power supply delivers a DC potential of 240 volts, while CR-107 and CR-108 (150 V – 10 W Zener diodes) provide two separate 150 VDC regulated outputs.

A 6.3-volt winding supplies the filaments of all tubes except the two V-201 tubes (416B’s) in the RF Tuners. The two V-201 tubes are supplied by a separate 12.6 VAC winding of the power transformer T-101 in series with external 5.1-Ohm dropping resistors.

f. SIGNAL STRENGTH AND TUNING METERS

The signal strength meter, M-101, indicates the relative strength of the carrier being received by reading the value of the AGC voltage with respect to ground; it works both in AM and in FM mode.

During FM reception only, the TUNING meter, M-102, indicates the accuracy of the receiver tuning. The meter does this by reading the value of the DC component of the discriminator output, a component which is zero when tuning is exact and, when tuning is inexact, is of a polarity determined by the direction in which tuning is off.

A potentiometer (R-118) placed in the rear apron of the receiver is useful for adjusting the tuning meter to zero.

The tuning meter functions only during FM reception because its operation is dependent on the discriminator output which does not reach the video amplifier during AM reception.

SECTION 3

OPERATION

1. INTRODUCTION

Since operating instructions for the receiver depend largely on system integration, a complete discussion of receiver operation is not presented here. However, Figure 1-1 shows the appearance and location of controls on the front panel of the Model G-187 Special Purpose Receiver.

2. CONTROL SETTINGS

a. POWER.--Turn on the power switch, S-105, located on the front panel.

b. FUNCTION SWITCH --The modulation and bandwidth ("Function") selector switch (S-102 A-F) has four positions, 40 Kc. AM, 40 Kc. FM, 200 Kc. AM or 200 Kc. FM. Use the one that best fits your receiving needs, keeping in mind that:

(Positions 1-3): AM 40 Kc. or AM 200 Kc. -- The "Mon" AGC rotary switch (small inner knob) could be in the "ON" (AVC) or the "OFF" (MAN) position, in the latter case the manual RF gain control (R-102) should be adjusted to produce the desired overall gain.

(Positions 2-4): FM 40 Kc.or FM 200 Kc. -- The "Mon" AGC rotary switch (small inner knob) and the RF gain control are inoperative in the FM positions. The zero-center tuning meter (M-102) is operative only in the FM positions.

c. SQUELCH.--The squelch circuit is inoperative with the squelch control (R-107) counterclockwise against its stop. In the absence of a signal, rotate the squelch threshold control clockwise until the background noise just becomes inaudible. Any usable signal should then disable the squelch circuit.

d. AUDIO GAIN -- Adjust as needed.

SECTION 4

MAINTENANCE

1. INTRODUCTION

The model G-187 receiver should give comparatively trouble-free performance. If, however, trouble occurs, rapid and effective trouble shooting may be accomplished by the application of a simple effect-to-cause reasoning process, along with the data given in this section.

A thorough knowledge of the theory of operation, as contained in Section 2, is essential to successful effect-to-cause reasoning. As a general statement, it may be said that frequent recurrence of a trouble usually indicates that the effect and not the cause has been remedied, and further investigation should be made.

In time, the blowers for the 416B tubes (V-201 x 2) may become clogged with dust collected from the atmosphere. Since this impairment of the blower's efficiency may cause the loss of very expensive tubes, it is recommended that the blowers be disassembled and cleaned whenever they are found to be sufficiently dirty to warrant such action.

The overall schematic diagram contained herein will be useful in locating trouble. Such trouble as broken leads or solder joints and loose or defective tubes will not be discussed at length here, but should be suspected and searched for in all cases where the trouble is not immediately apparent. The illustrations given in this section show the location of all major components and such smaller components as cannot be readily identified from adjacent stencils on the receiver.

All illustrations of an overall nature (front, top, bottom, and rear views of the receiver) are referred to the G-187 latest version (G-187-00951-1), equipped with an auxiliary 40-Kc. Bandwidth Nuvistor subchassis and provided with a four-position Function switch (40 Kc AM/40 Kc FM/200 Kc AM/200 Kc FM). With certain reservations, however, these illustrations will serve to represent all versions of the Model G-187 receiver, since all of them have identical chassis and sub-assemblies.

2. IF ALIGNMENT PROCEDURE. (***Sweep Method***)

a. General Instructions.— In order to minimize the frequency response of the detectors (including their decoupling networks) used for visual alignment, the sweep generator sweep width used should be no greater than that required to produce the desired oscilloscope pattern. The marker generator signal at 21.4 mc should be coupled in as required to produce a suitable marker pip. Check to see that the marker generator connection does not upset the response shape by disconnecting the marker generator and observing that the response shape does not change. In general, the marker signal can be introduced by connection to a turn or two of insulated wire wrapped around the sweep generator lead near the point of connection to the circuit under test, or by coupling to the sweep generator lead through a small capacitor.

In order to avoid extraneous coupling or regeneration, the sweep and the market generator leads should be dressed out and away (toward the input end) from the stages already tuned.

A low capacity shielded cable, such as RG-62/U coaxial cable should be used for connection to the oscilloscope. The cable capacity, plus oscilloscope input capacity, should be held to a maximum of 100 uuF. The direct coupled (DC) vertical amplifier connection should be used on the oscilloscope.

The adjustment procedure should be carefully followed and adjustments should be made in the order given. The receiver should be allowed sufficient warm-up time to stabilize its operation.

b. Equipment Required.—

(1) Sweep Generator Type RCA 59-C.

(2) Oscilloscope, Type Dumont 304-A or equivalent.

(3) 21.4 Mc center frequency crystal controller, marker, with side markers of 21.025 and 21.775 Mc.

(4) One 10.0 ohm, 1/2 Watt resistor.

(5) One 200 ohm, 1/2 Watt resistor.

(6) Assorted leads and connectors as indicated in text.

c. Control Settings.— During the entire alignment procedure the receiver controls must be set as follows unless otherwise indicated:

(1) Squelch Control .... Maximum CCW..

(2) Audio Gain ....Maximum CCW,

(3) Function Switch ....Place in 200 Kc. FM position.

(4) Mon (AGC) rotary switch......................................Place in OFF (MAN) position.

(5) RF GAIN Control ....Set maximum CCW.

"Master" 200 Kc. IF Channel Alignment

Turn on power. Set receiver tuning dial to lowest frequency and remove local oscillator tube V-204 in the "Master" Tuner.

d. Second Limiter, Adjustment of T-507.— Remove second IF amplifier V-502 from its socket. Connect the scope to second limiter grid (pin 1 of V-504).

Connect the sweep generator between first limiter grid (pin 1 of V-503) and ground on the tube socket mounting strap nut. Set the sweep generator output to maximum. Adjust T-507 for a symmetrical response centered around the center frequency marker at 21.4 Mc.

e. Discriminator, Adjustment of T-508.- Remove the first limiter V-503 from its socket. Connect the sweep generator between pin 1 of V-504 and ground on the tube socket mounting strap nut. Set the sweep generator output to maximum, Adjust the discriminator transformer T-508 for a Symmetrical S-shaped discriminator curve, centered around 21.4 Mc.

The discriminator peak-to-peak separation should be 750 Kc, plus or minus 30 Kc.

The adjustments for equal amplitude of the two peaks should be made with the marker disconnected to prevent base-line shift.

f. First Limiter, Adjustment of T-505, and T-506- Replace V-502 and V-503. Remove V-501. Connect the scope to first limiter grid (pin 1 of V-503). Connect the sweep generator between pin 1 of the second IF amplifier V-502 and ground on the tube socket mounting strap nut. Set the sweep generator to produce a peak scope deflection of 0.25 Volts. Adjust T-505 (primary) and T-506 (secondary) for a symmetrical response curve centered around 21.4 Mc. The shape of the response curve should be flat-topped or slightly double-peaked.

g. Second IF amplifier, adjustment of T-503 and T-504.— Replace V-501. Disconnect the cable connected to J-202 on the RF chassis. Connect the scope to first limiter grid (pin 1 of V-503). Solder a 10 Ohm resistor between pin 1 of V-501 and ground of the tube socket mounting strap nut. Solder a 200 Ohm resistor to pin #1. Connect the sweep generator between the 200 Ohm resistor and ground on the grounded lead of the 10 Ohm resistor. Set the sweep generator output as required to produce a peak scope deflection of 0.25 Volts. Adjust T-503 (primary) and T-504 (secondary) for a symmetrical response curve centered around 21.4 Mc. The response shape should be flat-topped or slightly double-peaked. After the adjustment is completed, remove the 10 and the 200 Ohm resistors.

h. First IF Amplifier, adjustment of T-501 and T-502.- Reconnect the cable to J-202. Install the IF bottom cover and tighten all the mounting screws. Connect the scope to first limiter grid (pin 1 of V-503). Connect the sweep generator to TP-202 (on the RF chassis) and ground on one of the trimmer capacitor studs. Set the sweep generator output as required to produce 0.25 Volts peak scope deflection. Adjust T-501 (primary) and T-502 (secondary) for a symmetrical response centered around 21.4 Mc.

The response shape should be very nearly flat-topped.

"Slave" 200 Kc. IF Channel Alignment

Turn on power. Set receiver tuning dial to lowest frequency and remove local oscillator tube V-204 in the "Master" Tuner.

d. 3rd IF amplifier, adjustment of T-307 and T-308. - Remove second IF amplifier V-302 from its socket. Connect the scope to the cathode of the detector diode CR-301.

Connect the sweep generator between the third IF amplifier grid (pin 1 of V-303) and ground on the tube socket mounting strap nut. Set the sweep generator output to maximum. Adjust T-507 and T-508 (alternatively) for a symmetrical response centered around the center frequency marker at 21.4 Mc.

e. 3rd-2nd IF amplifier, adjustment of T-305 and T-306. - Replace V-302 and remove V-301. Connect the scope to the 3rd IF amplifier grid (pin 1 of V-303). Connect the sweep generator between pin 1 of the second IF amplifier V-302 and ground on the tube socket mounting strap nut. Set the sweep generator to produce a peak scope deflection of 0.25 Volts.   Adjust T-305 (primary) and T-306 (secondary) for a symmetrical response curve centered around 21.4 Mc. The shape of the response curve should be flat-topped or slightly double-peaked.

f. Second IF amplifier, adjustment of T-303 and T-304.— Replace V-301.   Disconnect the cable connected to J-202 on the RF chassis. Connect the scope to first limiter grid (pin 1 of V-303). Solder a 10 Ohm resistor between pin 1 of V-301 and ground of the tube socket mounting strap nut. Solder a 200 Ohm resistor to pin #1. Connect the sweep generator between the 200 Ohm resistor and ground on the grounded lead of the 10 Ohm resistor. Set the sweep generator output as required to produce a peak scope deflection of 0.25 Volts. Adjust T-303 (primary) and T-304 (secondary) for a symmetrical response curve centered around 21.4 Mc. The response shape should be flat-topped or slightly double-peaked. After the adjustment is completed, remove the 10 and the 200 Ohm resistors.

g. First IF Amplifier, adjustment of T-301 and T-302.- Reconnect the cable to J-202.   Install the IF bottom cover and tighten all the mounting screws. Connect the scope to first limiter grid (pin 1 of V-303). Connect the sweep generator to TP-202 (on the RF chassis) and ground on one of the trimmer capacitor studs. Set the sweep generator output as required to produce 0.25 Volts peak scope deflection. Adjust T-301 (primary) and T-302 (secondary) for a symmetrical response centered around 21.4 Mc.

The response shape should be very nearly flat-topped.

"Master" 40 Kc. IF Channel Alignment

d. 40 Kc. Band-Pass Filter. Adjustment of L-606 and L-607.— Set the function switch to AM 40 Kc. Connect a 2.5 Mc. centered sweep generator between control grid of V-609 and ground on the nuvistor socket mounting strap nut. Connect the scope to control grid of V-610. Adjust L-606 and L-607 for maximum gain centered around the 2.5 Mc marker. The 18.9 Mc. pip, generated by the second local oscillator V-608, can be seen on the scope on the high frequency side of the response curve, well beyond the filter passband.. This pip may be identified by removing the 18.9 Mc. oscillator and observing the pip disappear.

Note: The adjustment of the L-606 and L-607 coils that form the 40-Kc. Band-Pass filter has been carefully done at the Factory and no further attempt should normally be required.

e. 2.5 Mc. IF Amplifier.- Connect a 21.4 mc marker signal to control grid of V-606 and tune L-608, L-610 and L-611 for a maximum indication of the Signal Strength meter, M-101, on the front panel. Eventually readjust also L-606 and L-607 for a maximum indication on the Signal Strength meter, M-101, on the front panel.

"Slave" 40 Kc. IF Channel Alignment

d. 40 Kc. Band-Pass Filter. Adjustment of L-602 and L-603.— Set the function switch to AM 40 Kc. Connect a 2.5 Mc. centered sweep generator between control grid of V-604 and ground on the nuvistor socket mounting strap nut. Connect the scope to control grid of V-605. Adjust L-602 and L-603 for maximum gain centered around the 2.5 Mc marker. The 18.9 Mc. pip, generated by the second local oscillator V-603, can be seen on the scope on the high frequency side of the response curve, well beyond the filter passband.. This pip may be identified by removing the 18.9 Mc. oscillator and observing the pip disappear.

Note: The adjustment of the L-602 and L-603 coils that form the 40-Kc. Band-Pass filter has been carefully done at the Factory and no further attempt should normally be required.

e. 2.5 Mc. IF Amplifier.- Connect a 21.4 mc marker signal to control grid of V-601 and tune L-604 for a maximum indication of the Signal Strength meter, M-101, on the front panel. Eventually readjust also L-602 and L-603 for a maximum indication on the Signal Strength meter, M-101, on the front panel.

3. LOCAL OSCILLATOR ADJUSTMENTS.

a. Local Oscillator Adjustment, "Master" RF Tuner only.

The only adjustment necessary in the local oscillator is to make the tuning dial read properly. This section may be disregarded if the dial is reading correctly. If a tube has been replaced and an error is noted, it may be corrected by adjustment of C-229. This adjustment should be made with a signal generator of high accuracy at 60 Mc.

The high-frequency end of the dial is controlled by the location of C-230 on the end inductor L-210, The correct adjustment is made at the factory and should not require readjustment in the field.

b. Mechanical Adjustments.— Normally the tuning dial will not need any adjustment in the field, however, if the above procedure fails to restore normal operation, refer to the following:

(1) Loosen both stops of the tuning mechanism..

(2) Rotate dial to the extreme low-frequency end until the dial is stopped by the inductuner stop of BOTH the "Master" and the "Slave" Tuners (please verify that the two inductuners stop at the same time, if not adjust their shaft for effective stop coincidence). Hairline should align with triangle on dial.

(3) Back up just off both the inductuner stops (for the very same amount) and tighten the set screws in the dial drive low-frequency stop.

(4) The dial mark just below 55 Mc. should line up under the indicator (this mark is the logging-scale "zero"). If this mark does not coincide with the indicator line, loosen the dial set screws, align and re-tighten the screws.

(5) Rotate dial to the extreme high-frequency end until the dial is stopped by both the inductuner stops (please verify this happens at the same time). Hairline should align with triangle on dial, if not, loosen the screws on both the inductuner shafts and align triangle.

(6) Back up just off both the inductuner stops (for the very same amount) and tighten the set screws in the dial-drive high-frequency stop. This completes the dial adjustments.

4. RF AMPLIFIER ALIGNMENT ***("Master" and "Slave" Tuners***).

RF Amplifier Alignment. The RF circuits are wide band compared with the IF selectivity and are designed around the highly stable Mallory S-4 spiral inductuner. The end inductors are also very stable, and therefore the unit should not require realignment. If realignment is found necessary:

(1) Unsolder C-248 from the inductuner lug and solder to the BNC test connector.

(2) Connect a sweep generator with a 50-Ohm source impedance to the BNC test jack.

(3) Connect oscilloscope to front-end test point TP-202.

(4) Set the dial to 70 Mc.

(5) Adjust C-217 and C-222 for a double-tuned symmetrical response centered at 70 Mc. Use 70 Mc. marker..

(6) Adjust C-220 for a 15% dip in the response.

(7) Repeat (5) above.

(8) Set dial to 250 Mc. and bend end inductors L-207 and L-209 to produce a symmetrical response centered at 250 Mc. Use 250 Mc. marker.

(9) Unsolder C-248 from the BNC test connector and resolder to the inductuner.

(10) Connect sweep generator to the antenna jack J-101 (or J-102 according to the situation). NOTE: An accurate 50-ohm source can be achieved by using a 6 or 10 dB Ohm pad between the sweep generator output and the receiver input.

(11) Set the dial to 70 Mc.

(12) Adjust C-243 for a symmetrical response.

(13) Set the dial to 250 Mc. and move the position of C-244 along the end portion of end inductor L-204 to produce a symmetrical round-nose response.

5. IF ALIGNMENT— ***(CW Method)***

a. Introduction.- In the event that it should become necessary to align the IF strip, and a suitable sweep generator and oscilloscope are not readily available, the following CW alignment procedure is included. It is to be noted that alignment by the sweep method is more efficient and effective than the CW method that follows, and, alignment by the sweep method is more easily adaptable to trouble-shooting should the necessity arise. Therefore, if suitable equipment is available, the sweep method of alignment should be used.

"Master" 200 Kc. IF Channel Alignment

b. Second Limiter Alignment.— (CW Method)

(1) Remove second IF amplifier V-502 from its socket.

(2) Set the signal generator to 21.4 Mc. and connect its output to the control grid (pin 1) of V-503.

(3) Connect a high-resistance voltmeter (VTVM) to the grid return of V-504.

(4) Set the signal generator output to produce approvimately 2.0 Volts on the VTVM.

(5) Detune the primary slug of T-507 counterclockwise against the stop.

(6) Increase the signal generator output to produce approximately the same value on the VTVM as in (4) above.

(7) Adjust the secondary slug of T-507 for a maximum reading on the VTVM.

(8) Adjust the primary slug of T-507 for a maximum reading, keeping the signal generator output adjusted for the same value on the VTVM as in (4) above. DO NOT readjust the secondary for a maximum as this will result in improper alignment.

The second limiter transformer, T-507, has a 3.0 dB bandwidth large enough. The low circuit Q’s and heavy coupling make visual alignment of this transformer desirable but not essential. The procedure outlined above will produce less than 1.0 dB tilt in the response of this transformer. Thus the slope is negligible over the 200 Kc. bandwidth.

c. Discriminator Alignment (CW Method).— In preparation for alignment of the discriminator transformer, T-508, remove the 6AK5 (second limiter tube V-504), and note the reading of the center frequency meter M-102. If it is off center, it should be centered by means of the potentiometer R-118, located on the rear apron of the chassis. Difficulty in readily securing an exact center reading is indicative of a defective 6AL5 tube (V-505), a defective 12AU7A tube (V-101) or their associated components, and must be corrected before proceeding further.

After this adjustment, replace V-504 and proceed as follows:

(1) Remove V-502.

(2) Set the signal generator to 21.4 Mc. and connect to pin 1 (control grid) of V-503.

(3) Connect a high-resistance DC voltmeter (VTVM) to the second limiter (V-504) grid return.

(4) Set the signal generator output to produce 2 Volts on the VTVM.

(5) Connect the VTVM to the discriminator output lead.

(6) Tune the secondary of T-508 to zero output, then counterclockwise until the VTVM shows a reading of 0.5 Volt.

(7) Tune the primary of T-508 to give a maximum reading on the VTVM.

(8) Retune the secondary to produce a zero (balance) reading on the VTVM.

(9) Detune the signal generator above and below 21.4 Mc. to produce a maximum positive and negative output. These voltages should be equal and have a magnitude of approximately +/- 8 Volts, D.C. Minor adjustment of the primary of T-508 will cause the two peak voltages to become exactly equal.

d. IF Amplifiers (CW Method).

(1) The characteristics of cascaded, critically coupled amplifier stages are such as to make alignment difficult; however, the advantages of response stability, gain, and adjacent-channel selectivity make this type of coupling most desirable. Alignment has been kept as simple as possible by designing the three capacitively coupled double-tuned IF transformers, comprising T-501, T-502, T-503, T-504, T-505 and T-506, to have almost identical characteristics.

The primary and secondary Q's have been kept high, and therefore the mutual coupling is low for the required bandwidth. These factors suggest a rather simple alignment procedure with a minimum of equipment. The resonant frequency of the primary or the secondary in the absence of the other (no couplings) is very nearly the proper tuning when the circuits are coupled. If the primary circuit is detuned, the secondary adjusted for maximum output, and the primary then returned to maximum, the overall response will be approximately correct.

This procedure is as follows:

(2) Remove the oscillator tube (V-204) to prevent mixing at the signal generator harmonic frequencies.

(3) Set the receiver dial to approximately 60 Mc.

(4) Set the generator to 21.4 Mc. and connect to pin 1 of V-203.

(5) Connect a high-resistance DC voltmeter (VTVM) to the second limiter (V-504) grid return.

(6) Set the generator output level to produce approximately 2 v on the VTVM.

(7) If the IF amplifier is known to be considerably out of adjustment, it will be necessary to peak T-501, T-502, T-503, T-504, T-505 and T-506, to provide adequate gain.

(8) Detune the primary (T-505) counterclockwise against the stop.

(9) Increase the signal generator output to produce 2 V on the VTVM,

(10) Adjust the secondary (T-506) for maximum reading on the VTVM.

(11) Adjust the primary (T-505) for maximum reading, keeping the signal generator output adjusted to maintain 2 V on the VTVM. DO NOT readjust the secondary (T-506) for a maximum as this will result in improper adjustment.

(12) Repeat steps 7 through 10 for T-502, T-503 and T-504. NOTE: It is not necessary to follow this sequence, as any transformer may be adjusted without affecting the others.

"Slave" 200 Kc. IF Channel Alignment

Turn on power. Set receiver tuning dial to lowest frequency and remove local oscillator tube V-204 in the "Master" Tuner.

b. 3rd IF amplifier, adjustment of T-307 and T-308. - Remove second IF amplifier V-302 from its socket. Connect the VTVM to the cathode of the detector diode CR-301.

Set the signal generator to 21.4 Mc., the generator output level to produce approximately 2 V on the VTVM and connect to pin 1 (control grid) of V-303.

Adjust T-507 and T-508 (alternatively) for maximum output.

c. IF Amplifiers. The characteristics of cascaded, critically coupled amplifier stages are such as to make alignment difficult; however, the advantages of response stability, gain, and adjacent-channel selectivity make this type of coupling most desirable. Alignment has been kept as simple as possible by designing the three capacitively coupled double-tuned IF transformers, comprising T-301, T-302, T-303, T-304, T-305 and T-306, to have almost identical characteristics.

The primary and secondary Q's have been kept high, and therefore the mutual coupling is low for the required bandwidth. These factors suggest a rather simple alignment procedure with a minimum of equipment. The resonant frequency of the primary or the secondary in the absence of the other (no couplings) is very nearly the proper tuning when the circuits are coupled. If the primary circuit is detuned, the secondary adjusted for maximum output, and the primary then returned to maximum, the overall response will be approximately correct.

This procedure is as follows:

(1) Remove the oscillator tube (V-204) to prevent mixing at the signal generator harmonic frequencies.

(2) Set the receiver dial to approximately 60 Mc.

(3) Set the generator to 21.4 Mc. and connect to pin 1 of V-203.

(4) Connect a high-resistance DC voltmeter (VTVM) to the cathode of the detector diode CR-301.

(5) Set the generator output level to produce approximately 2 V on the VTVM.

(6) If the IF amplifier is known to be considerably out of adjustment, it will be necessary to peak T-301, T-302, T-303, T-304, T-305 and T-306, to provide adequate gain.

(7) Detune the primary (T-305) counterclockwise against the stop.

(8) Increase the signal generator output to produce 2 V on the VTVM.

(9) Adjust the secondary (T-306) for maximum reading on the VTVM.

(10) Adjust the primary (T-305) for maximum reading, keeping the signal generator output adjusted to maintain 2 V on the VTVM. DO NOT readjust the secondary (T-306) for a maximum as this will result in improper adjustment.

(11) Repeat steps 6 through 9 for T-302, T-303 and T-304. NOTE: It is not necessary to follow this sequence, as any transformer may be adjusted without affecting the others.

"Master" 40 Kc. IF Channel Alignment

b. 40 Kc. Band-Pass Filter. Adjustment of L-606 and L-607.— Set the function switch to AM 40 Kc. Set the generator to 2.5 Mc. and connect to control grid of V-609. Connect the VTVM to the grid return of V-610 and set the generator output level to approximately 2 V. Adjust L-606 and L-607 for maximum gain.

Note: The adjustment of the L-606 and L-607 coils that form the 40-Kc. Band-Pass filter has been carefully done at the Factory and no further attempt should normally be required.

c. 2.5 Mc. IF Amplifier.- Set the generator to 21.4 Mc. and connect to control grid of V-606. Connect the VTVM to the to the detector diode CR-601, set the generator output level to approximately 2 V and tune L-608, L-610 and L-611 for a maximum VTVM indication. Eventually readjust L-606 and L-607 for a maximum indication on the Signal Strength meter M-101 on the front panel.

"Slave" 40 Kc. IF Channel Alignment

b. 40 Kc. Band-Pass Filter. Adjustment of L-602 and L-603.— Set the function switch to AM

40 Kc. Set the generator to 2.5 Mc. and connect to control grid of V-604 on the nuvistor socket. Connect the VTVM to the grid return of V-605, set the generator output level to approximately 2 V and adjust L-602 and L-603 alternatively for maximum gain. Note: The adjustment of the L-602 and L-603 coils that form the 40-Kc. Band-Pass filter has been carefully done at the Factory and no further attempt should normally be required.

c. 2.5 Mc. IF Amplifier.- Set the generator to 21.4 Mc. and connect to control grid of V-601. Connect the VTVM to the detector diode CR-601, set the generator output level to approximately 2 V and tune L-604 for a maximum VTVM indication. Eventually readjust L-602 and L-603 for a maximum indication on the Signal Strength meter, M-101, on the front panel.

Voltage measurements at tube sockets:

TUBE	TYPE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
FRONT END (MASTER)										
V-201	4I6B	Cathode	+6.95V	Filam.	6.0 VAC	Plate +	195V	Grid Ring	+6.9V	
V-202	6J4	Gnd	1.1	Gnd	6.3 VAC	Gnd	Gnd	130		
V-203	6AK5	-2.0	Gnd	6.3 VAC	Gnd	145	59	Gnd		
V-204	6AF4A	*53	Do not m.	Gnd	6.3 VAC	2.5	Do not m.*53			
FRONT END (SLAVE)										
V-201	4I6B	Cathode	+6.95V	Filam.	6.0 VAC	Plate +	195V	Grid Ring	+6.9V	
V-202	6J4	Gnd	1.1	Gnd	6.3 VAC	Gnd	Gnd	130		
V-203	6AK5	-2.0	Gnd	6.3 VAC	Gnd	145	59	Gnd		
V-204	6AK5	N/A	Gnd	6.3 VAC	N/A	N/A	N/A	N/A		
MAIN CHASSIS										
V-101	12AU7A	135	Gnd	6.7	Gnd	Gnd	137	-0.1	6.8	6.2 AC
V-102	12AU7A	235	138	141	Gnd	Gnd	235	138	141	6.2 AC
V-103	12AU7A	145	- 0,27	24	Gnd	Gnd	210	133	150	6.2 AC
V-104	12AU7A	98	0	5.7	Gnd	Gnd	230	0	8	6.2 AC
V-105	6C4	N/A	N/A	6.2 VAC	Gnd	N/A	N/A	N/A		
V-106	12AU7A	N/A	N/A	N/A	Gnd	Gnd	N/A	N/A	N/A	6.2 AC
200 Kc. IF AMPLIFIER (Master Channel, Function Switch in 200 Kc. FM Position)										
V-501	6DC6	-0.33	0.7	6.3 AC	Gnd	134	76	Gnd		
V-502	6DC6	-0.32	0.83	6.3 AC	Gnd	133	69	Gnd		
V-503	6CB6	-0.31	0.12	6.3 AC	Gnd	135	34	Gnd		
V-504	6AK5	-6.6	Gnd	6.3 AC	Gnd	37	83	Gnd		
V-505	6AL5	-0.22	-7.0	5.8 AC	Gnd	Gnd	Gnd	-12.4		

Table 4-1. Voltage Measurements, Model G-187.

TUBE	TYPE	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
200 Kc. IF AMPLIFIER (Master Channel, Function Switch in 200 Kc. AM Position)										
V-501	6DC6	-1.2	0.68	6.3 AC	Gnd	130	76	Gnd		
V-502	6DC6	-0.37	0.81	6.3 AC	Gnd	130	71	Gnd		
V-503	6CB6	-0.18	0.31	6.3 AC	Gnd	131	58	Gnd		
V-504	6AK5	-3.8	Gnd	6.3 AC	Gnd	35	85	Gnd		
V-505	6AL5	-0.13	-7.2	5.8 AC	Gnd	Gnd	Gnd	-12.0		
200 Kc. IF AMPLIFIER (Slave Channel, Function Switch in 200 Kc. FM Position)										
V-301	6DC6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		
V-302	6DC6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		
V-303	6CB6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		
200 Kc. IF AMPLIFIER (Slave Channel, Function Switch in 200 Kc. AM Position)										
V-301	6DC6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		
V-302	6DC6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		
V-303	6CB6	N/A	N/A	6.3 AC	Gnd	N/A	N/A	Gnd		

40 Kc. NUVISTOR IF AMPLIFIER, Both Channels, FM and AM mode:

From V-601 to V-611 (all 6CW4 or 7587 types): N/A

Notes: Line voltage 115 VAC, 60 Cps; dial tuned to 220 Mc., no signal input; Squelch and Audio Gain controls fully CCW; AGC ON; discriminator Tuning Meter balance set in accordance with procedure shown in Section 4 of this Manual; filament voltages measured between tube pin and chassis except V-201; DC voltages taken with an 11-MegOhm VTVM; all voltage measured with respect to Gnd.

Table 4-1. Voltage Measurements, Model G-187 (continued).

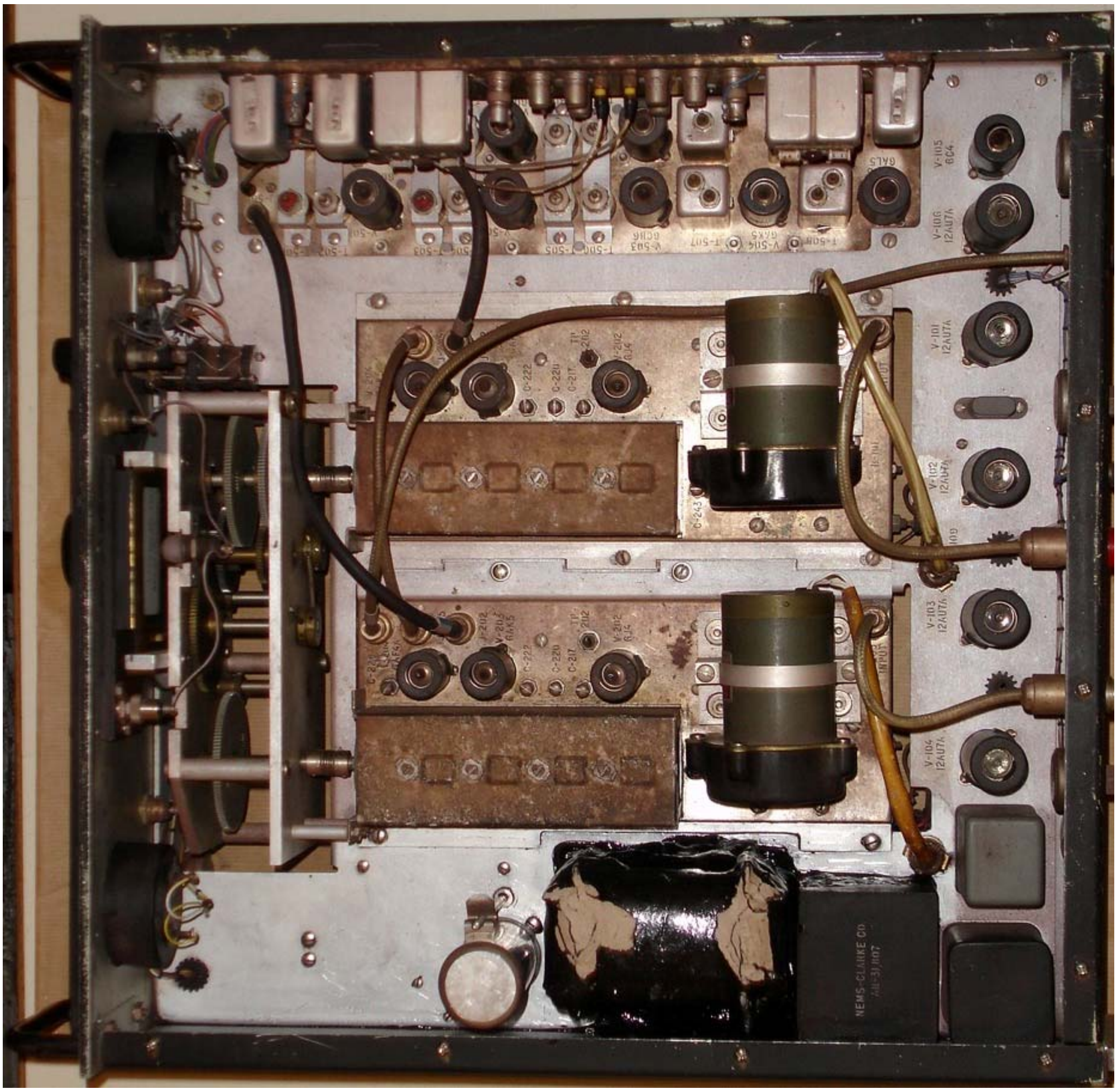

Fig. 4-1. Model G-187 Receiver, Top View (Cover Removed).

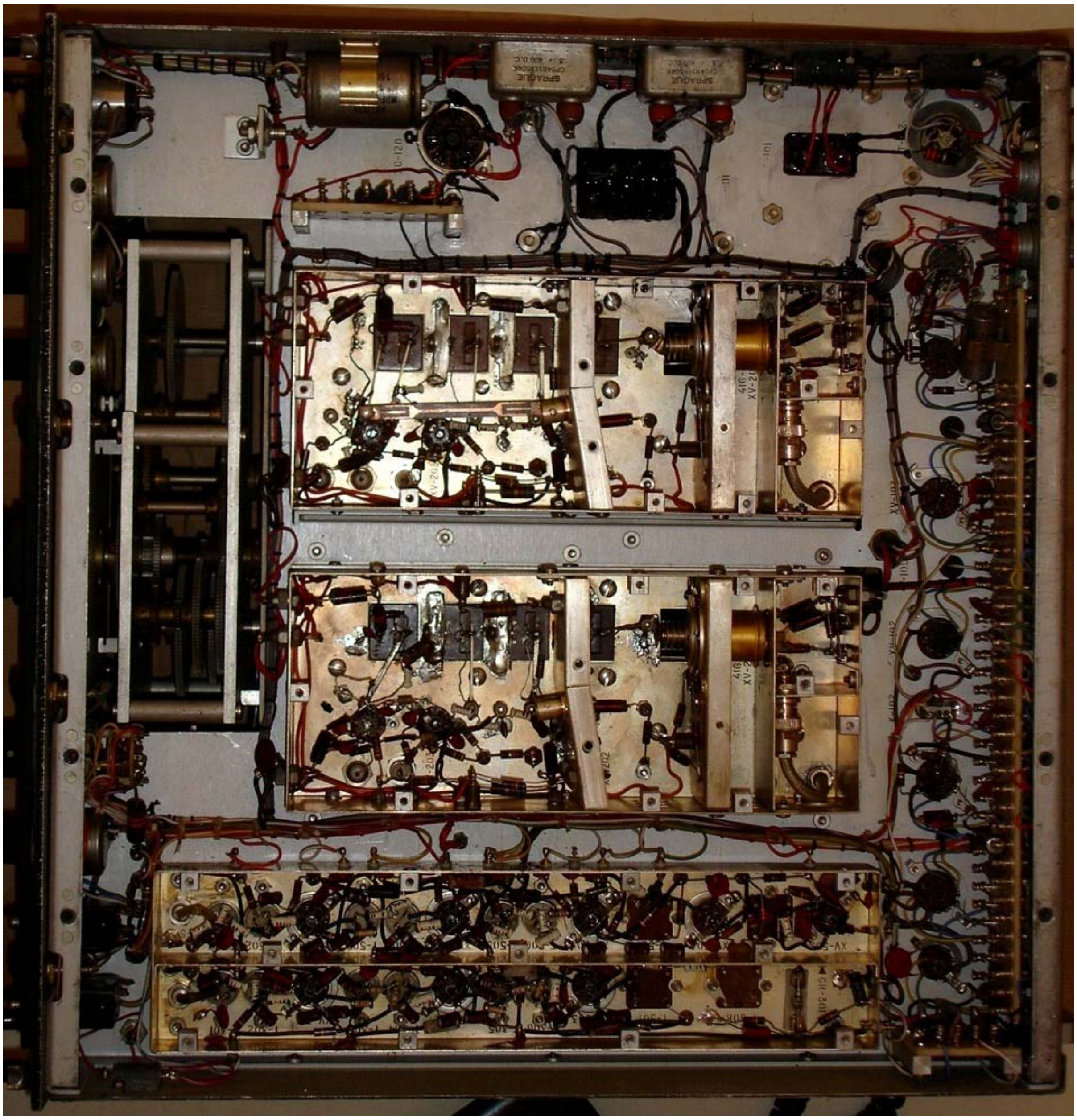

Fig. 4-2. Model G-187 Receiver, Bottom View (Covers Removed).

Fig. 4-3. Model G-187 Receiver, Rear View.

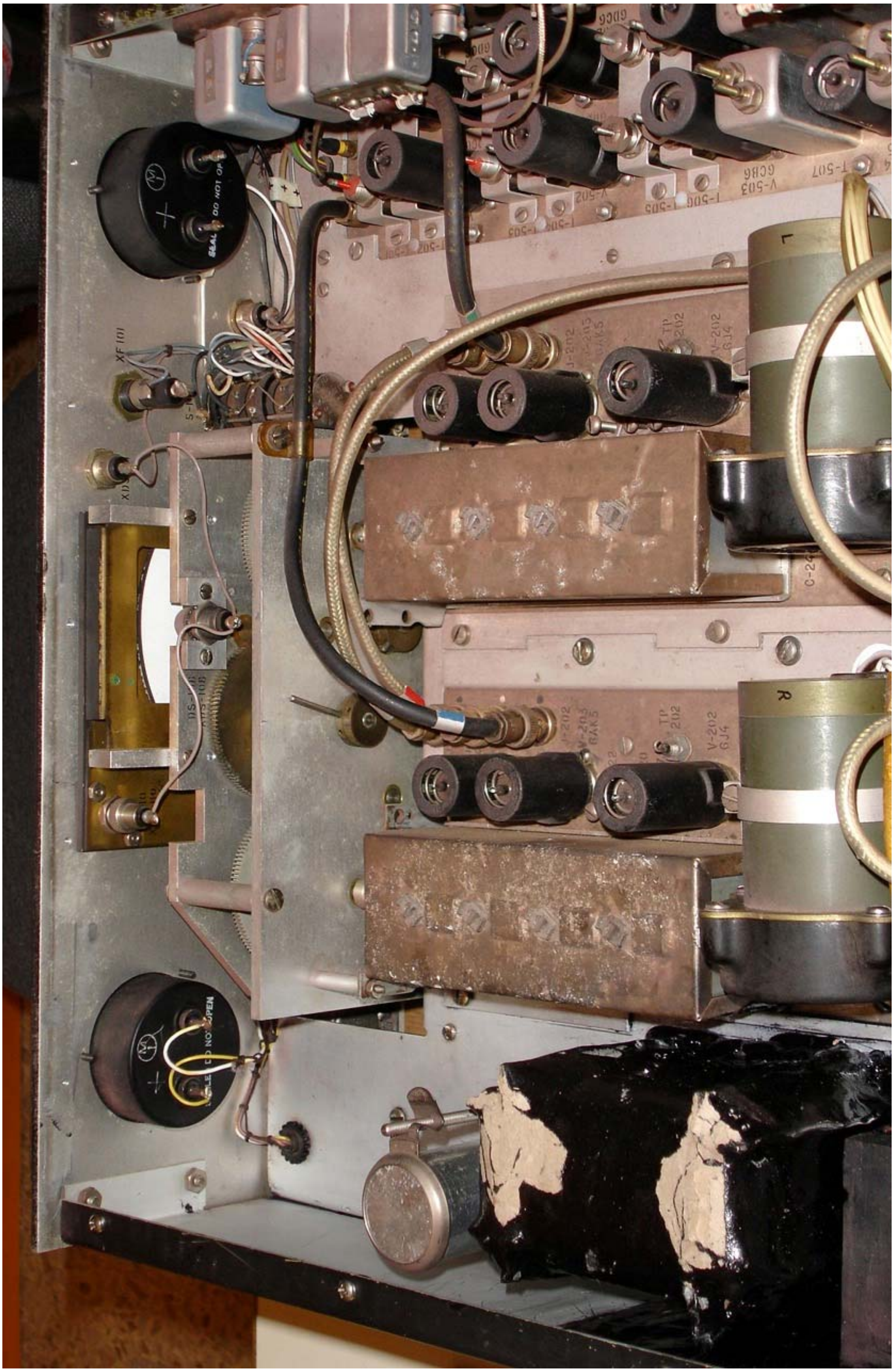

Fig. 4-4. Model G-187 Receiver, Panoramic Top View (Cover Removed).

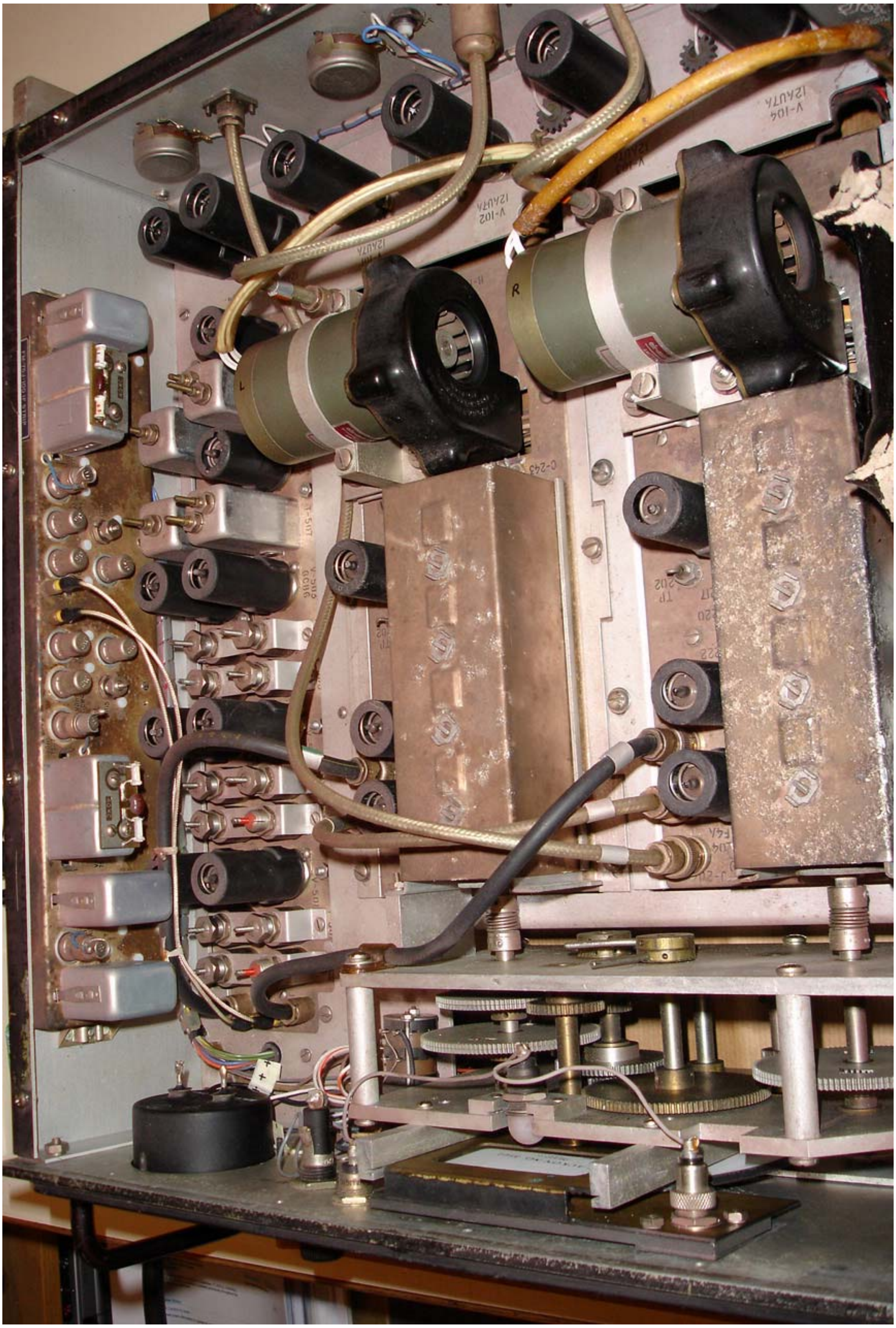

Fig. 4-5. Model G-187 Receiver, Panoramic Top View Left Side (Cover Removed).

Fig. 4-6. Model G-187 Receiver, Panoramic Top View Right Side (Cover Removed).

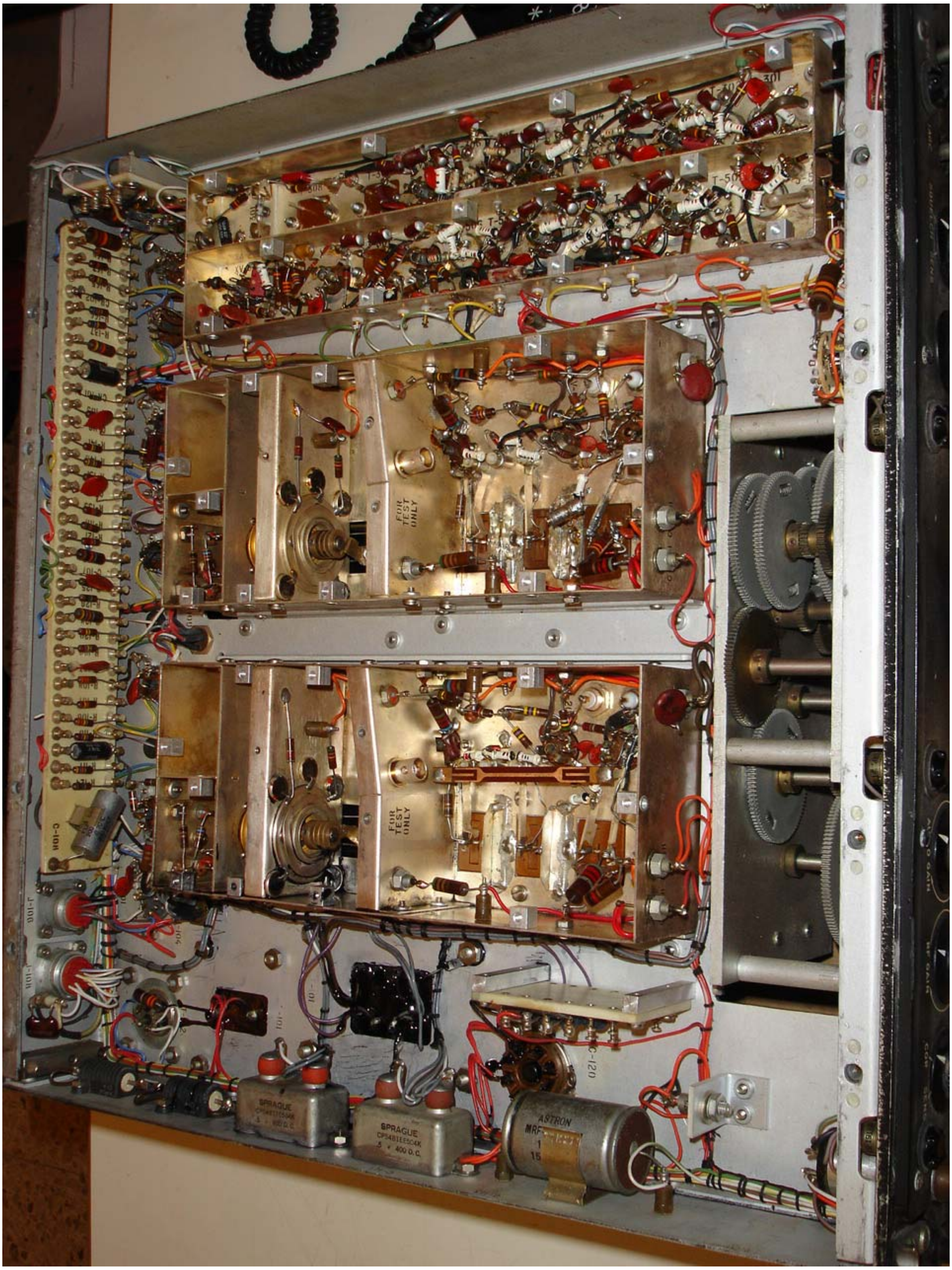

Fig. 4-7. Model G-187 Receiver, Panoramic Bottom View (Covers Removed).

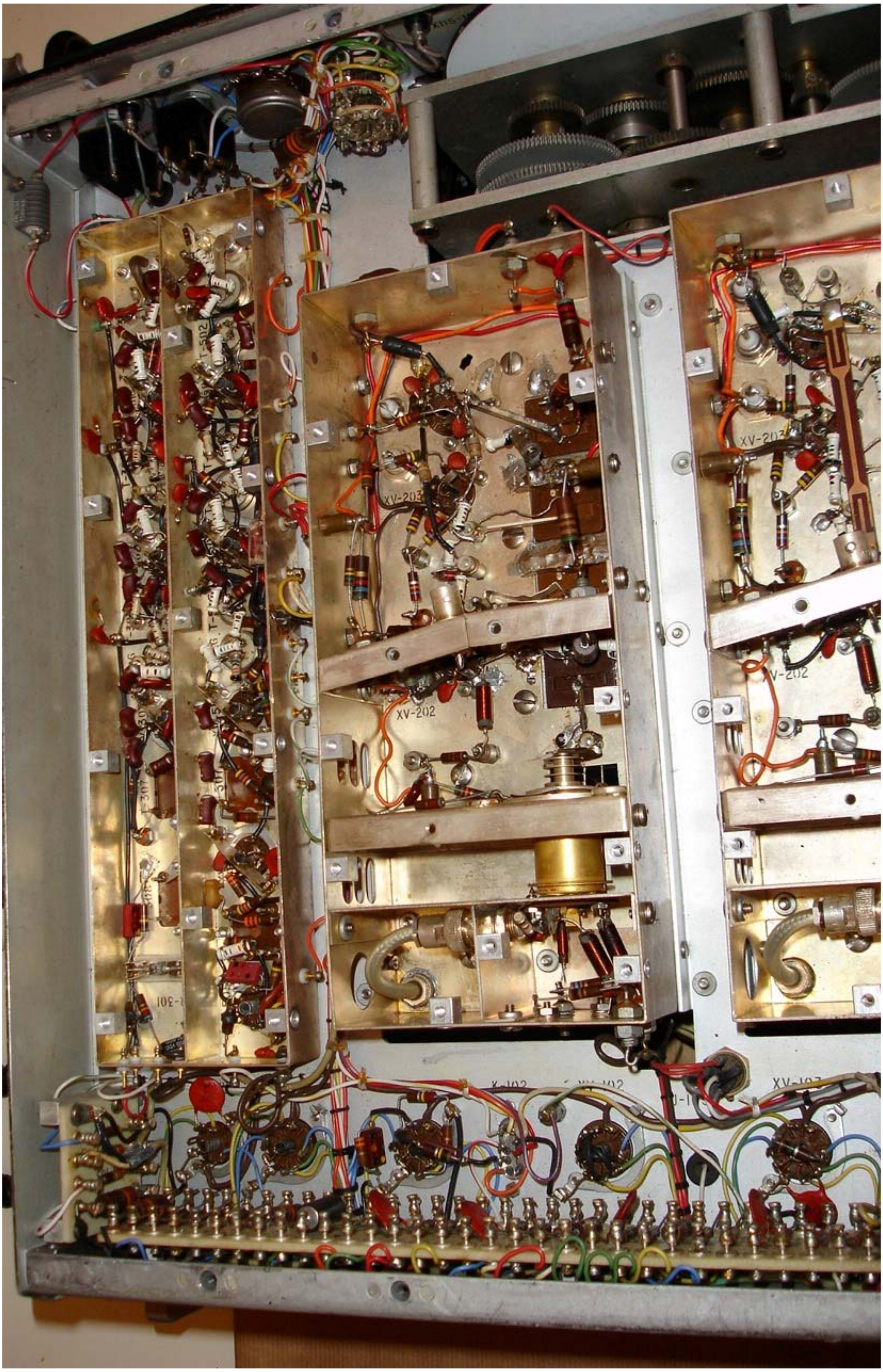

Fig. 4-8. Model G-187 Receiver, Panoramic Bottom View Left Side (Covers Removed).

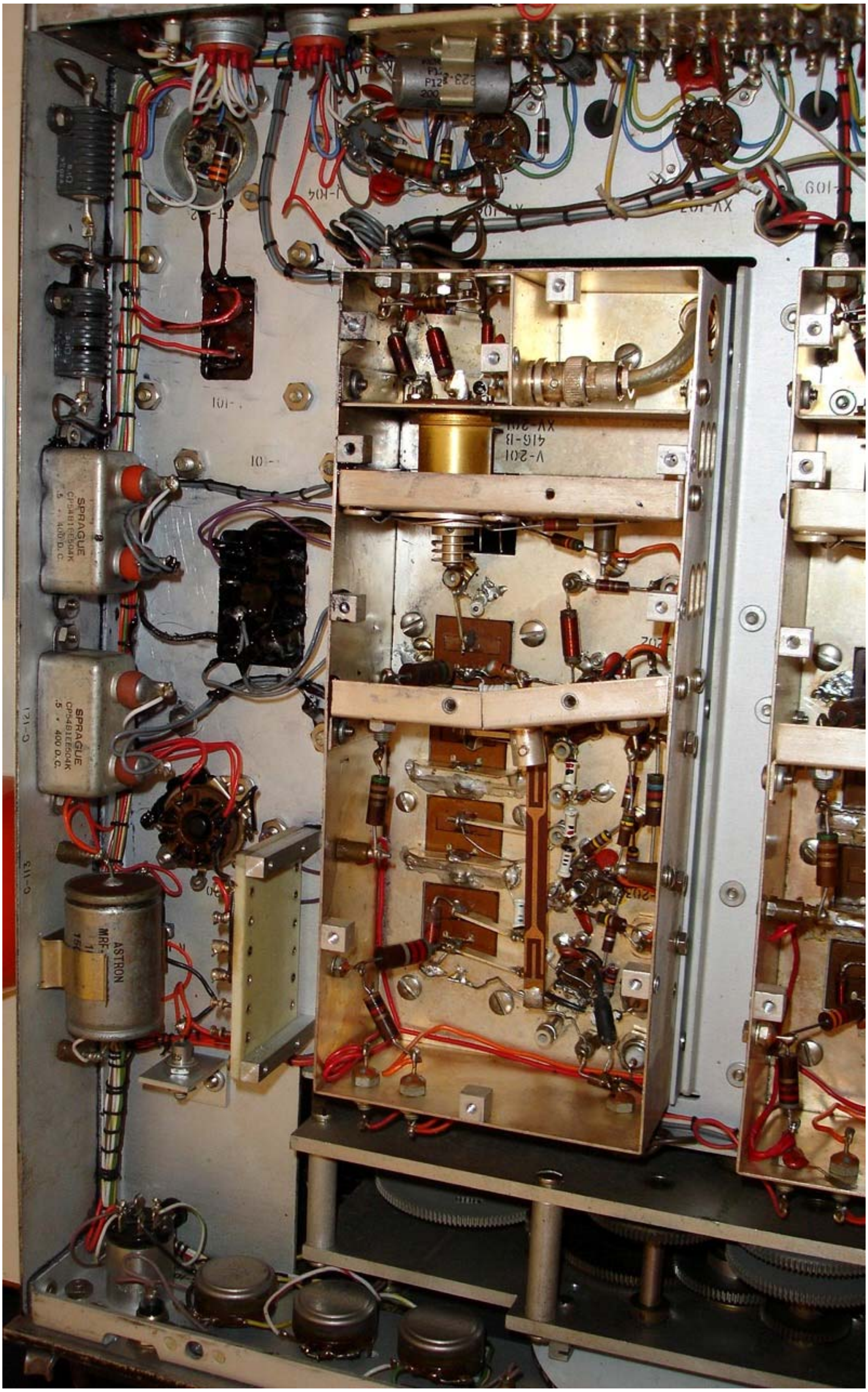

Fig. 4-9. Model G-187 Receiver, Panoramic Bottom View Right Side (Covers Removed).

C108	1µF, 300V
R124	1MΩ
R117	47KΩ
C104	0.1µF - 200V
R110	270KΩ
R106	330KΩ
R107	24KΩ
R108	33KΩ
C103	.01µF CER.
R109	270KΩ
R129	240KΩ
R128	47KΩ, 2W
R126	1MΩ
R125	1MΩ
C107	.01µF CER.
R123	10KΩ, 2W
R121	22KΩ
R118	15KΩ
R133	22KΩ
C111	.01µF CER.
R131	2KΩ
R140	470KΩ
R141	220KΩ
C112	.01µF CER.
R105	20MΩ
CR101	1N457 OR HUGHES #HD 6006 (AGC DELAY DIODE)
C102	0.1µF - 200V
R135	1MΩ
R136	47KΩ, 2W
R137	560KΩ
R144	68KΩ
CR102	1N458 ← (COR DIODE)
R145	100KΩ
R147	20KΩ
R148	300Ω
R150	12KΩ, 2W

COMPONENT BOARD #1
(LARGE)

R149	12KΩ, 2W
R103	330KΩ
R104	330KΩ
R132	4.7MΩ

COMPONENT BOARD #2
(SMALL)

P.V. 2011

NOTE:
ALL RESISTORS ARE ½W, 10%
UNLESS OTHERWISE SPECIFIED.

LTV G-187 COMPONENT BOARDS

Table 4-2. Model G-187 Receiver, Component Boards (Lists).

Fig. 4-10. Model G-187 Receiver, Large Component Board.

Fig. 4-11. Model G-187 Receiver, Small Component Board.

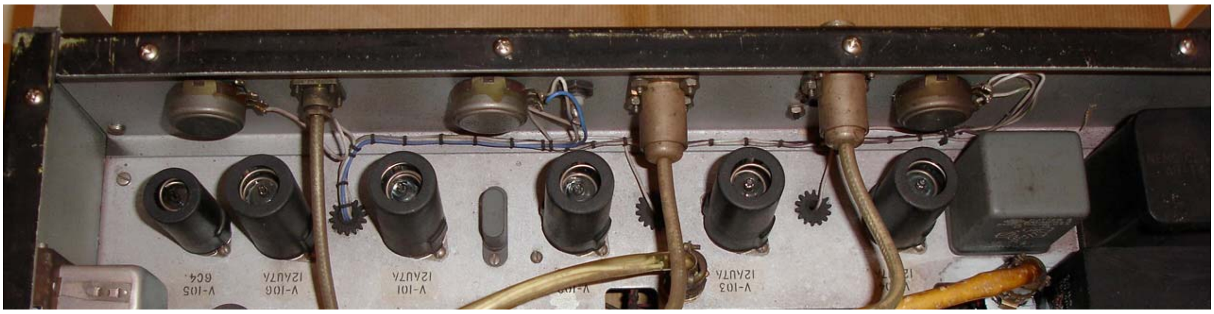

Fig. 4-12. Model G-187 Receiver, Auxiliary & Output Circuits (Top View).

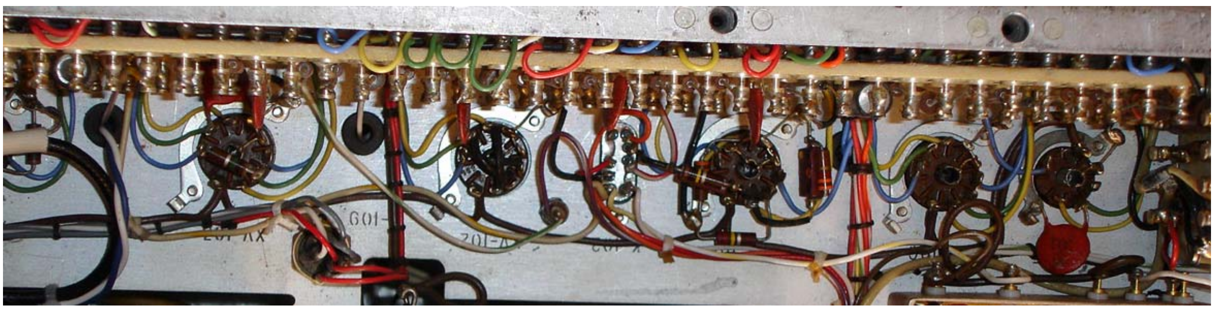

Fig. 4-13. Model G-187 Receiver, Auxiliary & Output Circuits (Bottom View).

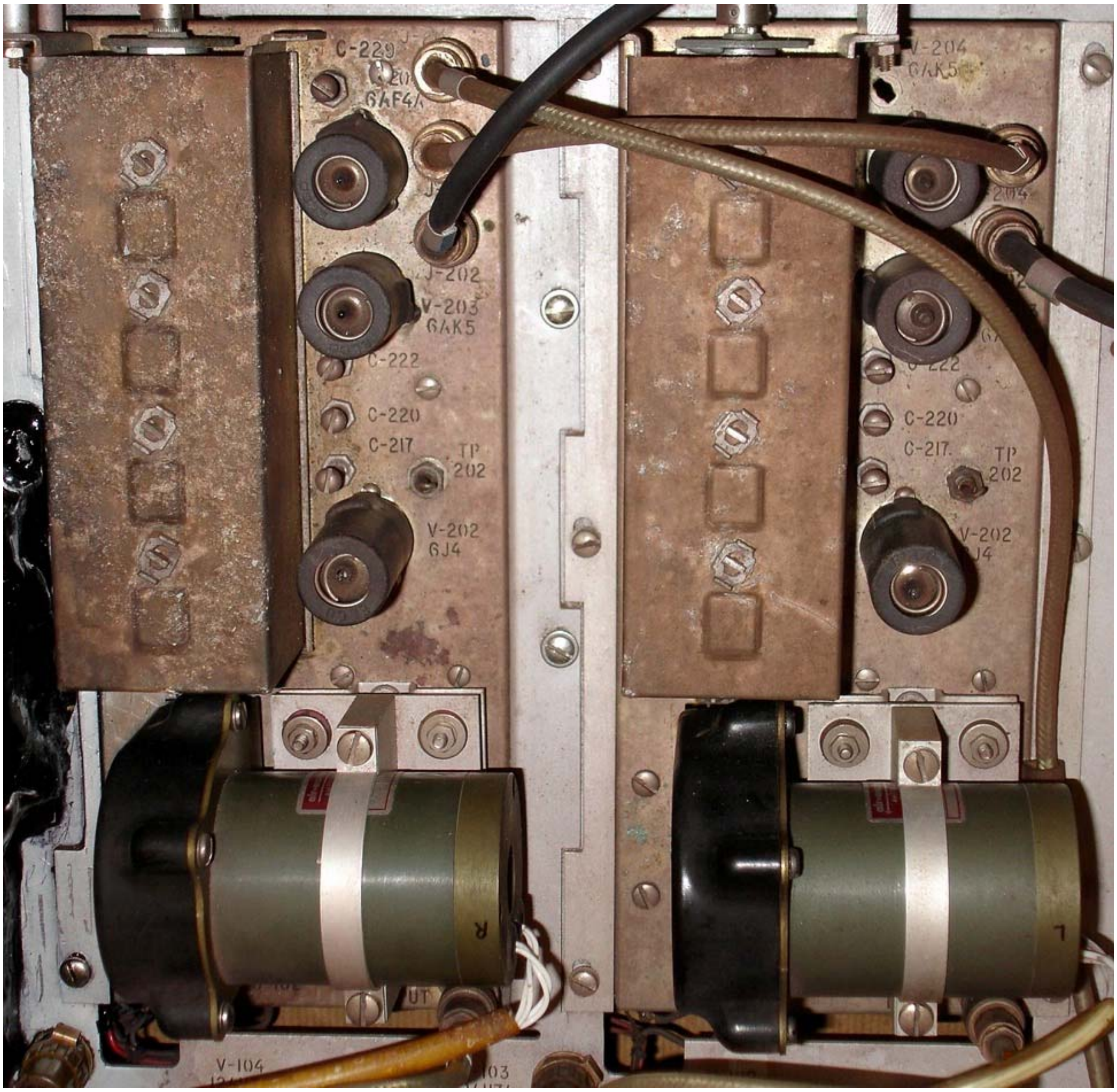

Fig. 4-14. Model G-187 Receiver, Master & Slave RF Tuners, Top View.

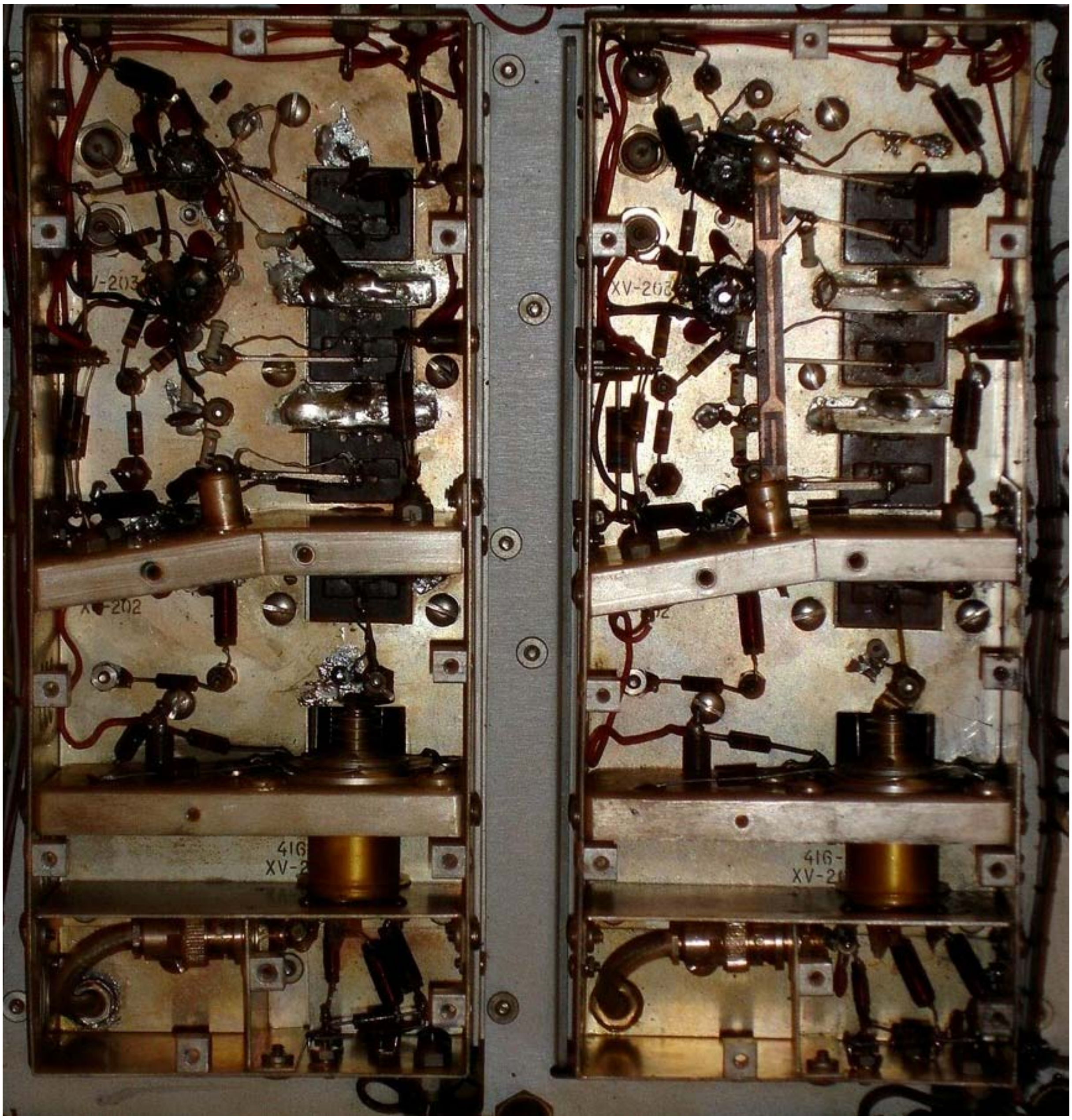

Fig. 4-15. Model G-187 Receiver, Master & Slave Tuners, Bottom View (Covers Removed).

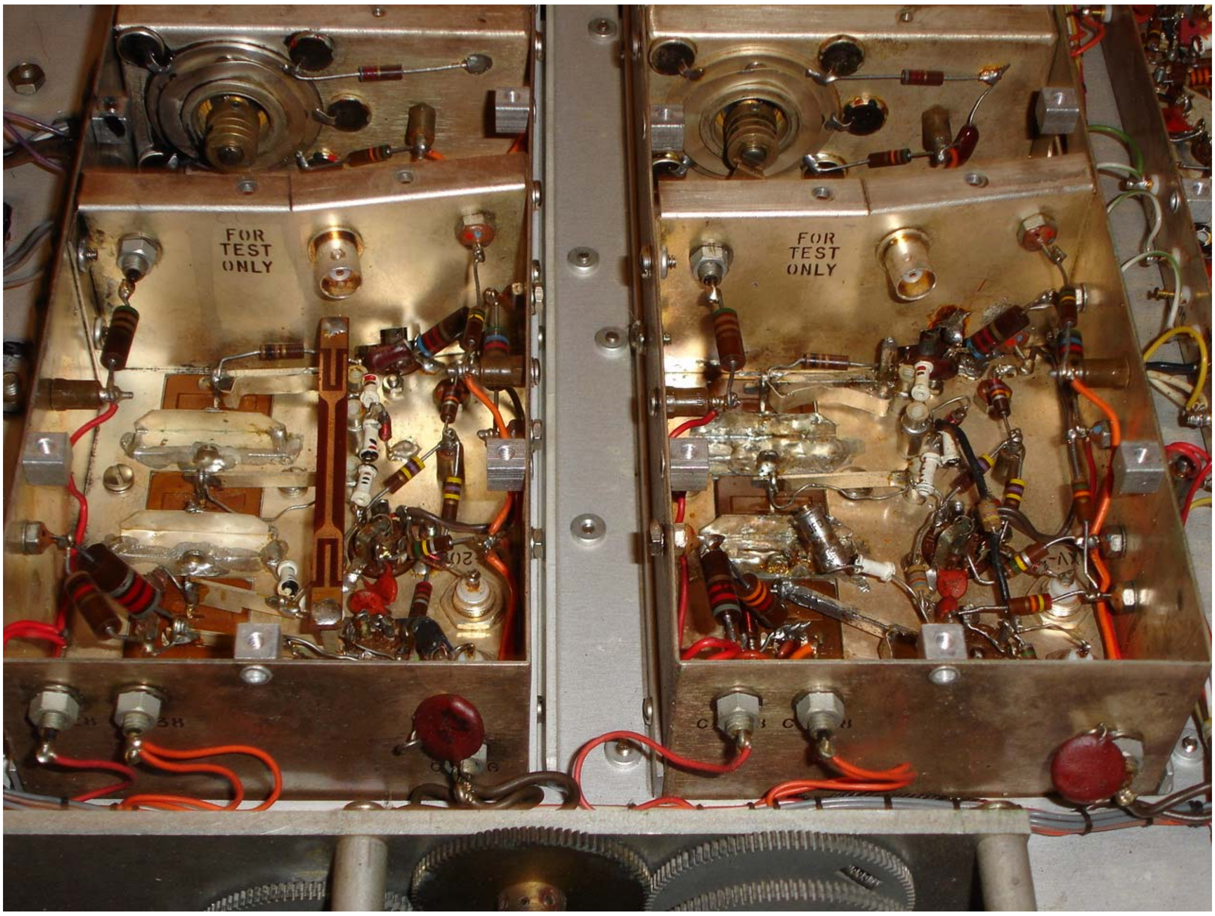

Fig. 4-16. Model G-187 Receiver, Master & Slave Tuners, Panoramic Bottom View (Covers Removed).

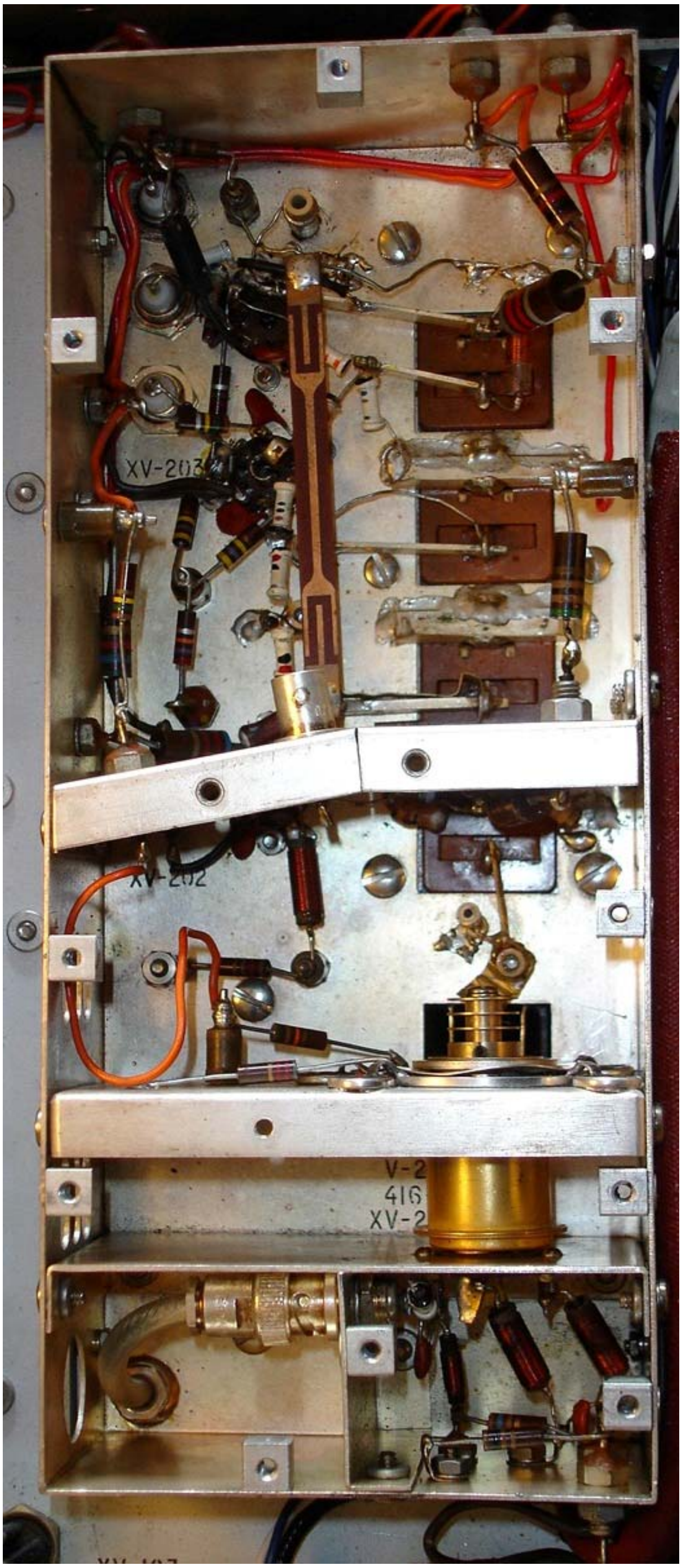

Fig. 4-17. Model G-187 Receiver, Master RF Tuner, Bottom View (Cover Removed).

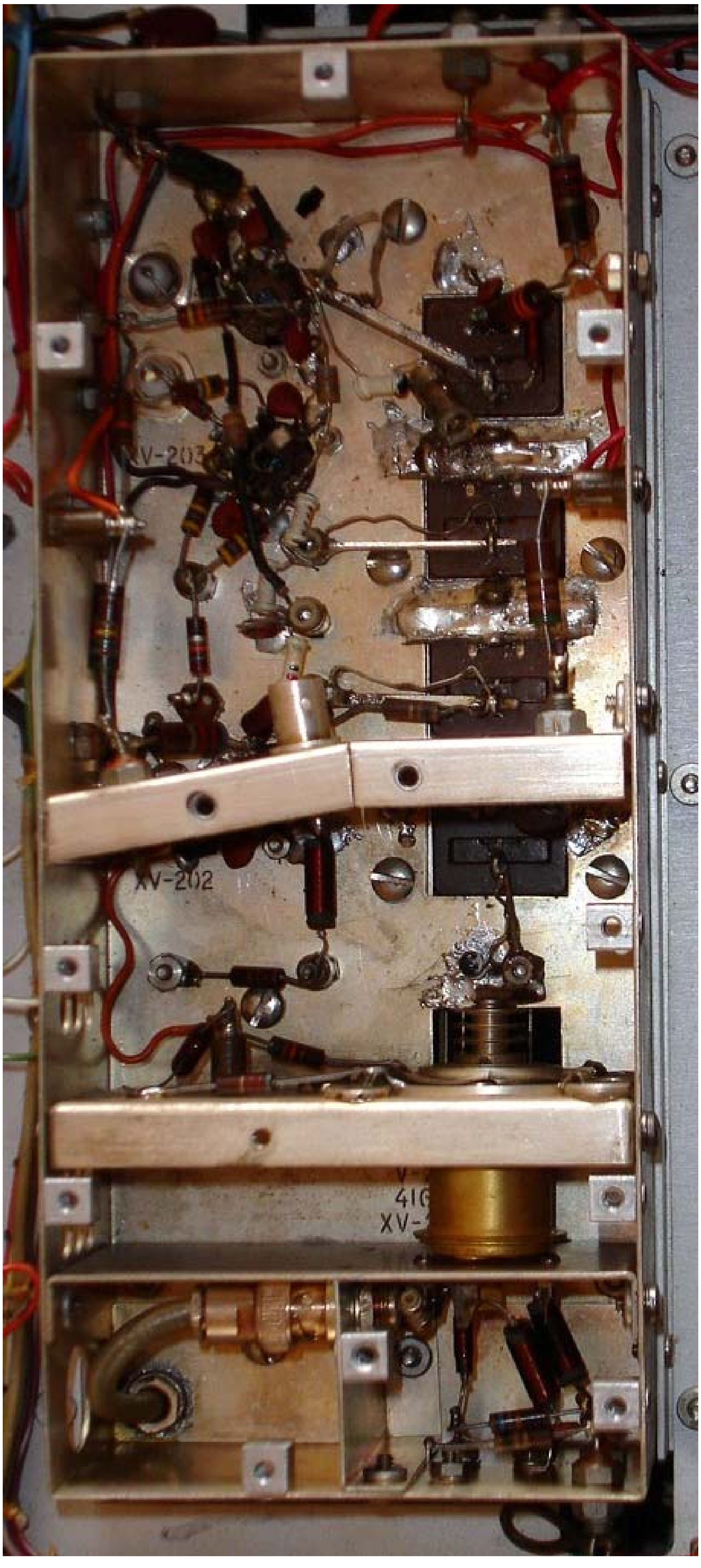

Fig. 4-18. Model G-187 Receiver, Slave RF Tuner, Bottom View (Cover Removed).

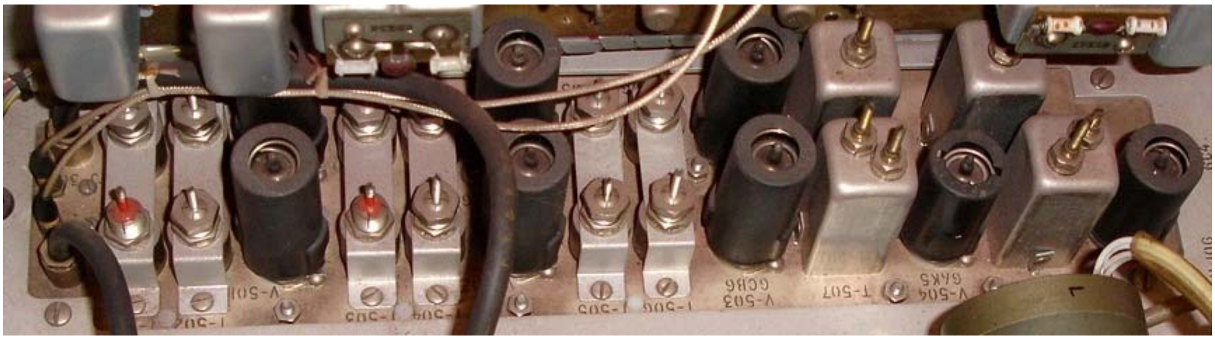

Fig. 4-19. Model G-187 Receiver, 21.4 Mc - 200 Kc. BW IF Strip (Master & Slave Channels), Top View.

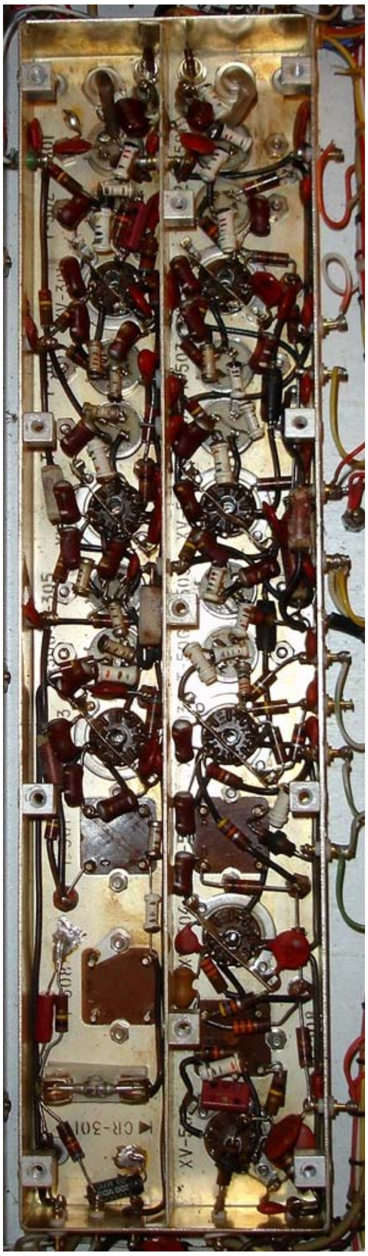

Fig. 4-20. Model G-187 Receiver, 21.4 Mc - 200 Kc. BW IF Strip, Bottom View (C.R.).

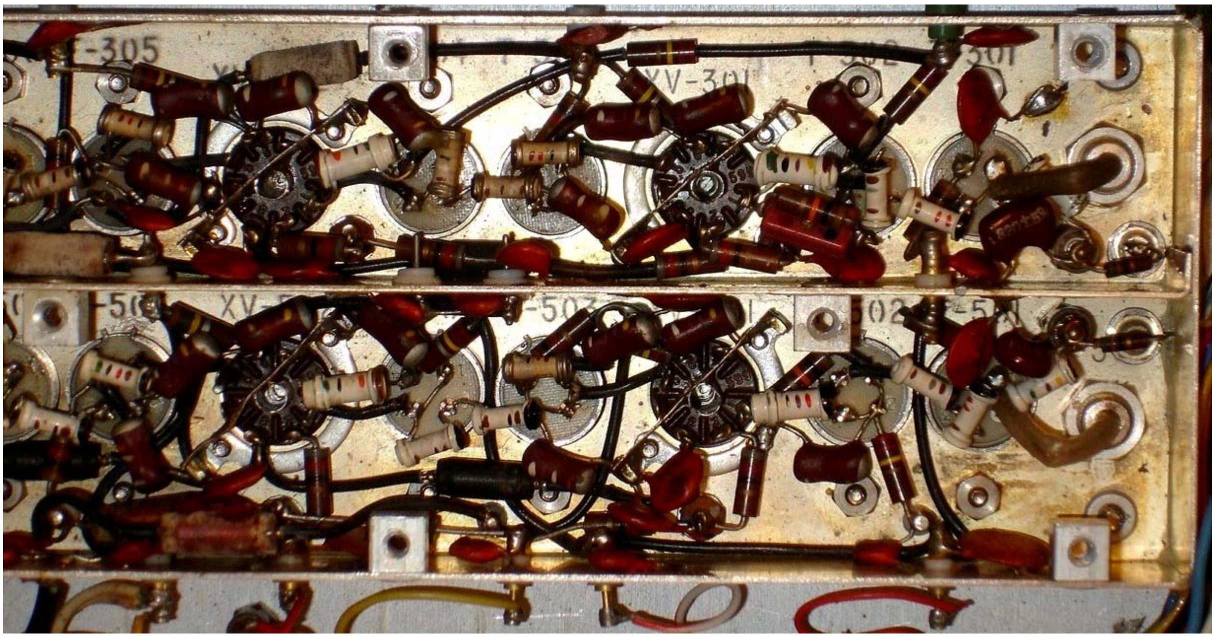

Fig. 4-21. Model G-187 Receiver, 21.4 Mc - 200 Kc. BW IF Strip (Master & Slave Channels), Bottom View, Input Side.

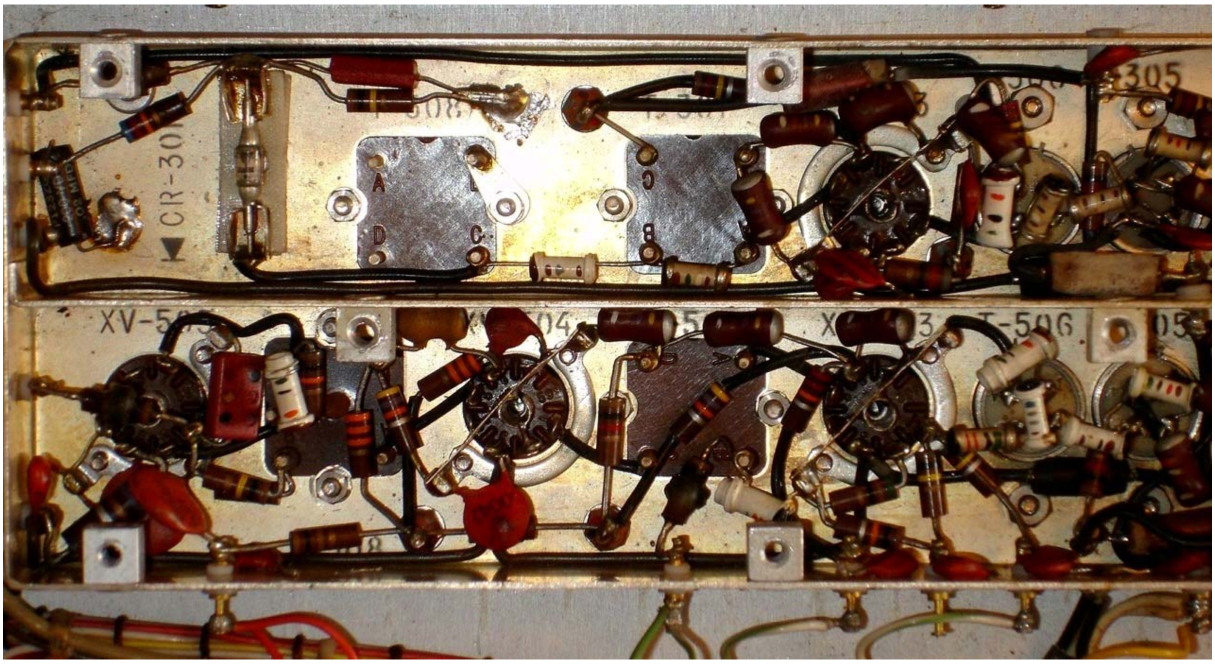

Fig. 4-22. Model G-187 Receiver, 21.4 Mc - 200 Kc. BW IF Strip (Master & Slave Channels), Bottom View, Output Side.

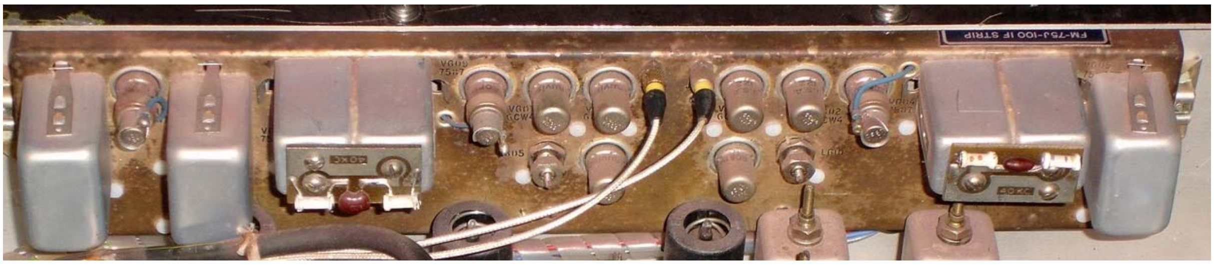

Fig. 4-23. Model G-187 Receiver, 2.5 Mc - 40 Kc. BW IF Nuvistor Strip (Master & Slave Channels), Top View.

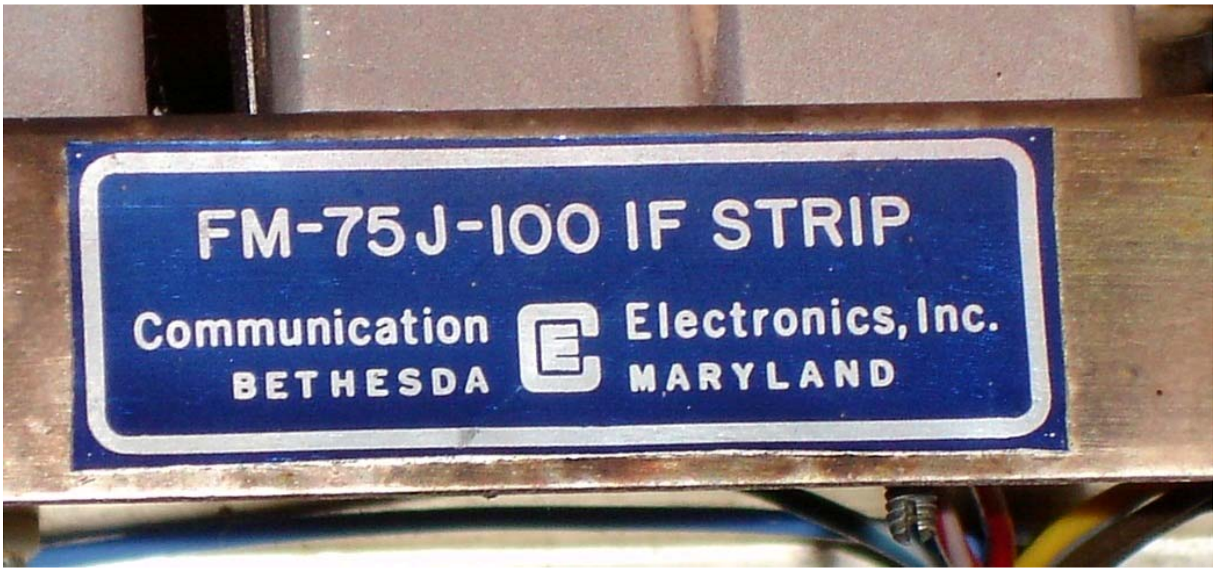

Fig. 4-24. Model G-187 Receiver, 2.5 Mc - 40 Kc. BW IF Nuvistor Strip, CEI Label on the chassis side.

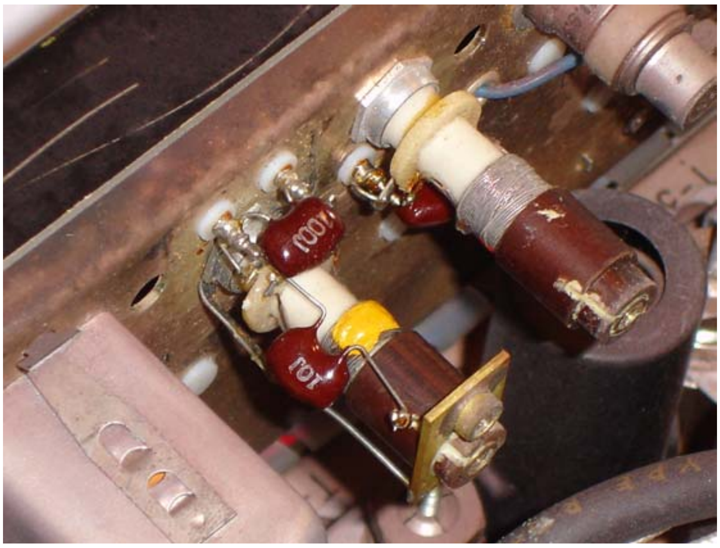

Fig. 4-25. Model G-187 Receiver, 2.5 Mc - 40 Kc. BW IF Nuvistor Strip (Master Channel), 40-Kc. Band-Pass Filter Details (Cover Removed).

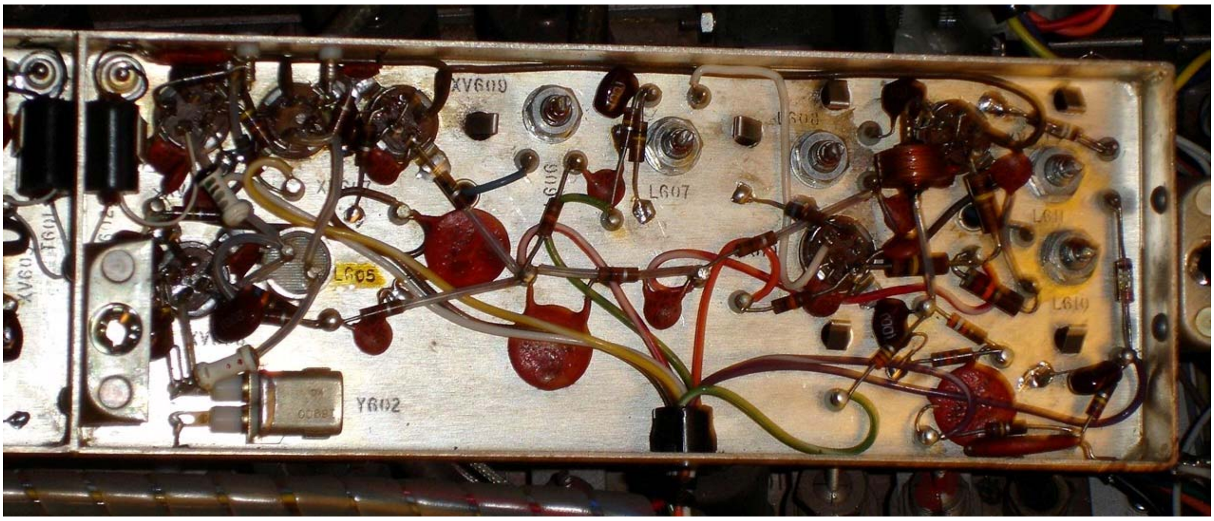

Fig. 4-26. Model G-187 Receiver, 2.5 Mc - 40 Kc. BW IF Nuvistor Strip (Master Channel), Bottom View.

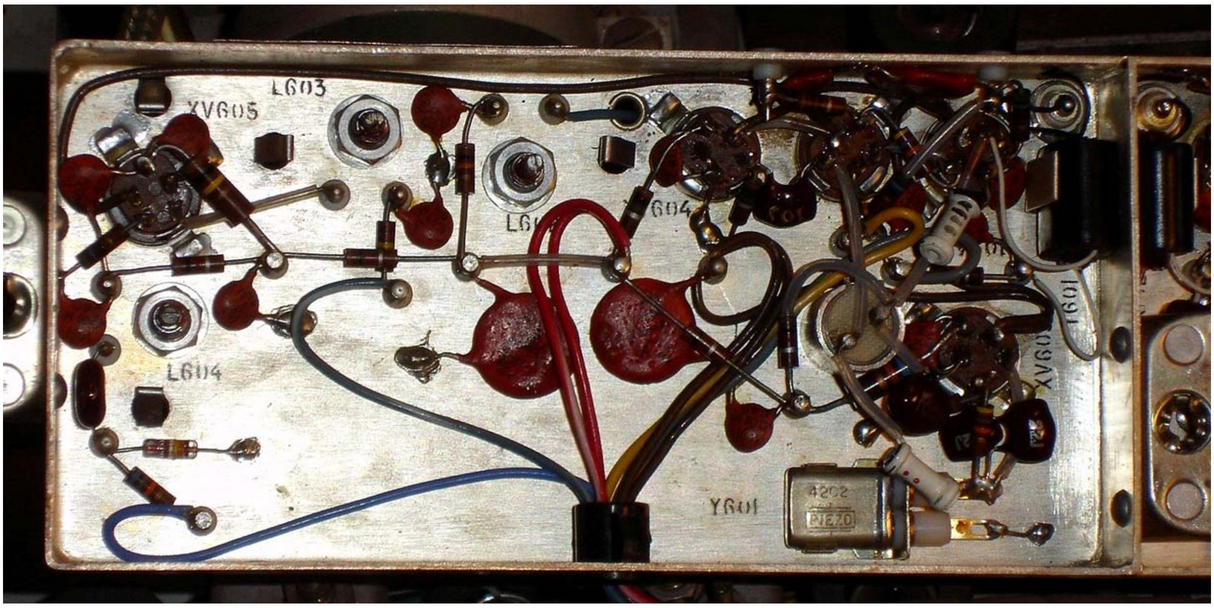

Fig. 4-27. Model G-187 Receiver, 2.5 Mc - 40 Kc. BW IF Nuvistor Strip (Slave Channel), Bottom View.

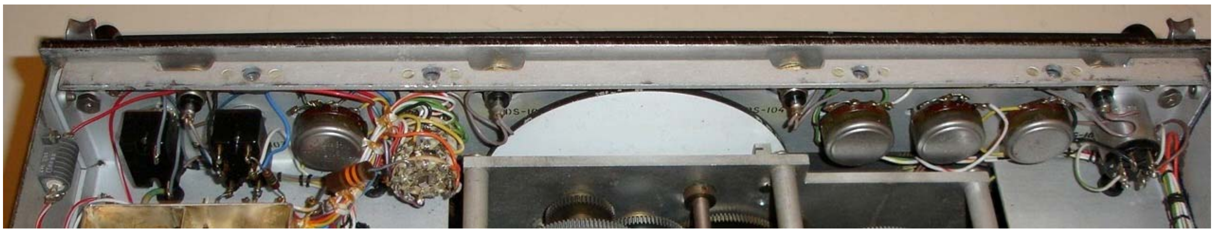

Fig. 4-28. Model G-187 Receiver, Controls in the Front Panel (Bottom Side).

Fig. 4-29. Model G-187 Receiver, AGC "MON/DF" and Function Switches in the Front Panel.

Fig. 4-30. Model G-187 Receiver, Rear of the Front Panel Function Switch.

Fig. 4-31. Model G-187 Receiver, Rear of the AGC "MON/DF" Rotary Switch.

Fig. 4-32. Model G-187 Receiver, The Power Supply Section, Top View.

Fig. 4-33. Model G-187 Receiver, The Power Supply Section, Bottom View.

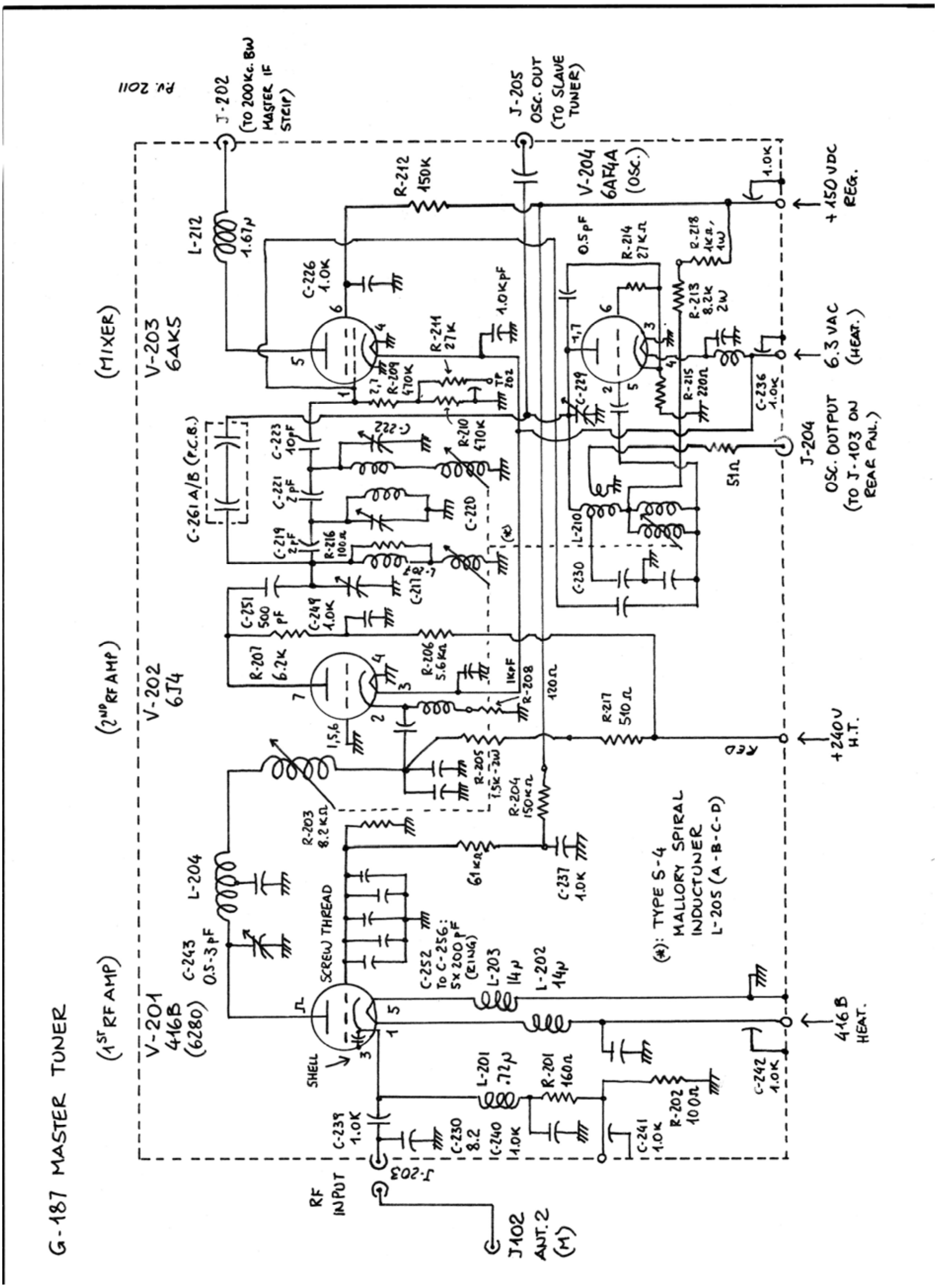

Fig. 5-1. Model G-187 Receiver, Schematic Diagram: Master RF Tuner.

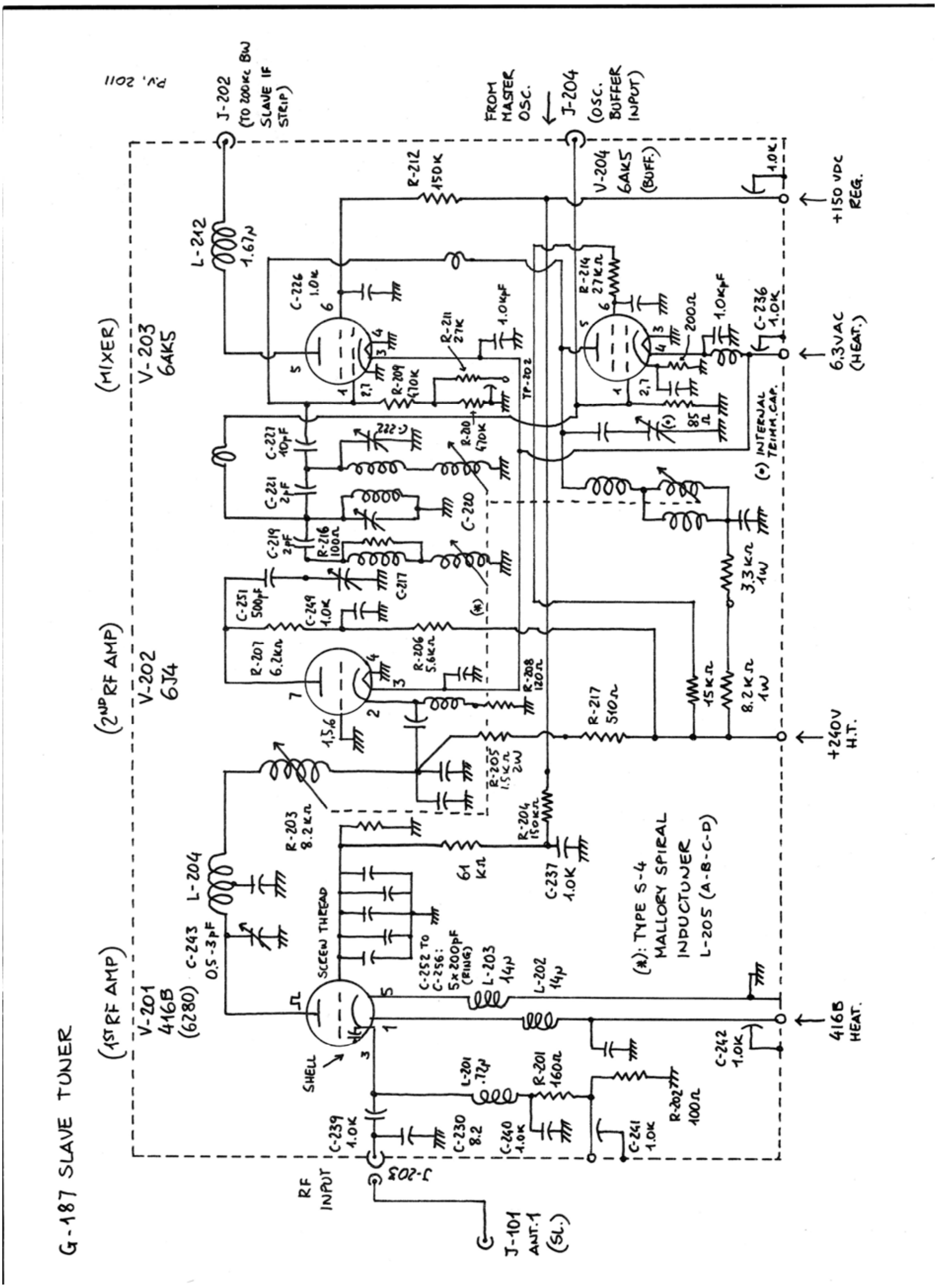

Fig. 5-2. Model G-187 Receiver, Schematic Diagram: Slave RF Tuner.

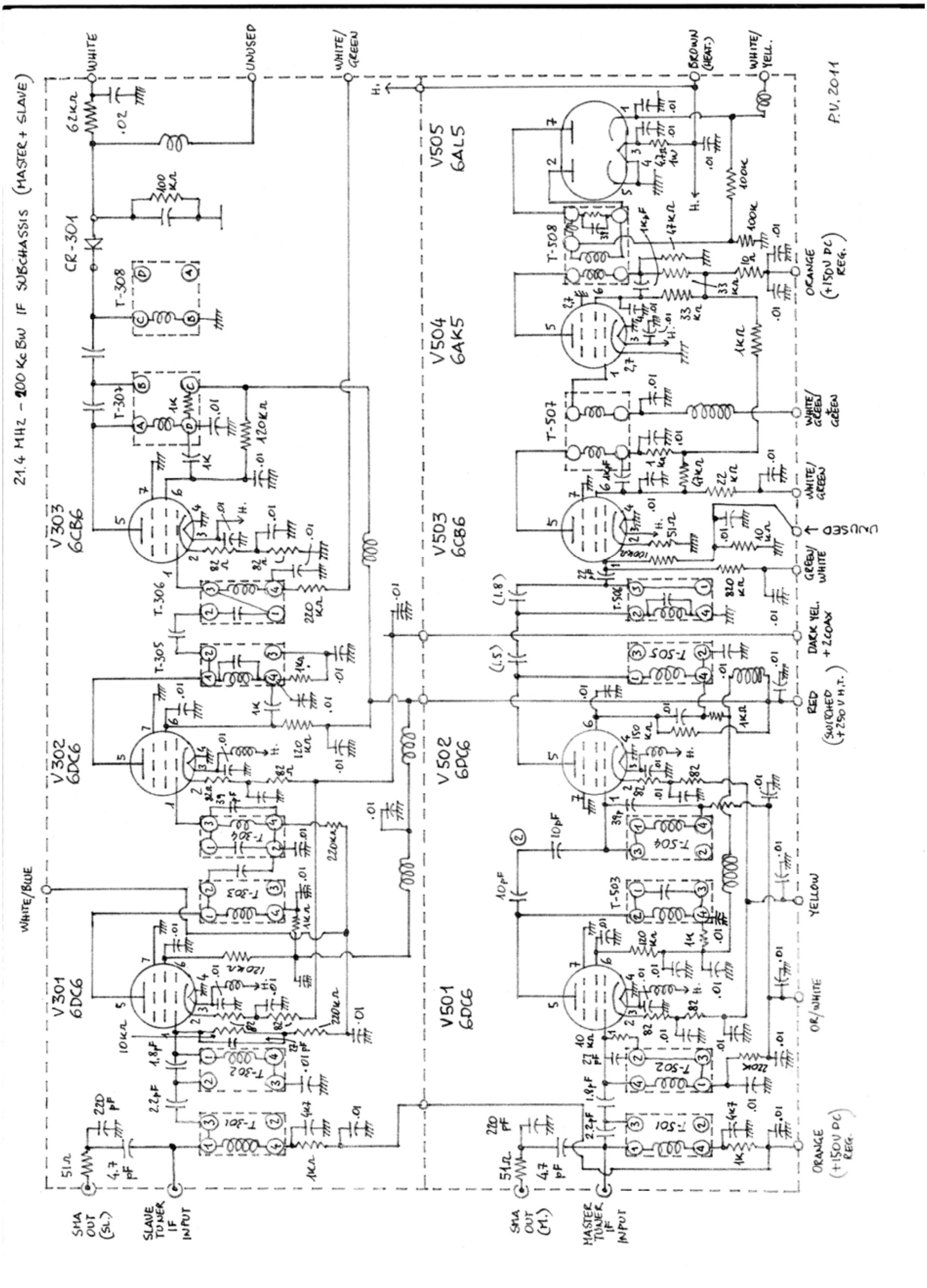

Fig. 5-3. Model G-187 Receiver, Schematic Diagram: 21.4 Mc.- 200 Kc. BW IF Strip (Master and Slave Channels).

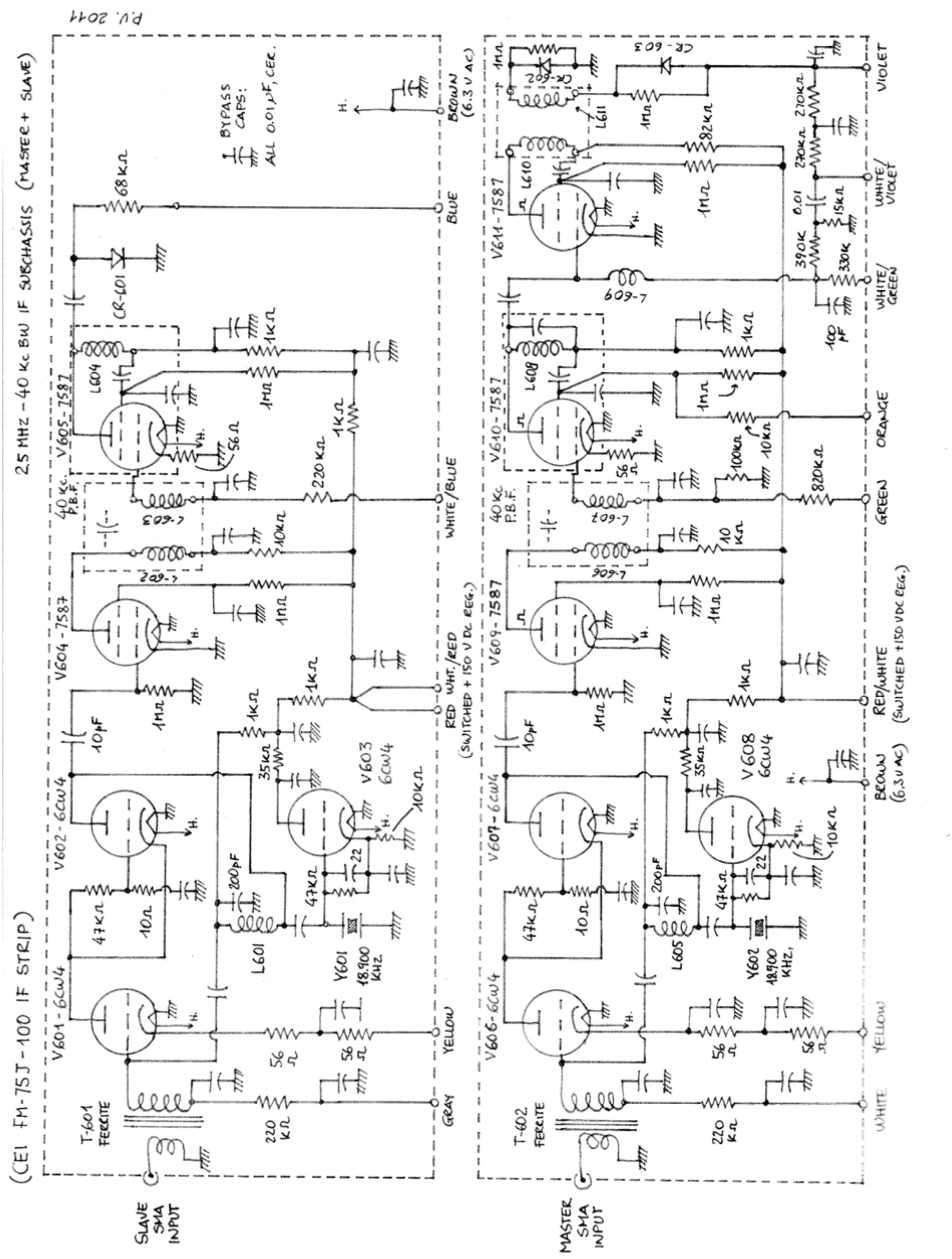

Fig. 5-4. Model G-187 Receiver, Schematic Diagram: 2.5 Mc.- 40 Kc. BW IF Nuvistor Strip (Master and Slave Channels).

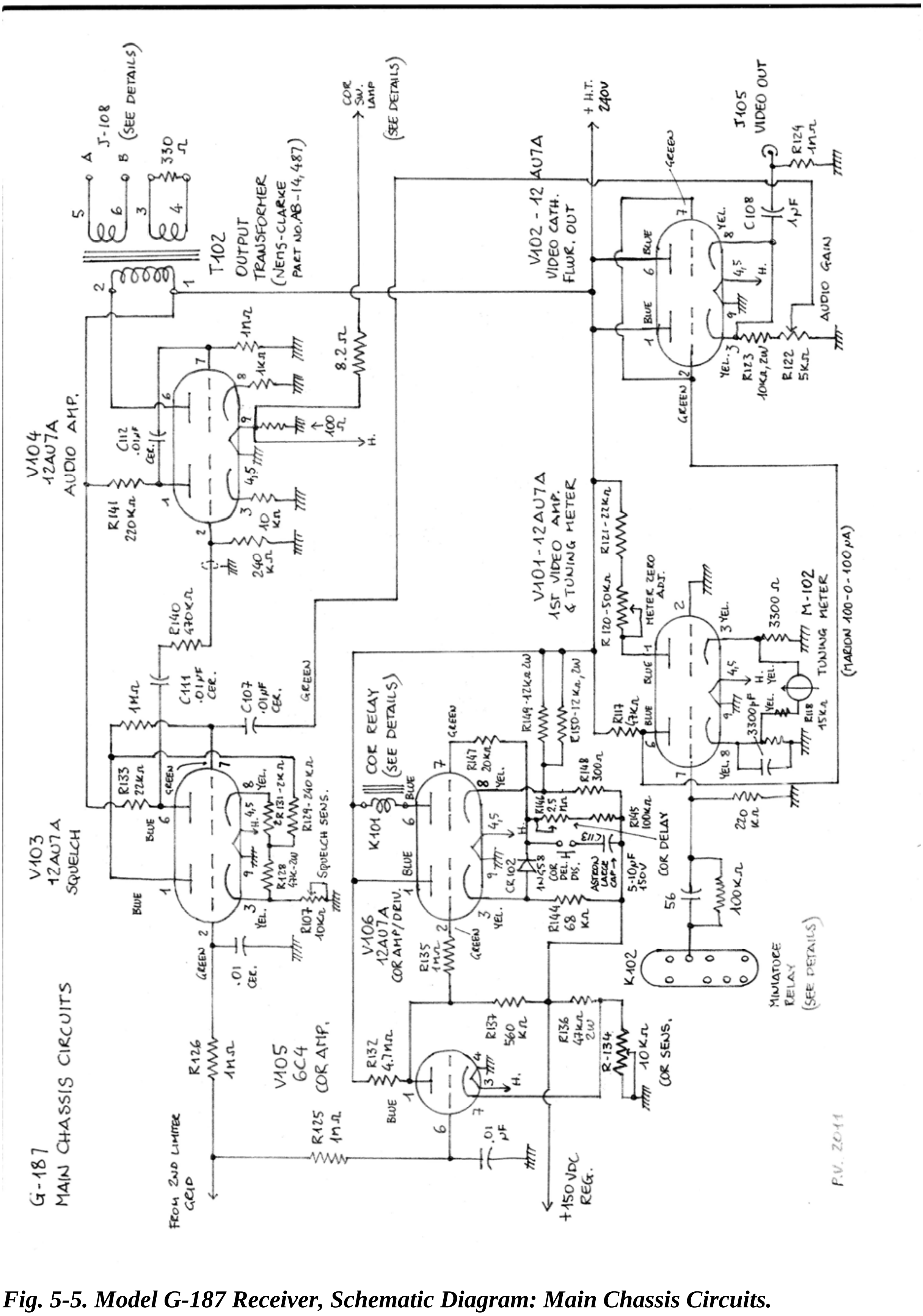

Fig. 5-5. Model G-187 Receiver, Schematic Diagram: Main Chassis Circuits.

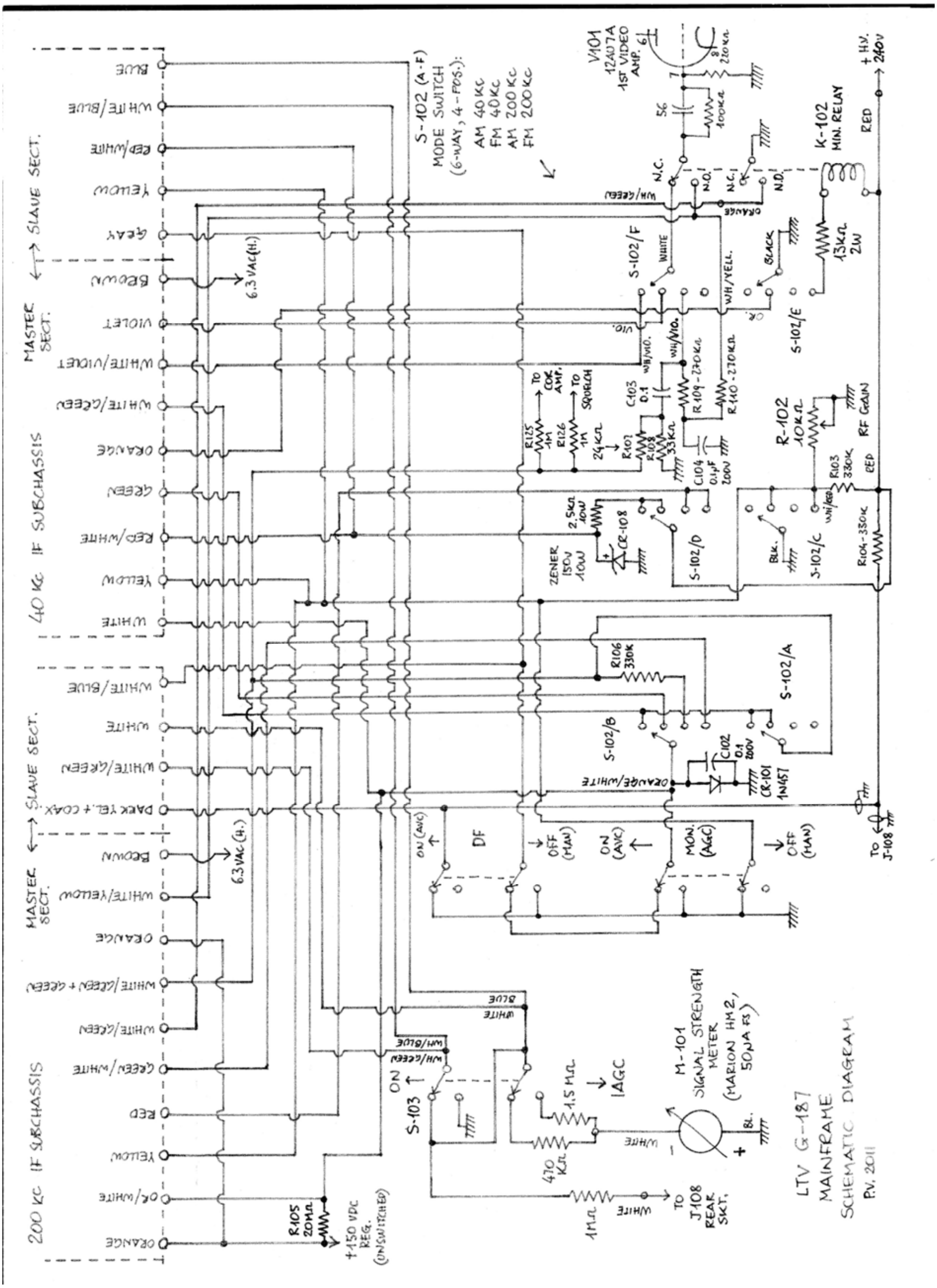

Fig. 5-6. Model G-187 Receiver, Schematic Diagram: Mainframe.

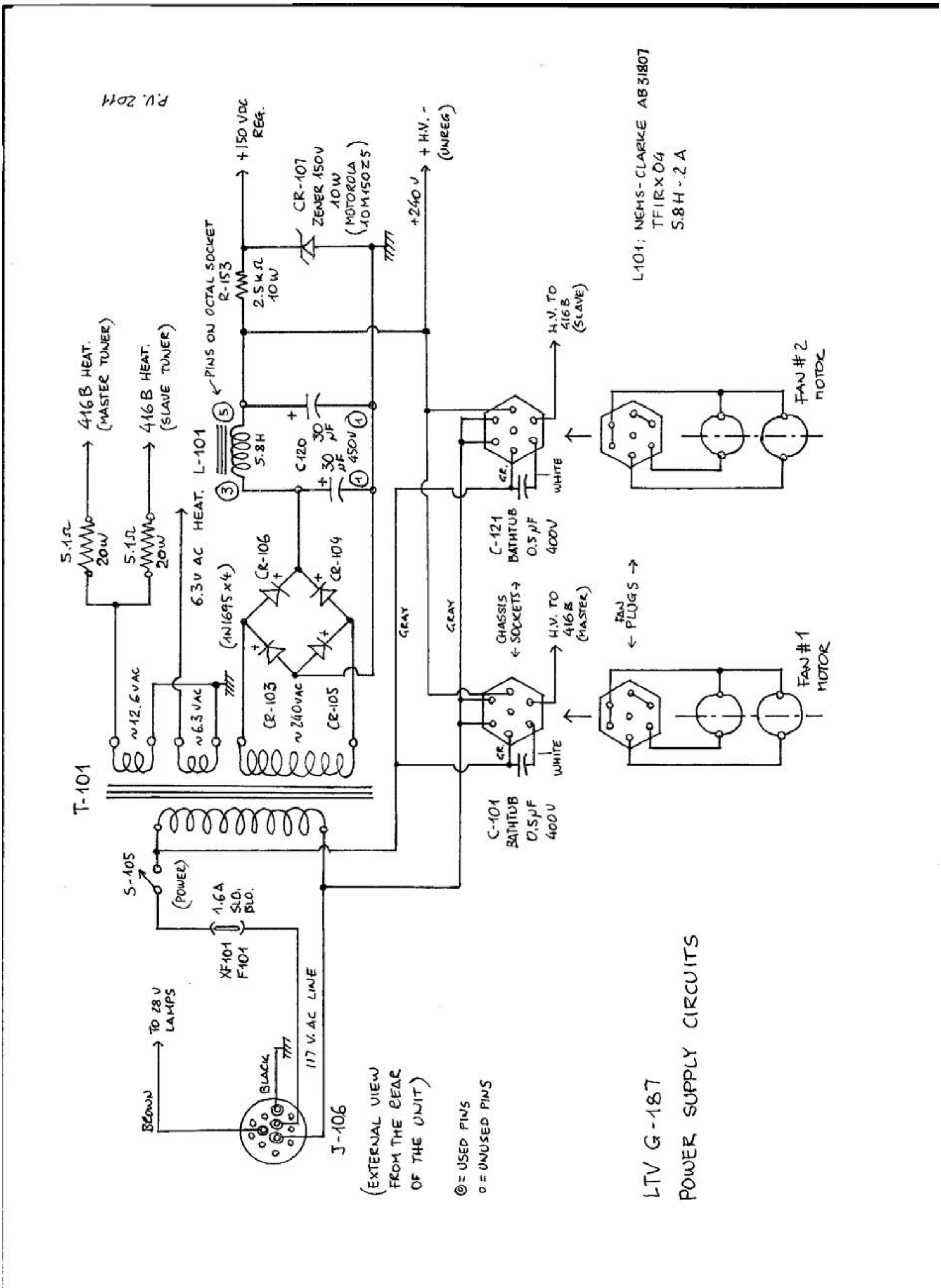

Fig. 5-7. Model G-187 Receiver, Schematic Diagram: Power Supply Circuits.

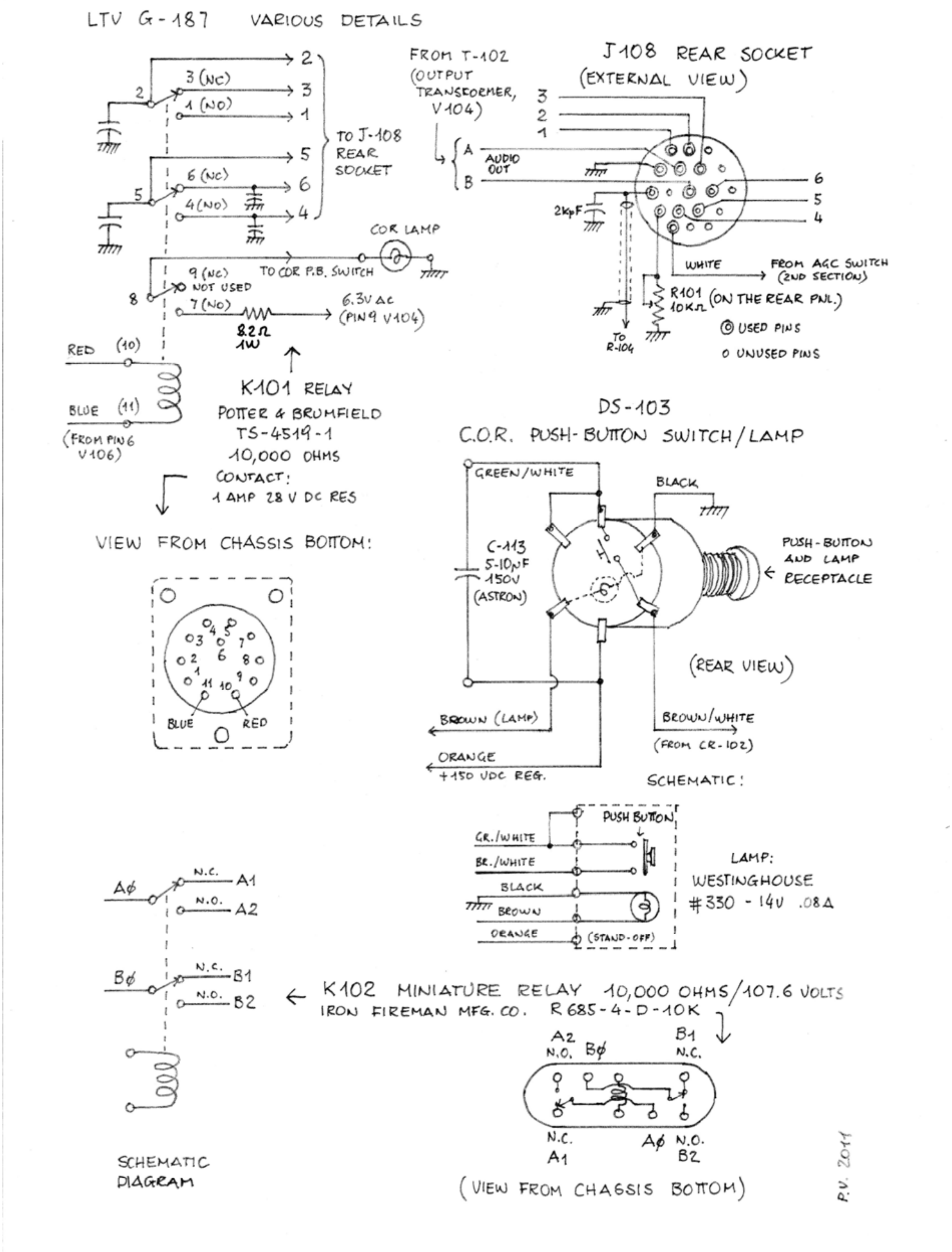

Fig. 5-8. Model G-187 Receiver, Schematic Diagram: Various Details.

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