SECTION 7. MEASURING EQUIPMENT

A MODIFICATION FOR TESTING 807 TUBES IN THE MODEL OD EQUIPMENTS

The following suggestion regarding the testing of type 807 vacuum tubes in the model OD series analyzers has been submitted by the Radio Material Officer at NYMI:

(1) The test of transmitting type 807 tubes in Navy model OD–b tube checkers has often resulted in serious damage to the tube checking instruments. Apparently self-oscillation takes place while testing these particular tubes and causes heavy surge currents and overloads to the instruments.

(2) A simple method of correcting this difficulty without affecting OD–b calibration has been found. Wind 25 turns of number 22 enamel wire over a 50-ohm (1-watt) resistor. Solder the coil leads to the resistor leads as close to the resistor as possible. Place this unit in series with symbol 71 (cap connection) immediately under the front panel.

The Bureau recommends that the assembled coil and resistor be inserted in a separate patchcord in order to eliminate the necessity for modifying the wiring within the analyzer. A suitable notation should be made on the test chart to indicate that this special patchcord should be used when testing 807 tubes.

●

MODEL OD SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered	Cause and Remedy
Failure of "Spring Back" toggle switches used for "Lamp Test," "Hum Test," "Microamps," and "Signal Supply".	A satisfactory substitute has been found to be Mallory-Yaxley No. 2007 push button switch. This switch fits into panel holes designed for toggle switches, provides stable and convenient operation, and with slight modification can be made to operate as a DPST or SPST—"normally open" or "normally closed".—U. S. S. *Long Island*

FIELD MODIFICATION OF MODEL OF–1 EQUIPMENTS TO OBTAIN USABLE OPERATING CHARACTERISTICS

Tests conducted by the Naval Research Laboratory on the performance characteristics of the model OF–1 radio interference locating equipment indicated that the equipment in its original condition was not usable for its intended purpose. However, with certain minor modifications, it is possible to obtain usable operating characteristics.

Any person or activity capable of carrying out the specified changes is authorized to perform the modifications which are as follows:

(1) Use the original tubes if possible; if the 1D5GP tubes are damaged, replace only with tubes selected for the following characteristics as measured on a General Radio vacuum tube bridge type 561–C or equivalent: a plate current of 0.4 ma. or higher, and a transconductance of 145 or higher with 2.0 volts on the filament, 85 volts on the plate, 62 volts on the screen grid, and —6.15 volts on the control grid. If the bridge is not available, the tubes should be tested on a Navy model OD vacuum tube analyzing equipment.

(2) Move the attenuator and mount it near the attenuator switch to permit the shortest possible lead lengths. (Less than one-half inch to the "X100" step if possible.)

(3) Pad the "X100" step of attenuator C–113 with sufficient capacity to permit correct adjustment at 1 mc. with a 15-mmfd. dummy in antenna lead. (125–225 mmfd.)

(4) The load on the type 1P1 ballast tube must be adjusted to permit regulation of the filament voltage at 2.0 volts as the "A" voltage drops from 3.0 to 2.4 volts. (Do not rely on the OF–1 meter for "A" voltage measurements.) Proper adjustment usually can be made by paralleling R120 with another resistor in the range of 40 to 100 ohms. The correct value must be determined by trial for each set. This adjustment will apply only to the individual 1P1 and particular set of tubes employed. A replacement in either may require a new adjustment.

(5) Change the battery in the AVC bias to 3 volts. Use the "Z" cell originally in parallel with the d-c amplifier bias and connect it in series with the AVC bias.

(6) Cut out multiple grounds on the coupled wave traps, i. e., cut the ground bus running from the common terminal of C–114 and C–115 to the selector switch. Leave only one ground lead as shown in Figure 4 of the instruction book.

(7) Connect R118 and R119 in parallel. This can be done readily by shorting between the "X" and "A" contacts of switch S105 (rear).

(8) Disconnect the screen lead of V–101 from its contact at the screen of the V–102 socket and connect V–101 to the positive terminal of the G–10 socket through a 30-ohm resistor.

(9) Disconnect the first i-f screen lead from its contact at the front section of the selector switch (S–107) and connect it directly to the positive terminal of the G–10 socket.

(10) Cut out the wire that runs from the screen of the first i-f socket to one end of R133. Connect that end of R133 to the positive terminal of the G–10 socket.

(11) Disconnect the lead from R–115 to the rear section of the attenuator switch at R–115 and connect this lead to the positive terminal of the G–10 socket through a 330-ohm resistor. (R–115 is no longer used.)

(12) Replace R–134 with a 375-ohm resistor or connect 500 ohms in parallel with it.

(13) Connect a 1000-ohm resistor in series with R–133.

(14) Check the alignment of the i-f transformers and if necessary to realign, follow the instruction book for model OF–1.

(15) Realign the r-f section. Follow the procedure in the instruction book. Refer to the corrections given in reference (b).

(16) Align the i-f rejection circuit. Follow the procedure in the instruction book.

(17) Align the output meter. Use the procedure given in paragraph (x).

(18) Connect a 5-mmfd. condenser in parallel with C105 if necessary, to increase the gain at the lower end of band "C".

(19) Check the meter scale tracking on at least three frequencies on each band. If the set is in proper alignment, it should be quite uniform over all frequencies on the "X" and "A" bands, and within a 10 percent error on all frequencies on the "B" and "C" bands.

(20) If the output meter tracks differently at frequencies on the "X" band than at 1 mc. where it was aligned, the trouble is probably due to regeneration. To correct this, tune the OF–1 to 300 kc. and without signal input observe the meter as the gain is advanced to maximum. A

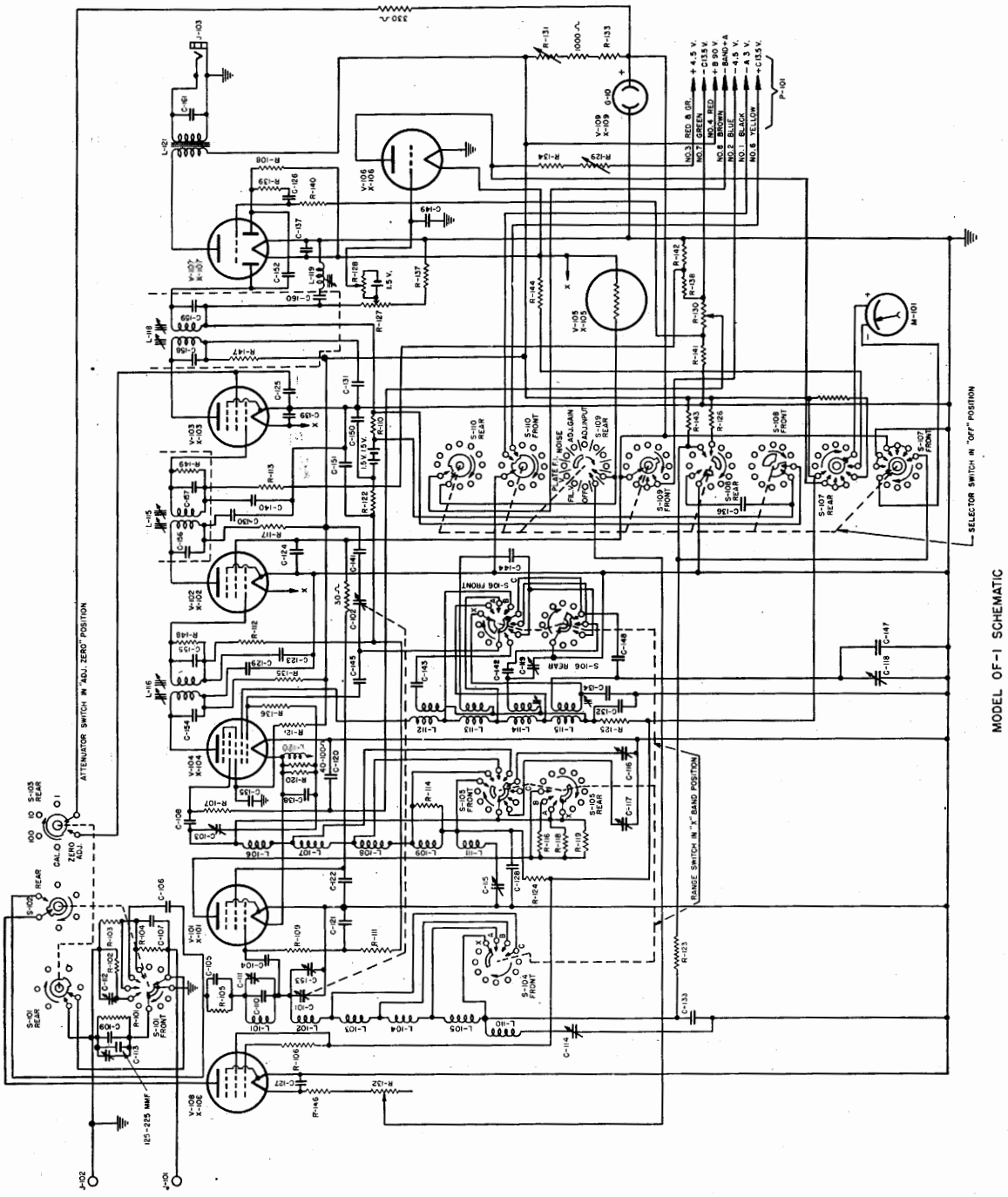

FIGURE 1.—Revised schematic of model OF–1.

large meter deflection (50 microvolts to full scale) indicates regeneration. Tune C–114 and C–115 for minimum deflection.

(21) Many factors influence the accuracy of the meter scale tracking at higher frequencies. The i-f resonance curve should be round topped and symmetrical. The oscillator should track perfectly at all frequencies and should have excellent frequency stability within the normal changes in plate and grid voltages which occur with various input signal levels and gain settings. An r-f trimmer and a mixer trimmer of proper capacity range are necessary to assure the alignment of the tuned circuits over the entire range of frequencies of each band. The ballast tube should be capable of maintaining a constant filament voltage. As none of these factors are met or wholly provided for in the design of the OF–1, errors in meter scale tracking are possible at spot frequencies within bands "B" and "C". The "X" and "A" bands have sufficient adjustments for good oscillator tracking. Uniform meter scale tracking results at all frequencies within the "X" and "A" bands. Insufficient adjustments on bands "B" and "C" result in non-uniform meter scale tracking.

(22) Calibration data should be taken in accordance with the instruction books for the OF–1. Any changes in tubes or alignment that effect the scale spread of the meter made after calibration will necessitate new calibration curves.

(23) The following changes are suggested to improve the ease with which calibration adjustments can be made:

(*a*) Replace the tapered 2-megohm potentiometer R130, used as gain control, with a 2-megohm linear potentiometer.

(*b*) Connect 100 ohms in parallel with R132, the input control.

(24) The following procedure for scale alignment of the output meter is suggested in place of the procedure given in the OF–1 instruction book.

(*a*) Turn ATTENUATOR switch to ADJ. Zero and set the meter needle to read zero by adjusting the ZERO knob.

(*b*) Turn ATTENUATOR switch to 1. Apply a 100-microvolt signal at approximately 1000 kc to the ANT. and GND terminals. Tune the equipment to this frequency by means of the FREQUENCY and R.F. TRIMMER knobs. Adjust the GAIN knob for a meter reading of 100 microvolts. Set the signal generator for 1000 microvolts and adjust R–127 for a meter reading of 1000 microvolts. Repeat the gain adjustment at a 100-microvolt input and the R–127 adjustment at a 1000-microvolt input until the 100- and 1000-microvolt marks on the meter are in alignment with the signal generator.

(*c*) Decrease the signal generator output to 10 microvolts and check the reading of the meter. If the meter reads low, obtain a new zero adjustment in the manner given in (*d*).

(*d*) With the ATTENUATOR switch on ADJ, turn the ZERO knob counterclockwise to a position near its limit and turn R128 clockwise part of a turn. This will unbalance the meter which must be made to read zero by adjusting R129.

(*e*) A change in R129 upsets the previous 100- to 1000-microvolt alignment of the meter, so repeat (*b*) and again check the reading for a 10-microvolt input as in (*c*).

(*f*) If the 10-microvolt reading is still low, repeat (*d*) and (*e*).

(*g*) When a 10-100-1000-microvolt meter alignment is obtained, check the readings at 40- and 400-microvolt inputs. If a low reading is obtained for a 40-microvolt input and a high reading is obtained for a 400-microvolt input, repeat (*d*) and (*e*), making adjustments of R131 and R128 in the same manner as when 10 microvolts read low.

(*h*) This may cause the meter to read high for a 10-microvolt signal. If so, repeat (*d*) and (*e*) until the percent error at the 40- and 400-microvolt levels is the same as the percent error at the 10-microvolt level. With matched tubes, selected for the OF–1, this will give meter scale tracking within 5 percent over the entire reading range of the scale.

(*i*) If the above procedure fails to yield good meter scale tracking, switch 1D5GP tubes in the r-f and two i-f stages to obtain a better match of tubes in the AVC stages. Then repeat the alignment procedure above.

(*j*) A revised schematic incorporating these field changes plus the correction of a few errors in the original drawing is printed herewith as Figure 1.

CHOICE OF TUBES FOR MODELS OF, OF–1 AND OF–2 INTERFERENCE LOCATORS

Difficulty is frequently encountered in the operation of the models OF, OF–1 and OF–2 interference locators after replacement of one or both of the intermediate-frequency amplifier tubes, type 1D5GP. This is due to the fact that replacement tubes for these equipments must be especially selected in order to provide proper operation of the equipment.

The Naval Research Laboratory has conducted tests to determine the proper characteristics for type 1D5GP tubes for replacement use and found that tubes must be chosen for two criteria: a high transconductance to allow calibration; and proper slope of the plate current versus grid voltage characteristic curve in order to provide proper tracking of the meter scale

It was found that a satisfactory 1D5GP tube should have a plate current of 0.4 milliamperes or higher and a transconductance of 145 micro-ohms or higher when the tube is operated under the following conditions: filament voltage 2.0 volts, plate voltage 85 volts, screen voltage 62 volts, and control grid bias—6.15 volts. It should be emphasized that tests to determine the suitability of replacement tubes should be made using a tube tester such as the General Radio vacuum tube bridge model 561–C or Navy model OD. Tests made with "English reading" good or bad scales such as Navy model OZ are of no value in determining the proper characteristics of the 1D5GP tubes for this use.

MODEL OF SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered	Cause and Remedy
Model OF–1.—Inability to set meter to zero by adjustment of zero set control on front panel.	Check potentiometer R128 mounted on back of chassis. This control has been found to develop a high resistance leakage to chassis, the leakage being of the order of 100,000 ohms. A replacement control is furnished in the spare parts. After replacement, the meter scale spread should be adjusted as described in paragraphs 5–10 to 5–19 in the instruction book. Adjustment of the meter scale spread need not be followed by realignment as implied in the instruction book. In paragraph 5–13, page 21, line 2, the word "positive" should be changed to "negative", and in line 3 the word "negative" should be changed to "positive".

MODEL OZ SERIES TROUBLE SHOOTING NOTES

Difficulty Encountered	Cause and Remedy
Meter would read backwards against pin, without depressing any of the test buttons, when certain tubes such as the 5U4G, 5Z3, 6H6, 6SN7, 6A6, etc. were inserted for test. This occurred infrequently and only when certain specific types of tubes were tested. Other types checked normal.	Trouble was traced to a bad factory solder job. A "gob" of solder was shorting two of the lug connections on the push "switch" labelled RECTIFIER STANDARD. Extra solder was removed and the tube tester worked properly on all types of tubes.

MODEL OAL TUBE CHART

The Precision Apparatus Company's Supplementary Tube Chart Form DRC (supplement 8–15–44) contains incorrect information on the tube type 1A3. Under short test it should read "1A3—must show short on 'B', 'E', and 'F'."—*U. S. M. C. Depot of Supplies, Philadelphia.*