SECTION IV – THEORY OF OPERATION

SECTION IV
THEORY OF OPERATION

1. GENERAL.

a. The Models RBB/RBC radio receiving equipments are designed for five types of reception. A master switch (S304), designated "RECEPTION" on the receiver front panel enables the operator to select the various types of reception.

(1) The "MOD" position is generally employed when MCW (tone) reception is desired, although this position can also be used for voice. In this position the manual r-f sensitivity (volume) control (R361-A, B) is operative. This control is identified as "GAIN" on the receiver front panel.

(2) When the "RECEPTION" switch (S304) is in the "MOD-AVC" position, the manual r-f sensitivity control (volume controls R361-A, B) is disconnected whereas the manual audio gain control ("OUTPUT LEVEL," R363-A, B) is made operative. In addition, the automatic volume control circuit is utilized. This type of reception is generally used for voice.

(3) When the "RECEPTION" switch (S304) is in the "MOD-AVC-SIL" position, the circuit employs the same component parts used in the "MOD-AVC" position. In addition, the "SILENCER" control is made operative. This position is generally operated for reception of intermittent voice transmissions.

(4) The "CW" position is intended for telegraph reception. In this position the cw oscillator and "GAIN CONTROL" are connected to operate.

(5) When the "RECEPTION" switch (S304) is placed in the "CW-OL" position, the cw oscillator remains operative and the output limiter is connected. The "OUTPUT LEVEL" control (R363-B) is made operative and the "GAIN" control is again connected. This type of reception provides the equivalent of a.v c. action on cw signals and reduces noise interference by limiting noise peaks exceeding the signal output level. It is useful in cases of severe fading on cw reception.

(6) For all types of reception the antenna input (preselector), r-f, first detector, and heterodyne oscillator stages remain the same except for a.v.c. and "GAIN" control operation. See Block Diagrams, Figures 4-1 to 4-5. The r-f signal is received by the antenna and is fed into the antenna input (preselector) stage. The signal is then applied to the r-f stages, where it is amplified. The local oscillator signal frequency is fed into the first detector (mixer) and combines with the amplified r-f input. The resultant beat frequency of 400 KC is fed into the i-f stages and amplified.

(7) When the "RECEPTION" switch (S304) is in the "MOD" position, the i-f frequency of 400 KC is coupled to the second detector (see Figure 4-1). An audio voltage is developed in the second detector and is applied to the a-f stages where it is amplified. All audio stages employ negative feedback. The final a-f stage is coupled to the output stage; the audio output, in turn, is fed into the headphones.

(8) When the "RECEPTION" switch (S304) is in the "MOD-AVC" position, the antenna input (preselector), r-f, first detector, and oscillator stages remain unchanged, except that a.v.c. is applied to the r-f amplifiers. In this position, an automatic volume control (a.v.c.) circuit is connected (see Figure 4-2). The a.v.c. is coupled to the r-f amplifiers, final i-f stage, and the first a-f stage. This automatic gain control of the r-f signal eliminates use of the r-f sensitivity control (R361-A, B). The final i-f stage is coupled to the second detector. The audio voltage that is developed in the second detector is amplified by the a-f stages. The final a-f stage is coupled to the output stage.

(9) When the "RECEPTION" switch (S304) is in the "MOD-AVC-SIL" position, all the circuits discussed in the preceding paragraph (8) remain the same. In this position, however, a silencer circuit is added between the second detector and first audio stages (see Figure 4-3). This circuit functions to cut off receiver output for inputs below a predetermined level.

(10) When the "RECEPTION" switch (S304) is in the "CW" position, the antenna input (preselector), r-f, first detector, and heterodyne oscillator stages function the same as described in Paragraph (6) above. In this position, the cw oscillator is connected to operate (see Figure 4-4). The cw oscillator frequency is fed into the second detector (mixer). The resultant beat frequency of 1,000 cycles difference is coupled to the a-f stages where it is amplified. An audio band-pass filter circuit is located between the first and second audio stages. The amplified audio frequency (1,000 cycles) is fed to the output stage and in turn to headphones.

(11) In the "CW-OL" position, the cw oscillator remains operative and the output limiter is connected. In addition the "OUTPUT LEVEL" control (R363-B) and "GAIN" control (R361-A, B) are made operative (see Figure 4-5).

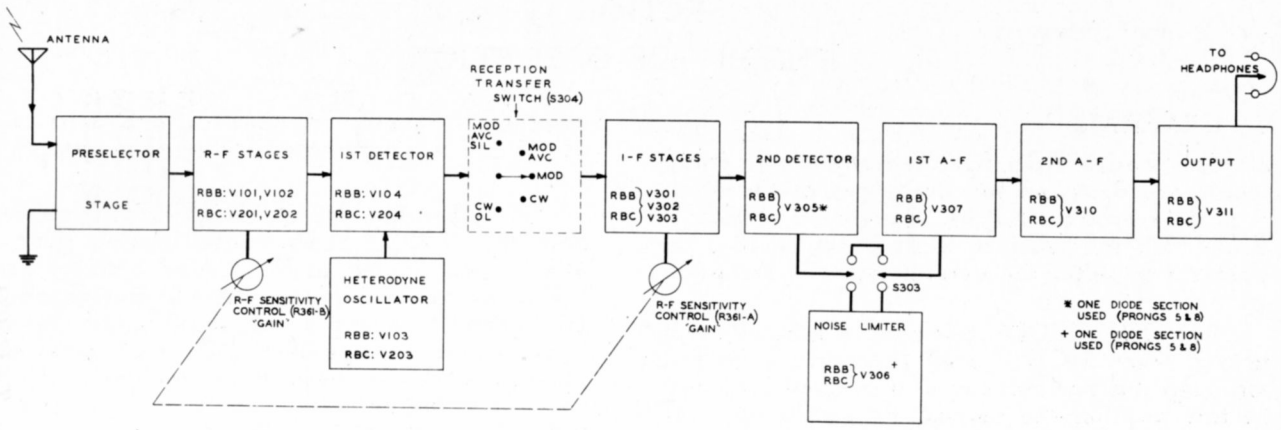

Figure 4-1 — Models RBB/RBC Radio Receivers, "MOD" Reception (Block Diagram, P-717906)

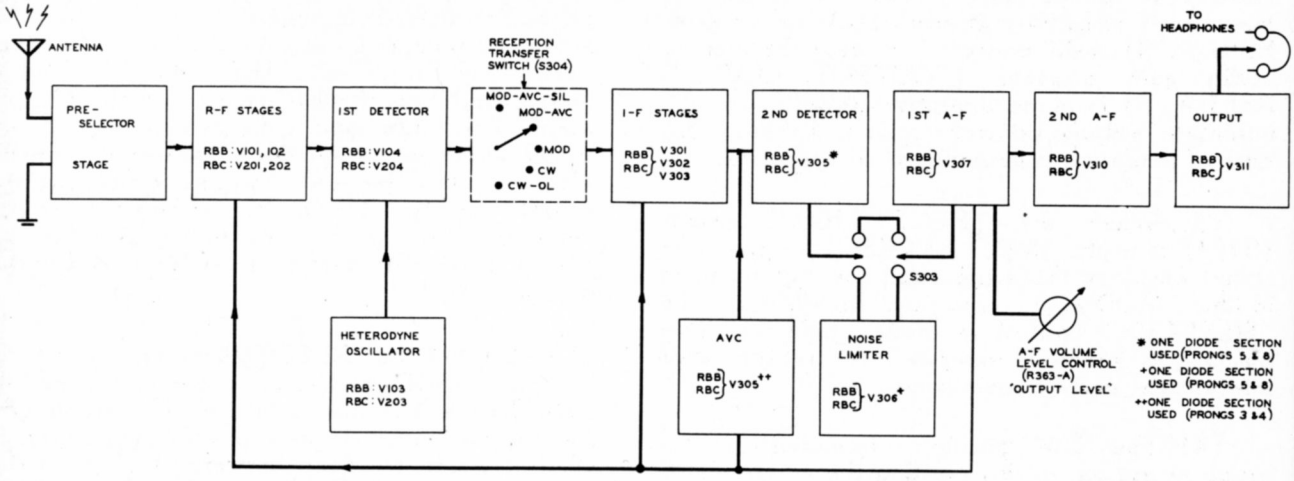

Figure 4-2 — Models RBB/RBC Radio Receivers, "MOD-AVC" Reception (Block Diagram, P-717921)

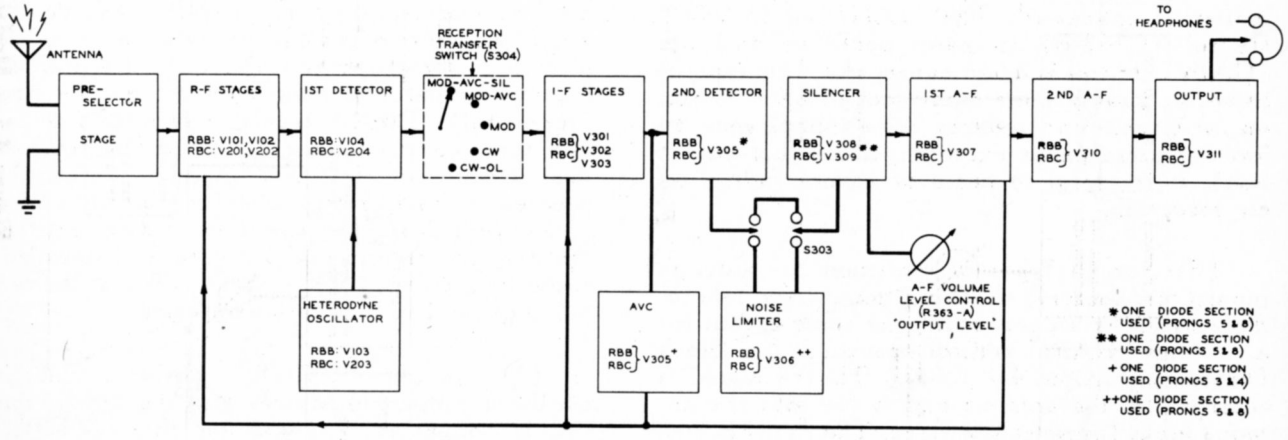

Figure 4-3 — Models RBB/RBC Radio Receivers, "MOD-AVC-SIL" Reception (Block Diagram, P-717922)

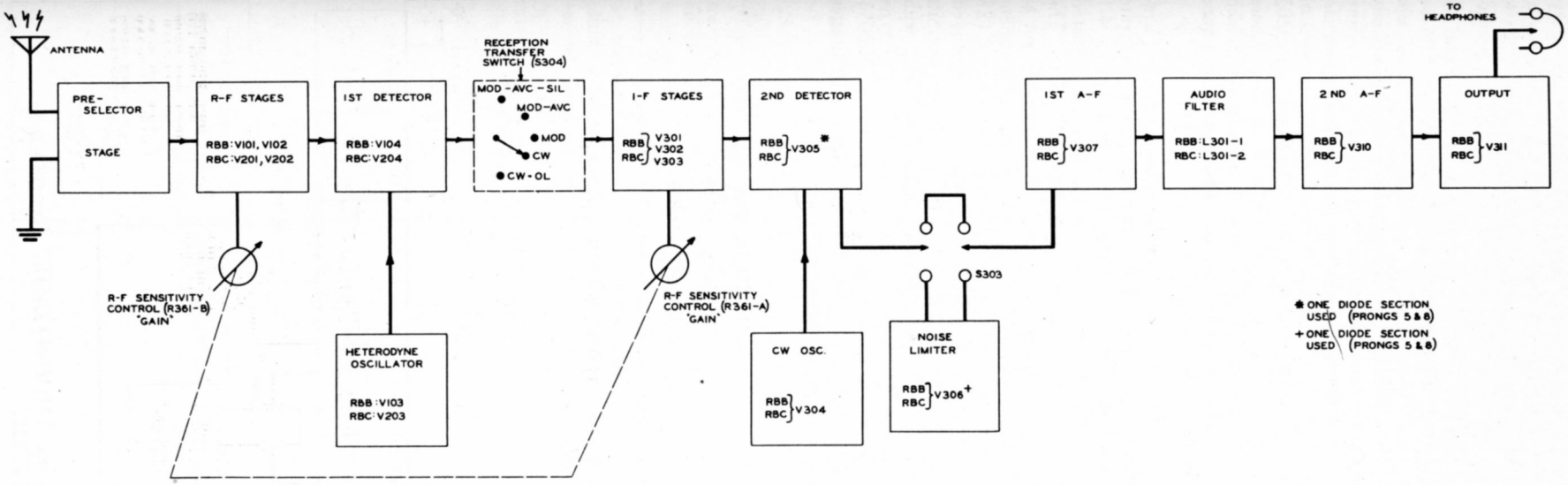

Figure 4-4 — Models RBB/RBC Radio Receivers, "CW" Reception (Block Diagram, T-617602)

RESTRICTED

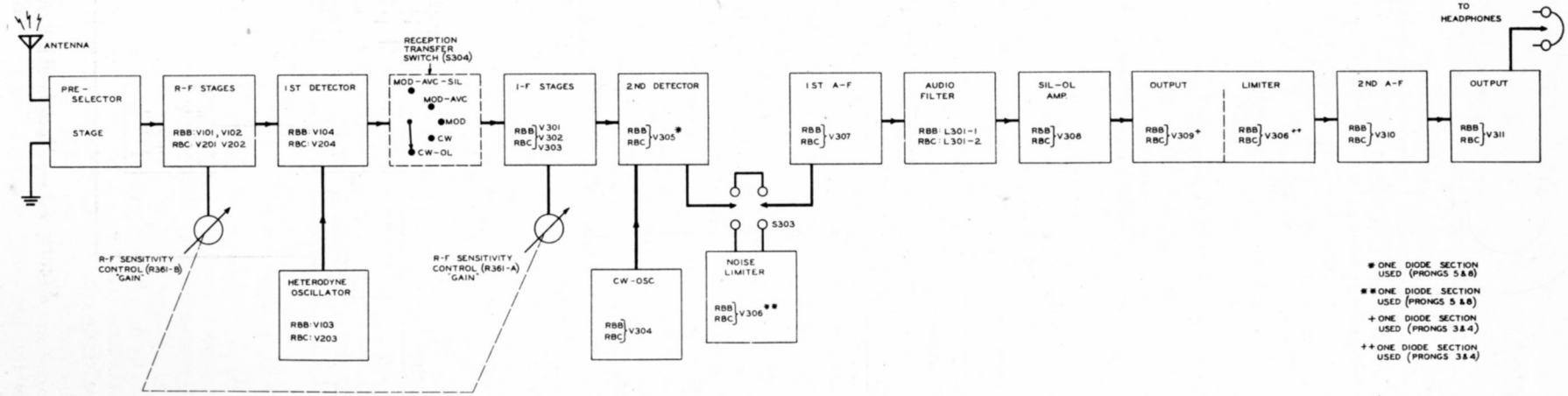

Figure 4-5 — Models RBB/RBC Radio Receivers, "CW-OL" Reception (Block Diagram, T-617603)

RESTRICTED

2. PRESELECTOR (R-F) UNIT.

a. GENERAL.—

(1) In the following discussion, frequent reference should be made to the schematics, Figures 7-19 and 7-25.

(2) The r-f circuits of the Models RBB/RBC radio receiving equipments include an antenna input stage, two-stage r-f amplifier, heterodyne oscillator, and first detector (mixer). Five variable tuned circuits are used; two preceding the first r-f tube (V101 or V201); two as interstage coupling circuits; and one in the heterodyne oscillator circuit.

b. ANTENNA INPUT STAGE.—

(1) The r-f input connection for the preselector unit is a concentric jack (J101 or J201) located at the rear of the unit. This jack is connected to a terminal board (E105 or E209), carrying link connectors for adapting the input circuit to the various operating conditions shown in Figure 2-4. For operation of a single equipment from a simple antenna or transmission line, the link connectors provide for connecting the input to either of two input systems designed to match the antenna impedance or line impedance as the case may be. The RBB receiver connected for line operation employs a capacitor (C107) to shunt the unused antenna input system in order to maintain alignment of the first circuit. For common operation of more than one RBB equipment on the same antenna, a decoupling resistor (R101) is inserted in series with the input to each equipment. For operation of the RBB equipment in common with other low frequency receivers from a transmission line input a decoupling capacitor (C150) is employed. For common, operation of the RBC and RBB equipments from a single antenna, a decoupling capacitor (C217) is employed in series with the RBC input circuit.

(2) For transmission line input, the coupling system for the Models RBB/RBC radio receiving equipments consists of separate coupling coils for each band, magnetically coupled to the low potential side of the respective tuned circuit.

(3) This particular method of coupling, described in Paragraph (2) above, minimizes capacitance coupling. The proper coupling coils for transmission line input are designed to match the receiver input to an average of 70 ohms resistance over each frequency band. The proper coupling coil for a particular band is selected by a section of the gang band switch (S101 or S201).

(4) For antenna input, the Model RBC antenna input coupling system is similar to the line input systems (see Paragraphs (3) and (4) above), except that the coupling coils are designed to match the receiver input to an average of 300 ohms resistance at the high frequency end. In the Model RBB radio receiving equipment, the input coupling coils are designed to resonate in conjunction with the antenna at a frequency below the low limit of the particular band, and to match the receiver input to impedances varying from approximately 300 ohms resistance at the high frequency end of the equipment range to 1,500 ohms reactance at the low frequency end.

(5) The input circuit of each band is coupled to the control grid (4) of the first r-f tube (V101 or V201) through two tuned circuits, that is, the coupling coils are magnetically coupled to the first tuned circuits which in turn are magnetically coupled to the second tuned circuits. The desired band is selected by sections of the gang band switch S101 and S102, or S202 and S207 (See Figures 7-19 and 7-25.) These switches also operate to short out circuits which would otherwise introduce spurious resonance effects or "dead spots."

(6) The tuned circuits discussed in Paragraph (5) above, are supplied with separate trimmer capacitors for each band. See Tables 4-1 and 4-2. Each inductance may also be adjusted by means of a magnetite adjustable core. The inductance values, however, are accurately set at the factory and normally require no adjustment in service. An additional trimmer capacitor C128 or C236 ("ANT. COMP." control) is employed for the first tuned circuit. This capacitor permits trimming the first tuned circuit to resonance with antennas of 80 to 500 mmfd. capacity. The type –991 gaseous discharge tube (V105 or V205) protects the input circuit from high r-f voltages induced by local transmitters.

TABLE 4-1
TRIMMERS
MODEL RBB

Band	Trimmer for 1st Tuned Circuit	Trimmer for 2nd Tuned Circuit
1	C129	C133
2	C130	C134
3	C131	C135
4	C132	C136

TABLE 4-2
TRIMMERS
MODEL RBC

Band	Trimmer for 1st Tuned Circuit	Trimmer for 2nd Tuned Circuit
1	C237	C241
2	C238	C242
3	C239	C243
4	C240	C244

c. R-F AMPLIFIER STAGES (MODEL RBB).—

(1) The two r-f amplifier stages of the Model RBB radio receiving equipment employ two Type –6SK7 tubes (V101, V102). In the Model RBB radio receiving equipment, where the r-f selectivity appreciably affects the overall weak signal selectivity, degeneration is introduced in the r-f tube cathode circuits by resistors R124 and R125. These resistors tend to neutralize variations in tube input capacities and thus minimize changes in overall selectivity with gain control variation. Resistors R102 and R103 are cathode bias resistors. The capacitors C115, C118 effectively by-pass the radio frequency around the resistors R102, R103. A trap circuit (L101, C106) is in the screen grid circuit of the first r-f tube (V101) to reduce interference from signals on the i-f amplifier frequency. Resistors R113, R122 and R114, R123 are screen grid voltage divider networks for the first r-f and second r-f tubes respectively. These networks tend to neutralize voltage variations in the r-f screen grid circuits. Screen grid by-pass capacitors C116 and C119 are filters to keep r-f from passing through to the plate supply. R105, R106 are plate filter resistors and C117, C120 are plate by-pass capacitors. The combination R110, C113 form a control grid filter network for the second r-f tube.

(2) The r-f amplifier stages of the Model RBB radio receiving equipment employ separate r-f transformers for each band, selected by the band switch section S103 and S104. The third tuned circuit consists of transformers T105 to T108 and the fourth tuned circuit consists of the transformers T109 to T112. The transformers employ loosely coupled primaries, resonant at frequencies considerably higher than the high limit of their respective bands. This particular design limits the r-f gain to a value just sufficient to insure the desirable high signal-to-noise ratio and the tubes are permitted to operate at the optimum for maximum signal-to-noise ratio and minimum cross modulation. The tuned circuits discussed in this paragraph are supplied with separate trimmer capacitors for each band (see Tables 4-3 and 4-4).

TABLE 4-3
R-F TRANSFORMERS AND TRIMMERS
MODEL RBB

Band	Transformer	Trimmer Capacitor
1	T105 T109	C137 C141
2	T106 T110	C138 C142
3	T107 T111	C139 C143
4	T108 T112	C140 C144

TABLE 4-4
R-F TRANSFORMERS AND TRIMMERS
MODEL RBC

Band	Transformer	Trimmer Capacitor
1	T205 T209	C245 C249
2	T206 T210	C246 C250
3	T207 T211	C247 C251
4	T208 T212	C248 C252

d. R-F AMPLIFIER STAGES (MODEL RBC).

(1) Capacitor C210 couples the antenna input stages to the first r-f amplifier stage. The first r-f stage of the Model RBC radio receiving equipment, employs a Type –6AB7 tube (V201), which, by virtue of its high transconductance characteristic, permits better signal-to-noise ratio in the higher frequency bands. The second r-f stage employs a Type –6SK7 tube (V202). R216 and R217 are grid leak resistors for the first and second r-f tubes respectively. R209, C222, and R210, C223 are control grid filter networks. The bias on the control grids (4) of V201 and V202 is set at the proper operating value by action of the cathode resistors R201 and R202. The capacitors C225 and C228 effectively by-pass the r-f around resistors R201 and R202. Capacitors C226 and C229 prevent any variation on the screen by passing the r-f to ground. Resistors R205, R206 are plate filters for the first and second r-f tubes and C227, C230 are plate by-pass capacitors. Capacitor C201 couples the first r-f tube (V201) to the second r-f tube (V202) which in turn is coupled to the first detector tube (V204) by means of the capacitor C203.

(2) The r-f amplifier stages of the Model RBC radio receiving equipment employ separate r-f transformers (T205 to T212, see Figure 7-25 and Tables 4-3 and 4-4) for each band, selected by the band switch sections S203 and S204. This switch also short-circuits coils not in use, in order to eliminate spurious resonance effects. The transformers employ primaries which resonate in conjunction with the tube plate capacitance at frequencies below the low limits of their respective bands. Grid loading effects are minimized by connecting the r-f grids to the tuned circuits through capacity dividers, such as capacitors C211 and C204 in the case of the second r-f tube. The r-f amplifier gain is limited to a value just sufficient to insure the desirable high signal-to-noise ratio by the transformer coupling, thus permitting the r-f tubes to operate at the optimum conditions for maximum signal-to-noise ratio and minimum cross modulation.

e. OSCILLATOR.—

(1) The heterodyne oscillator of either Model RBB or RBC radio receiver is specially designed to offer a high degree of stability under adverse operating conditions of varying humidity, temperature, supply voltage, and vibration. The Type –6AB7 tube (V103 or V203) is used since its high transconductance characteristic permits departures in circuit design in the interest of stability which are not possible with lower transconductance tubes. Separate inductances and trimmers are used for each band selected by the band switch sections S105 and S106 or S205 and S206. These switches also short out such circuits as may be necessary to avoid spurious resonance effects. The oscillator tube grid and cathode circuits connect through the switching arrangement to taps on the tuned circuit inductances T113 to T116 or T213 to T216. The tap ratios are adjusted for optimum stability as regards supply voltage variations. This adjustment contributes to temperature and humidity stability by minimizing the effect on frequency of circuit Q changes. The oscillator supply voltages are further stabilized by the use of the heater voltage regulator tube (V106 or V206) and a plate voltage regulator (V402) located in the rectifier power unit.

(2) The screen grid of the oscillator tube functions as the plate of the oscillator circuit and operates at ground potential for r-f through the low impedance connection of capacitors C123 or C233 so that any coupling between the oscillator circuit and the plate circuit of the Type –6AB7 tube other than electron coupling is minimized. Stray coupling occurring at the higher frequencies of the Model RBC equipment range is eliminated by the neutralizing circuit, consisting of coil L201 and capacitor C216. Instability at high frequencies resulting from cathode heater capacity variations is eliminated by operation of the heater and cathode at the same r-f potential through the use of choke coil L201 and capacitor C259. The circuit is stabilized for temperature through the use of controlled components. The main tuning capacitor C149 or C257 is constructed from low temperature coefficient materials. The inductances are designed so as to utilize the difference in coefficients of expansions of the coil form and brass stud which supports the molded iron core to compensate for the circuit temperature coefficients at the low frequency ends of their respective bands. At the high frequency ends of the bands the circuit temperature coefficients are compensated for by means of negative coefficient capacitors C101 to C104 or C206 to C209.

(3) The oscillator circuits are adjusted to track at 400 KC higher frequency than the radio frequency and tuned input circuits over the frequency bands. This action is accomplished by the use of fixed series capacitors C108 to C111 or C218 to C221, and proper adjustment of the inductances. Parallel trimmer capacitors (C145 to C148 or C253 to C256) are provided for service alignment. The oscillator supply voltages are stabilized by the use of heater voltage regulator tube (V106 or V206) and a plate voltage regulator tube (V402) located in the rectifier power unit. Stray coupling, occurring at the higher frequencies of the Model RBC radio receiving equipment range, is eliminated by the neutralizing combination L201, C216.

f. FIRST DETECTOR.—

(1) The output of the oscillator circuit in the RBB radio receiver is coupled to the cathode of the first detector (mixer) tube (V104) by capacitor C124. In the RBC radio receiver the oscillator output is coupled to the first detector by C212. The difference frequency (400 KC) is fed from the first detector plate to the i-f amplifier input through a concentric shielded conductor.

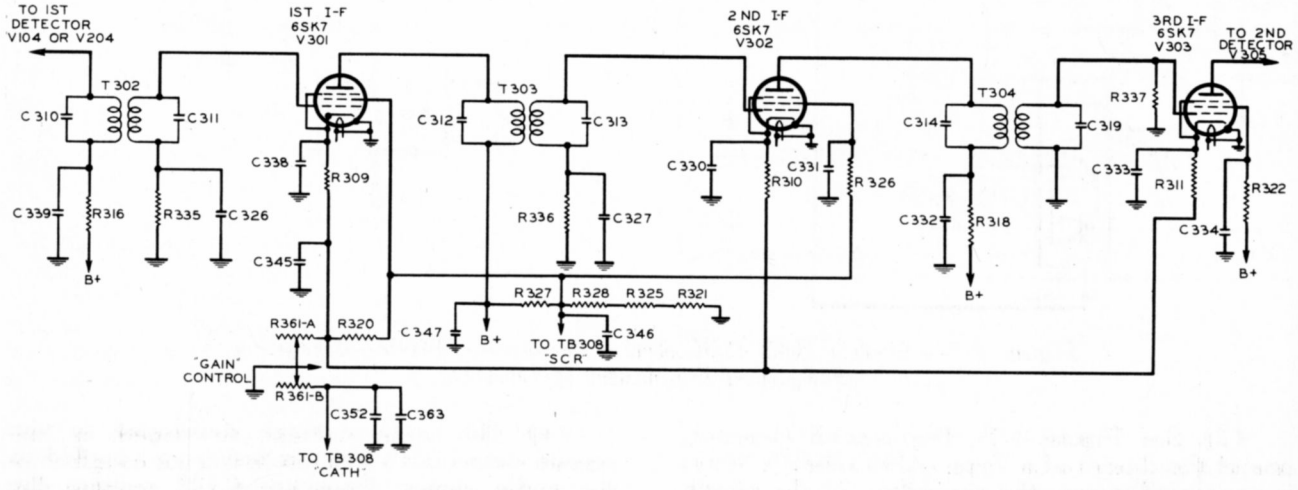

Figure 4-6 — Models RBB/RBC Radio Receivers, I-F Stages (Simplified Schematic, P-717966)

3. I-F/A-F UNIT.

a. GENERAL.—

(1) See overall schematic, Figure 7-31. The i-f/a-f unit includes a 400 KC, three stage i-f amplifier, second detector, two stage audio amplifier, cw oscillator, automatic volume control, noise limiter circuit, silencer circuit, and output limiter circuit. To understand better the complete i-f/a-f circuit the five types of reception will be discussed individually.

b. "MOD" RECEPTION.—

(1) The beat frequency of 400 KC difference is inductively coupled from the first detector to the i-f section. The i-f circuit consists of three stages, utilizing three Type –6SK7 tubes (V301, V302, V303). See simplified schematic, Figure 4-6. The i-f transformers (T302, T303, T304, and T305) are designed to provide three degrees of selectivity and are controlled by the gang switch S306, S307 and S308 (see overall schematic, Figure 7-31). The tuned circuits employ fixed capacitors and are tuned by means of adjustable molded magnetite cores in the transformer primary and secondary windings. R309, R310, and R311 are cathode minimum bias resistors. A manual gain control (R361-A, B) is provided, which varies the gain of both the i-f/a-f unit and the preselector unit. The potentiometer R361-B controls the gain of the first and second r-f amplifier stages by variation of cathode voltages. The potentiometer R361-A similarly controls the gain of the three i-f amplifier stages.

(2) See Figure 4-7. The second detector, one of the diodes of a Type –6H6 tube (V305), is connected across the secondary of the fourth i-f transformer (T305). Half the audio voltage developed in the diode circuit is fed to the audio amplifier, that is, the audio voltage is developed across resistor R348. The combination R347, C309 functions as a filter for the i-f frequency. The diode direct current is made available for test purposes by the provision of a link connector, which permits insertion of a microammeter in series with the ground return of the diode load resistor R348. The combinations R345, C320 and R363-A, C328 are a-c load impedance networks and are kept as high (with respect to the d-c load impedance R347, R348) as permitted by other desired operating characteristics in order to minimize distortion on deep modulation.

(3) The noise limiter is one of the diodes of a Type –6H6 tube (V306). When a loud noise impulse is received the noise limiter acts as a switch to open the circuit between the diode load resistor R348 and the grid coupling capacitor C328. This diode normally acts as a low resistance in series with this circuit, since its plate is kept at a positive potential with respect to its cathode. (This is the voltage drop across the resistor R347.) When electrical (noise) interference causes a sudden high voltage (above a minimum or threshold level) the plate of the diode (V306) has the higher voltage applied immediately, but the voltage to the cathode is delayed by the length of time required to charge the capacitor C320 through resistor R345. Thus, for a fraction of a second, the cathode becomes more positive than the plate, and during this time, the diode acts as an open circuit. This momentary delay, usually is sufficient time to block the receiver until the noise has died down.

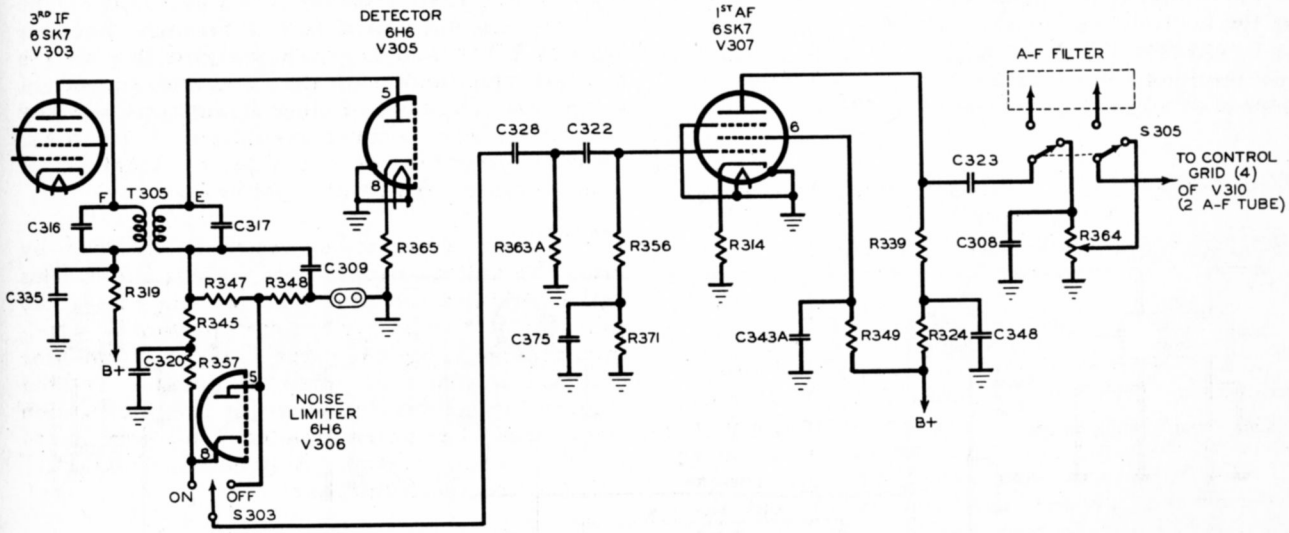

Figure 4-7 — Models RBB/RBC Radio Receivers, "MOD" Reception (Simplified Schematic, M-430724)

(4) The audio voltage developed in the second detector (V305) is resistance coupled to the audio stages. Capacitor C322 couples the second detector to the first a-f stage. The first a-f stage employs a Type –6SK7 tube (V307). R356

is a grid leak resistor. The C bias for the tube V307 is obtained by action of the cathode resistor R314. Proper operating voltage for the screen grid of V307 is obtained by the voltage drop across resistor R349. The decoupling circuit R324, C348 is intended to keep the a. c. out of the power supply and to reduce hum.

(5) The output of the first audio is coupled to the second audio stage by means of capacitor C323. Switch S305 switches an audio band-pass filter in or out of the circuit. When the audio band-pass filter is switched out of the circuit, a pad resistance (R364) is inserted and permits the gain to be adjusted between 3 and 5 db below the gain with the filter in.

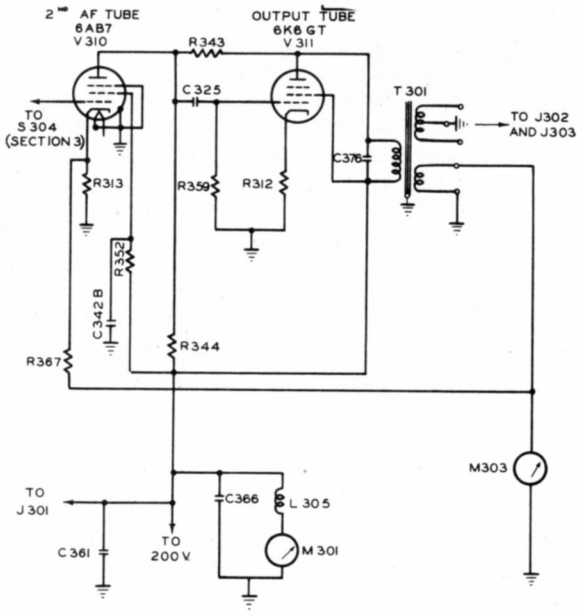

Figure 4-8 — Models RBB/RBC Radio Receivers, Second Audio Stage
(Simplified Schematic, K-891622)

(6) See Figure 4-8. The second a-f stage employs a Type –6AB7 tube (V310). Inverse feedback is applied to the second a-f and output stage by coupling from the output transformer (T301) back to the second a-f cathode, through the resistance divider R367 and R313. The resistor R313 also furnishes self-bias for the tube (V310).

(7) Capacitor C325 couples the second a-f to the output stage. This stage employs a Type –6K6–GT tube (V311). The output stage is degenerative through the use of coupling resistors R343 and R312. The resistor R312 also supplies self-bias for the tube (V311). The degeneration serves to hold the output voltage, essentially constant for wide variations in plate loading. Thus the output winding of transformer T301 will supply from one to twenty pairs of 600-ohm headphones connected in parallel with not more than 3 db change in output voltage.

(8) (See overall schematic, Figure 7-31.) The output transformer is provided with an electrostatic shield between the primary and secondary. The output winding has a grounded center tap suitable for feeding a balanced 600-ohm line. The output winding is connected in parallel to a headphone jack (J303) located on the front panel and an output receptacle (J302) mounted at the rear of the i-f/a-f unit. Both of these output connections are suitably filtered to minimize pickup from local transmitters.

(9) The output transformer contains a separate secondary winding which is connected to the output meter (M303) and output range switch (S302).

c. "MOD-AVC" RECEPTION.—

(1) (See Figure 4-9.) The a.v.c. system utilizes the other diode of the detector-a.v.c. tube (V305). The plate of the final i-f tube (V303) is coupled to the a.v.c. diode tube (V305, prongs 3 and 4). A delay voltage (bias) is applied to the cathode of the a.v.c. diode (V305) to prevent a.v.c. action below a predetermined input signal level. This voltage is obtained from the bleeder network R327, R328, R325, and R321. A d-c voltage is set up across a.v.c. diode load resistors R338 and R355. The full voltage developed is fed through the filter resistor R354 and controls the grid bias of the two r-f amplifiers and the first and second i-f amplifiers. The final i-f stage is not controlled by the a.v.c., since proper operation of the a.v.c. requires operation of the final i-f amplifier at near its optimum output capabilities.

(2) An audio a.v.c. action is obtained by using the voltage drop across resistor R338. This action supplies the grid bias for the first audio tube (V307). The a.v.c. time constant is determined largely by capacitor C342-A. The time constant is made as small as possible without introducing serious distortion for low modulation frequencies. The potentiometer R363-A is the a-f volume level control, designated "OUTPUT LEVEL" on the front panel.

(3) This a.v.c. system helps to keep the overall gain of the receiver fairly constant for considerable change in input signal. Capacitor C322 couples the detector diode tube (V305) to the grid of the first a-f tube (V307).

(4) The noise limiter circuit, a-f, and output stages are the same as previously described in Paragraphs 3b (3) to 3b (8) inclusive.

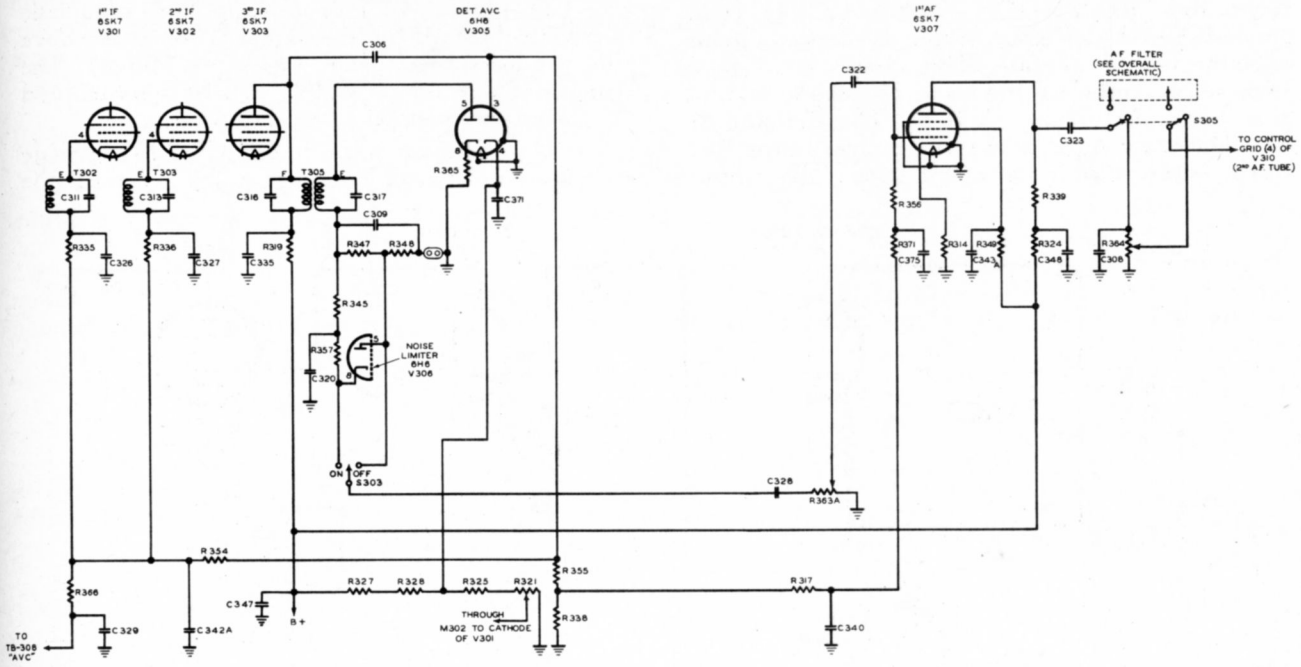

Figure 4-9 — Models RBB/RBC Radio Receivers, "MOD-AVC" Reception (Simplified Schematic, T-617612)

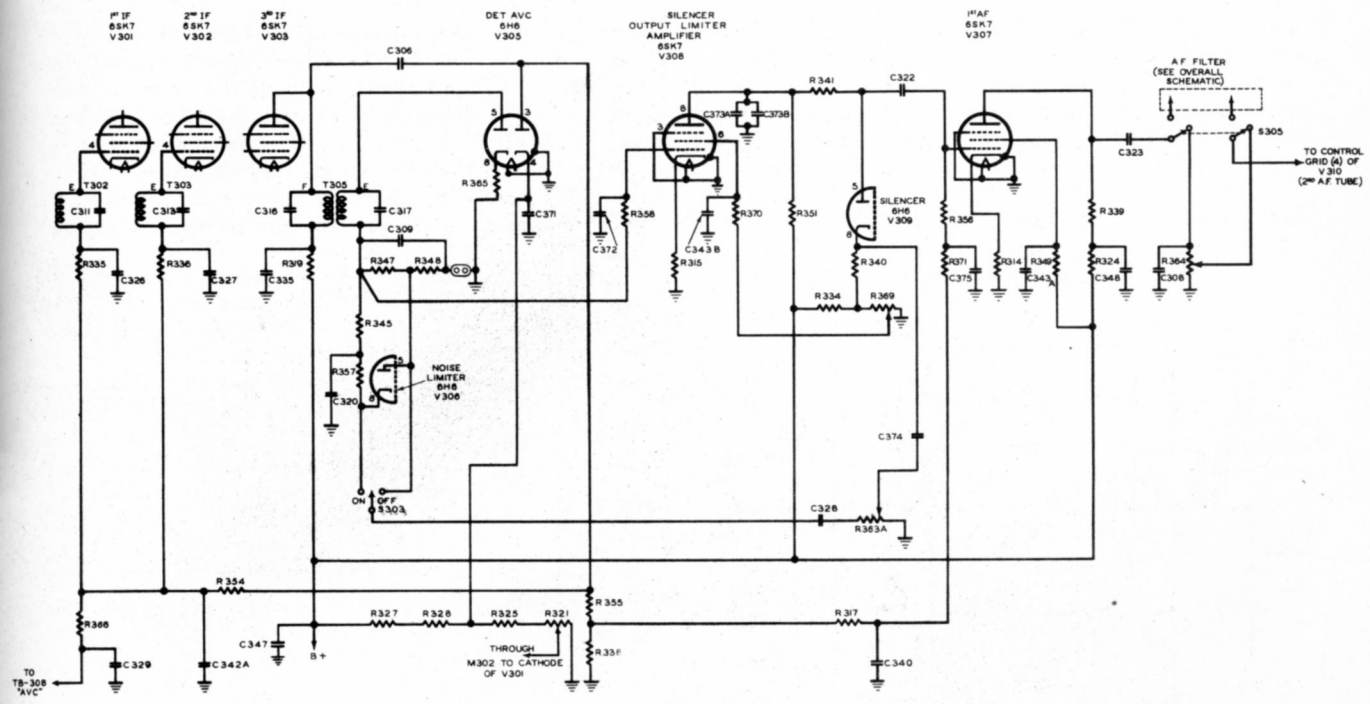

Figure 4-10 — Models RBB/RBC Radio Receivers, "MOD-AVC-SIL" Reception (Simplified Schematic, T-611995)

d. "MOD-AVC-SIL" RECEPTION.—

(1) (See Figures 4-10, 4-11, and 4-12.) When the "RECEPTION" switch (S304) is in the "MOD-AVC-SIL" position, a silencer circuit is connected to operate. This circuit employs a Type –6SK7 tube (V308) and one diode section of a Type –6H6 tube (V309). The function of the silencer circuit is to cut off receiver output for inputs below a predetermined level. The output (R369). This control varies the screen voltage of tube V308 (see Figure 4-10).

(2) Figure 4-11 is a simplified schematic showing the path of the signal when it is above the predetermined level (see note above). The silencer diode tube (V309) acts as a switch and is placed in series with the audio input.

(3) The silencer diode tube (V309) is made conductive or non-conductive by varying the

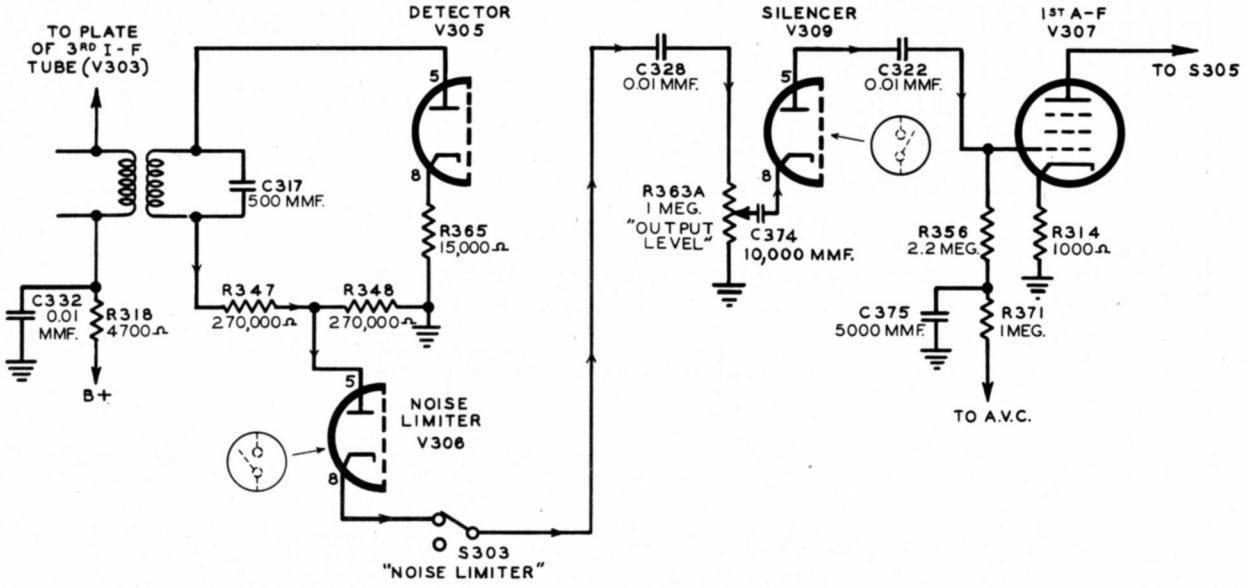

Figure 4-11 — Models RBB/RBC Radio Receivers, "MOD-AVC-SIL" Signal Circuit (Simplified Schematic, M-430757)

remains cut off for noise pulses considerably above this level due to the time constant of the circuit. When the input signal is above the predetermined level, the silencer circuit permits the signal to pass to the receiver output. NOTE: The circuit may be adjusted to operate on any carrier input level in the range of 5 to 10,000 microvolts by means of the "SILENCER" control voltage across the resistors R340 and R341 (see Figure 4-12). The voltage developed across load resistors R347 and R348 is applied to the control grid of V308 through filter resistor R358. When the signal falls below a predetermined level, this voltage makes the control grid of V308 less negative. This action produces a greater plate current, thereby causing a greater voltage to be developed

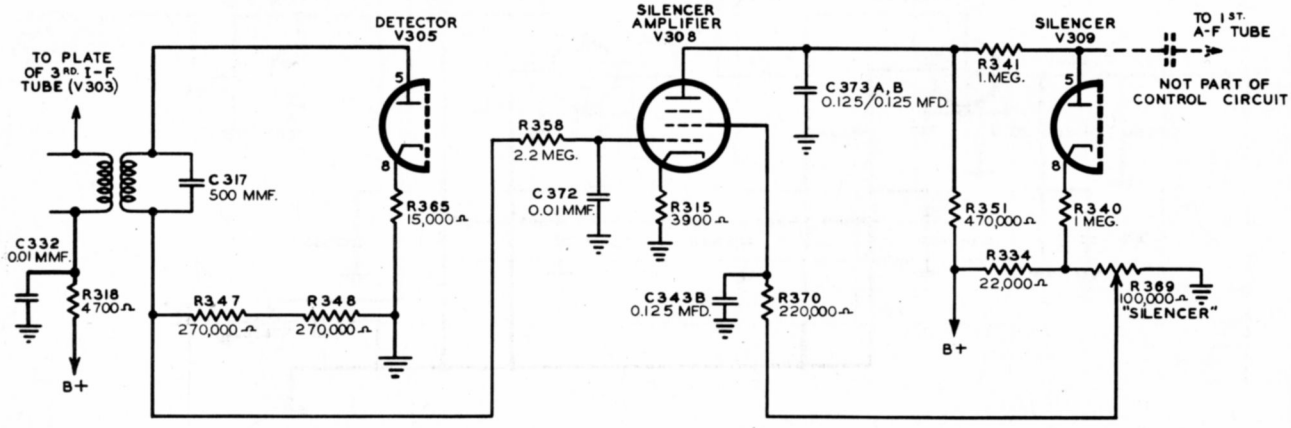

Figure 4-12 — Models RBB/RBC Radio Receivers, "MOD-AVC-SIL" Control Circuit (Simplified Schematic, M-430756)

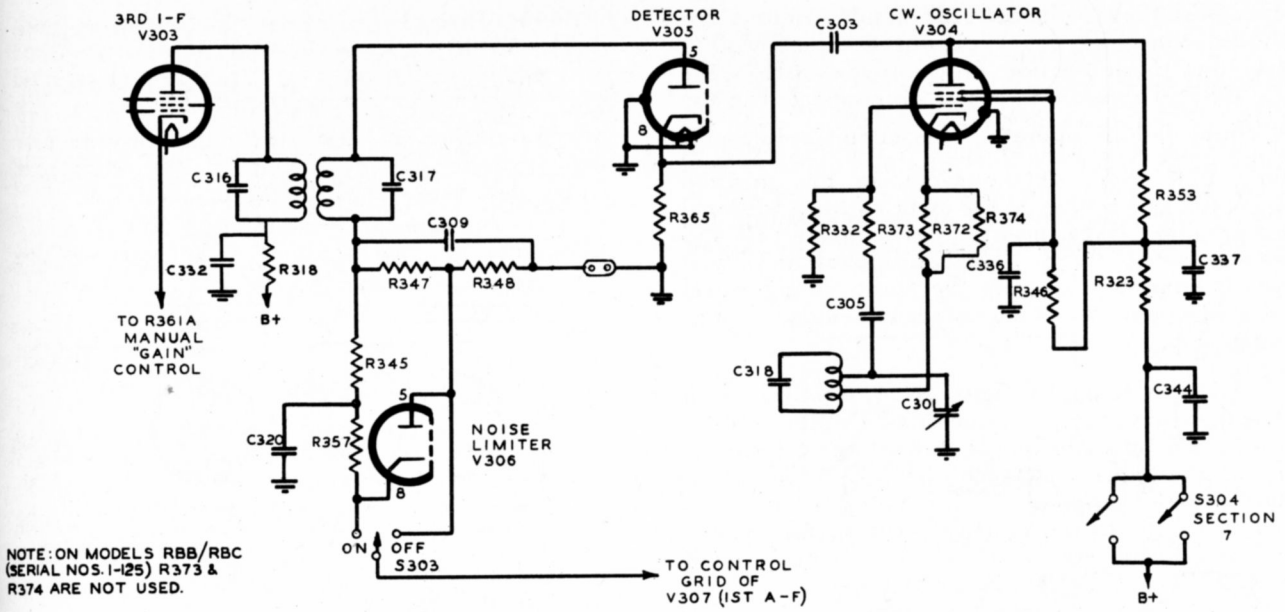

Figure 4-13 — Models RBB/RBC Radio Receivers, "CW" Reception (Simplified Schematic, M-430771)

across R351. This biases the silencer diode tube (V309) below cut off, thereby removing the input to the audio amplifier. In order to prevent noise pulses from breaking through, when the receiver is operating in the silenced condition, the resistance-capacity combinations R358, C372 and R351, R373-A, B are used to introduce a time constant which holds the plate current of tube V308 relatively constant for noise pulses considerably above the desired signal level.

e. "CW" RECEPTION.—

(1) For "CW" reception an oscillator, tuned to 1,000 cycles (±5%) higher than the intermediate frequency, is connected into the circuit through the cathode resistor (R365) of the detector diode V305 (see Figure 4-13). The cw oscillator uses a Type –6AB7 tube (V304) and employs a circuit similar to that used in the heterodyne oscillators of the preselector units (see Paragraph 2e). The variable capacitor C301 is provided so that a variation of approximately 1,500 cycles on either side of the preset oscillator frequency may be obtained. The tuned circuit consists of transformer T306 and capacitor C318.

f. "CW-OL" RECEPTION.—

(1) See Figure 4-14. The output limiter circuit is designed primarily for telegraph reception and functions to hold the output constant for

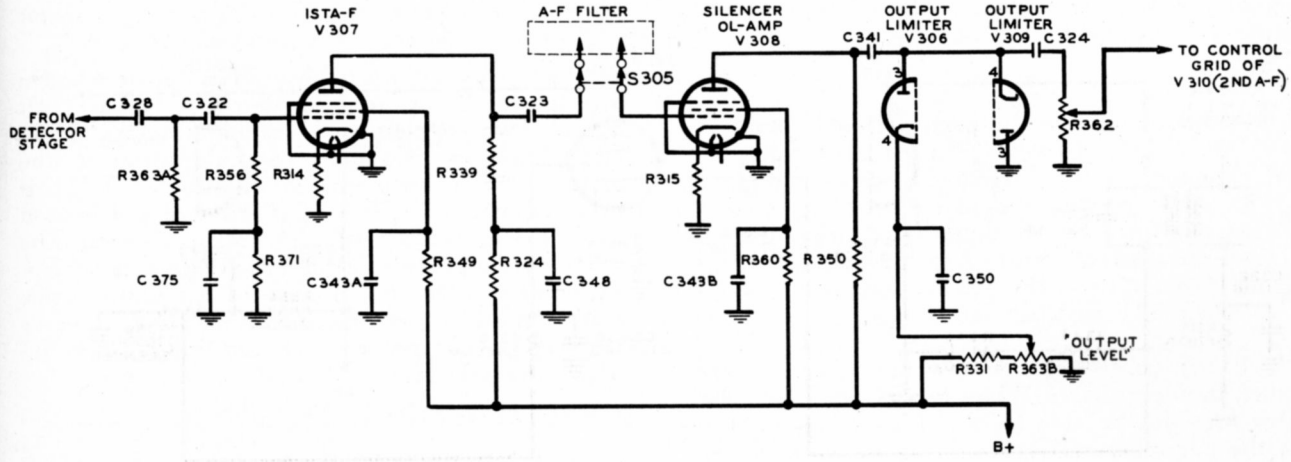

Figure 4-14 — Models RBB/RBC Radio Receivers, "CW-OL" Reception (Simplified Schematic, M-430797)

wide variations of input. This circuit employs one diode section of the Type –6H6 tube (V306) and one diode section of the Type –6H6 tube (V309). These diode tubes are connected in the form of a full-wave rectifier in shunt with the plate load (R350) of tube V308 in order to limit both sides of the cycle. In this position (CW-OL) the tube V308 acts as an additional a-f amplifier stage, inserted between the first and second audio stages. This additional amplification is employed to raise the audio voltage level to a high enough value to secure efficient limiting action.

(2) Referring to Figure 4-14, it will be seen that the diode sections concerned (V306, V309) are biased by a portion of the voltage developed across the entire resistance of R363-B. The voltage actually applied to the cathode must be balanced out by an equally great signal voltage before limiting occurs. Thus, by varying R363-B ("OUTPUT LEVEL" control), the limiting action may be made to act on very weak signals, or it may be delayed until it acts only on very strong signals. The bias voltage is applied to both cathodes as soon as emission occurs in the diode (V306). Thereafter, bias is maintained on V309 by the delay introduced by the R-C components in the circuit.

(3) It will be noticed that the effect of this circuit on the audio wave is somewhat similar to that of the noise limiter effect on r-f waves. The major difference is that the noise limiter is slow in action and cuts off all signals completely during a noise peak of short duration. The output limiter, however, is very rapid in action, and exerts a continuous control on the audio wave peaks as long as it exceeds a certain value, that is, volume level.

(4) The correct setting of the "OUTPUT LEVEL" control is determined by the weakest signal to be received. If the circuit is set to cut off wave peaks (i.e., limit) at the level of the weakest signal, all stronger signals will be kept at this same volume level.

NOTE

Although effectively both "GAIN" and "OUTPUT LEVEL" controls cause changes in the received signal, the "GAIN" control should be set to permit a comfortable volume level for the weakest signal before any limiting action is brought into the circuit by means of "OUTPUT LEVEL" control.

(5) Figure 4-15b shows the effect of too much limiting action. When this occurs, the operator may not be able to obtain sufficient volume at the headphones. Figure 4-15a indicate the effect when there is not enough limiting action. This results in different volume levels. Figure 4-15c shows the correct amount of limiting action.

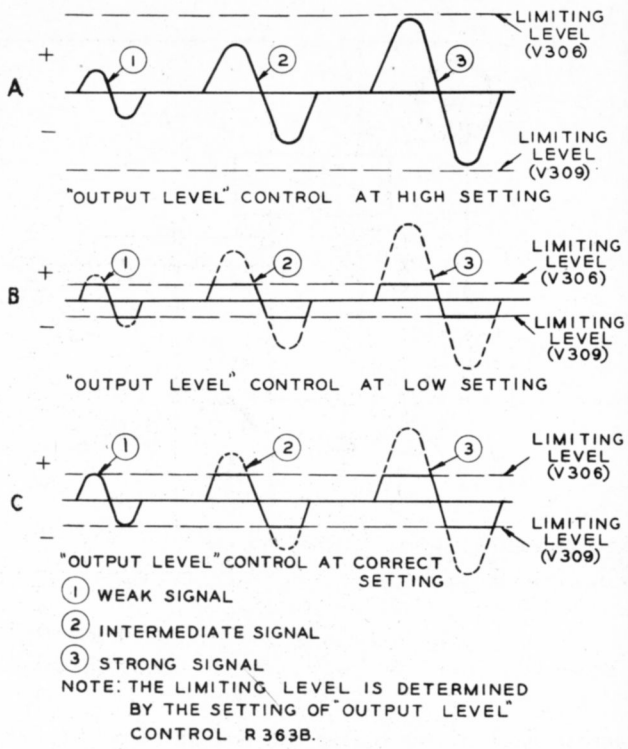

Figure 4-15 — Models RBB/RBC Radio Receivers, Output Limiter Action (K-892926)

g. "INPUT" METER.—

(1) An "INPUT" meter (M302) is included in the i-f/a-f unit circuit. The meter is connected through the "RECEPTION" transfer switch (S304) in such a manner that it is operative only in the "MOD-AVC" and the "MOD-AVC-SIL" positions. In these positions the a.v.c. is operative and varies the bias on the first i-f tube (V301) in proportion to the input signal level. The tuning meter is connected across the cathode resistor (R309). Variation of the bias on tube V301 results in voltage variations across R309 due to plate current variation. The deflection of meter M302, thus, indicates the input signal level.

(2) The meter is calibrated in decibels above one microvolt up to 120 decibels or one volt input. Two adjustments, potentiometers R368 and R321 are provided for calibration of the meter. One adjustment, potentiometer R321 is the front panel "ZERO SET" control and is used to set the meter to zero with no signal input. The other potentiometer R368 which is a screwdriver adjustment is located on the i-f/a-f unit chassis, and is used to set the maximum deflection as required to compensate for conditions of variation in overall gain, tube replacement, etc.

h. AUDIO BAND PASS FILTER.—

(1) An audio band-pass filter is connected or disconnected from the circuit by means of the "AUDIO SELECTIVITY" switch (S305). The filter unit is arranged as a separate assembly and

different units L301-1 and L301-2 are employed for operation with the Models RBB/RBC radio receiving equipments respectively. The two units differ as to the band-pass width, 200 cycles at 6 db attenuation for the Model RBB filter and 300 cycles for the Model RBC. The wider band is used in the Model RBC equipment to facilitate tuning at the higher frequencies. Both filters are designed to pass 1,000 cycles and have 0.1-megohm input impedances. The output resistance load is incorporated in the filter unit and in the case of L301-2 serves also as an attenuator so that the two units are interchangeable as to insertion loss. When the filter is switched out of the circuit, a variable pad resistance (R364) is inserted. This permits the gain to be adjusted between 3 and 5 db below the gain with the filter connected. The filter circuit is located between the first and second audio stages.

i. POWER INPUT.—

(1) Power input to the receiver unit is into the i-f/a-f unit through receptacle J301 at the rear of the i-f/a-f unit and is connected to the preselector unit by means of an internal interconnecting cable between the units. The power leads are by-passed in the i-f/a-f unit to minimize stray pickup from external fields. In addition, the power leads are filtered as required to minimize cross talk between two receivers (as an emergency, it may be required to operate two receivers from one power unit). The i-f/a-f circuits are separately filtered and shielded to minimize interstage coupling and regenerative effects. The first audio stage is provided with resistance and capacity filtering which is effective in reducing a-c hum introduced into the circuit through the plate supply.

4. RECTIFIER POWER UNIT.

a. (See Figure 4-16). The Power Unit Circuit includes a power transformer, rectifier, voltage regulator, filtering for a-c ripple, and r-f filtering. Both sides of the a-c input circuit are fused. An r-f filter is connected in the a-c input circuit. This filter, in conjunction with electrostatic shielding employed in the power transformer, provides attenuation (between either a-c input terminal and any d-c or a-c output terminal of the power unit) of at least 80 decibels to r-f interference in the range of 0.5 and 27 megacycles. The filter also offers excellent protection against r-f interference at lower frequencies. The "POWER" switch is located on the receiver unit and breaks one side of the a-c input circuit to the power transformer.

b. The input circuit connects to the power transformer, T401, through a terminal board which provides means of connecting to taps on the primary winding of the power transformer as required for operation from 110-, 115-, or 120-volt supply. The power transformer employs electrostatic shielding between the primary and secondary windings. Four secondary windings are provided for supplying rectifier heater voltages, rectifier plates, receiver 6.3 v. a-c, and receiver 17 v. a-c.

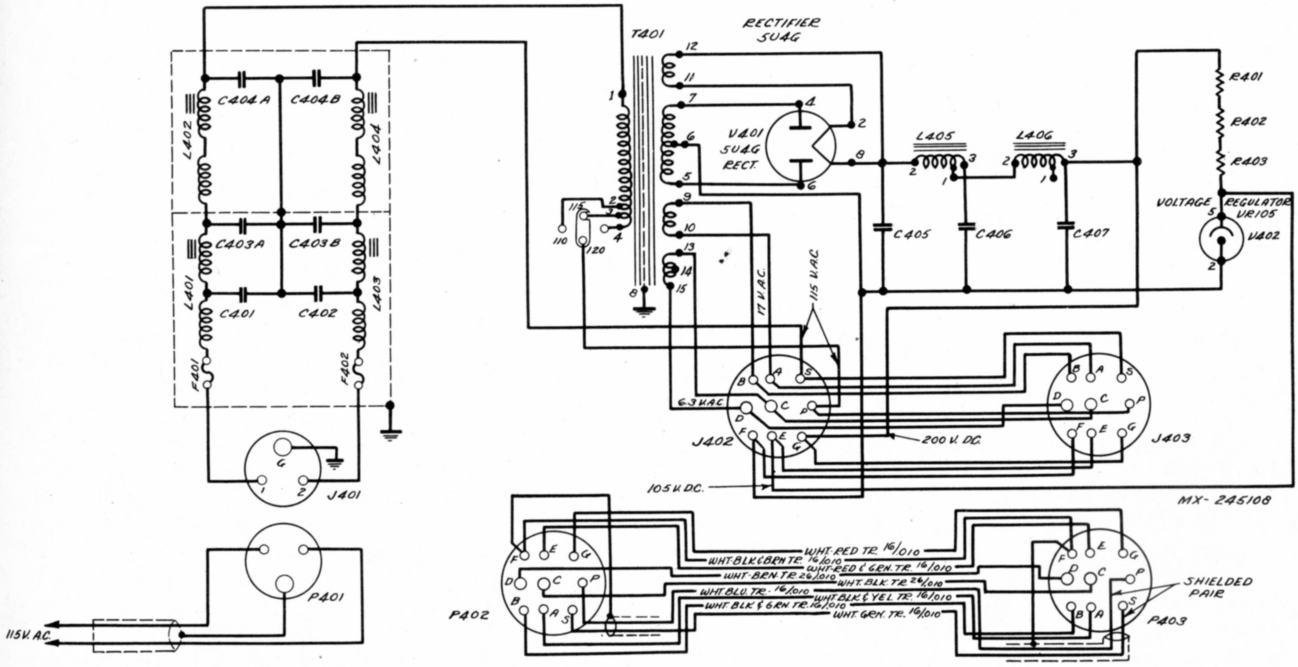

Figure 4-16 — Rectifier Power Unit (Schematic, MX-245108)

c. A type –5U4G full wave rectifier tube (V401) is used. The rectified output of the tube is fed to a choke input, two stage ripple filter L405, C406, L406, C407. The capacitor C405 at the filter input is employed for r-f filtering and is of sufficiently low capacity as to have a negligible effect on regulation. The filter thus functions as a choke input filter and provides good regulation. The first stage of the filter employs a tapped choke, the tap portion being in series resonance with C406 at the ripple frequency. The d-c output is connected to the output receptacles, J402 or J403, and furnishes the receiver "B" supply.

d. The VR105 regulator tube (V402) is connected through the series dropping resistors R401, R402 and R403 to the rectified d-c output. This circuit provides a regulated d-c supply for the heterodyne oscillator in the receiver unit.

e. Two output receptacles, J402 and J403, are furnished. These receptacles are connected in parallel and either receptacle may be used for connection to the receiver unit. Both receptacles are used for the emergency condition of operation where two receiver units are operated from a single power unit.