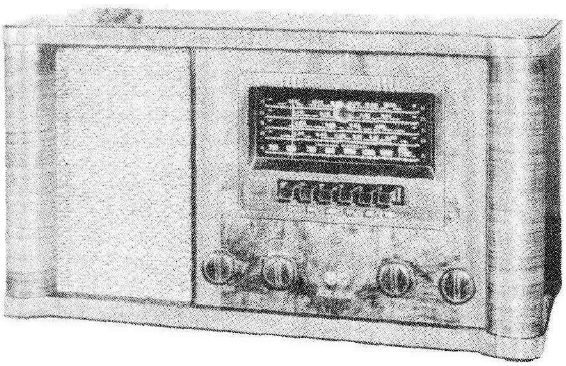
RCA Victor

MODELS A3 and A4

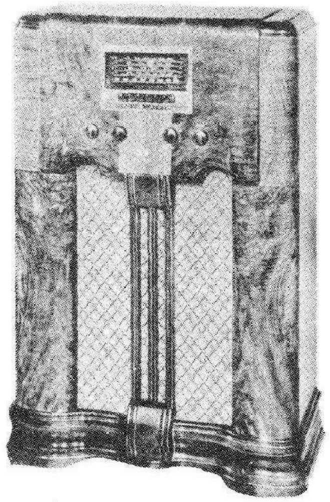
Seven-Tube, Five-Band, A-C, Superheterodyne Receivers

TECHNICAL INFORMATION AND SERVICE DATA

SERVICE DIVISION • RCA VICTOR COMPANY LIMITED • MONTREAL



Model A3



Model A4

Electrical Specifications

FREQUENCY RANGES

Standard Broadcast (A) .... 540-1,720 kc
"49 M" (49 Meters) .... 5,900-6,240 kc
"31 M" (31 Meters) .... 9,410-9,690 kc
"25 M" (25 Meters) .... 11,680-11,920 kc
"19 M" (19 Meters) .... 15,090-15,380 kc

R-F ALIGNMENT FREQUENCIES

"49 M" (49 Meters) .....6,100 kc. (osc., det., ant.)
"31 M" (31 Meters) .....9,550 kc. (osc.)
"25 M" (25 Meters) ....11,800 kc. (osc.)
"19 M" (19 Meters) ....15,200 kc. (osc.)
"Standard Broadcast" 600 kc. (osc.), 1,500 kc. (osc., Det., Ant.)

Intermediate Frequency .... 455 kc.

TUBE COMPLEMENT

(1) Type-6SK7 .... R-F Amplifier
(2) Type-6SA7 .... First Detector, Oscillator
(3) Type-6SK7 .... Intermediate Amplifier
(4) Type-6SQ7 ..Second det., A-F Amp., and A.V.C.
(5) Type-6F6G .... Power Output
(6) Type-6U5 .... Tuning Tube
(7) Type-5Y4-G .... Full wave Rectifier

Pilot Lamps (2) .... Mazda No. 44, 6.3 volts, 0.25 amp.

POWER SUPPLY RATINGS

Rating A......105-125 volts, 50-60 cycles, 80 watts
Rating B......105-125 volts, 25-60 cycles, 80 watts

POWER OUTPUT

Undistorted .... 2 watts
Maximum .... 5 watts

LOUDSPEAKER (RL79-1) (A3)

Type .... 6 inch Electrodynamic
Impedance (V.C.) .... 3.4 ohms at 400 cycles

LOUDSPEAKER (RL70H-1) (A4)

Type .... 12 inch Electrodynamic
Impedance (V.C.) .... 3.4 ohms at 400 cycles

General Description

These receivers employ a seven-tube, five band, superheterodyne circuit, the arrangement of which is shown by the Schematic Circuit Diagram. Features of design include: Spread Band "Overseas" dial; an r-f amplifier stage with "qumulative-wound" antenna and detector "A" Band coil for high signal to noise ratio; magnetite-core i-f transformers and low frequency oscillator tracking; full automatic volume control; phonograph television sockets; "Magic Eye" Tuning Tube; dust-proof electrodynamic loudspeaker; plunger-type, air dielectric trimming capacitors; temperature-stabilized capacitors; radio-phono-television tone control switch, and an edge lighted horizontal dial and pointer.

Circuit Arrangement

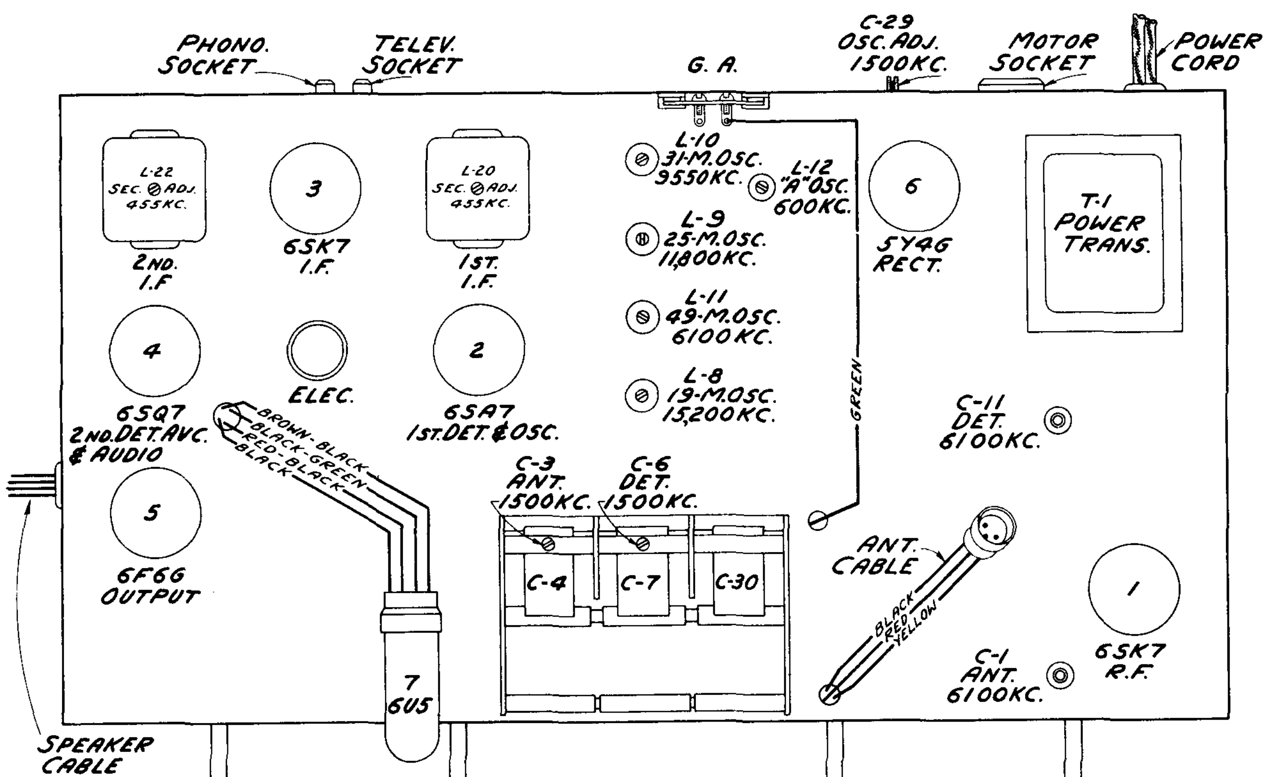
The circuit consists of an r-f amplifier stage; first detector, oscillator stage; i-f amplifier stage; second detector, audio voltage amplifier, and automatic volume control stage; power-amplifier stage; tuning indicator; and a full-wave rectifier.

The antenna and first-detector coils are constructed with a special type of winding (qumulative) to provide increased sensitivity and selectivity on the "Standard Broadcast" band. Special capacitors shunting the spread-band oscillator coils compensate for temperature variations to reduce oscillator frequency drift.

Spread-band tuning is accomplished electrically by shunting the oscillator section of the variable capacitor with relatively large temperature-stabilized fixed capacitors for tuning the oscillator coils on the "19M," "25M," "31M" and "49M" bands. Antenna and first-detector coils are designed to be sufficiently broad-tuned to require no variable tuning over the narrow frequency range of the spread-bands.

The spread-band oscillator coils and the "Standard Broadcast" band oscillator, first detector, and antenna coils are all wound on separate forms. The antenna and first detector spread-band coils are tapped. Undesirable interaction between coils is avoided by shorting the unused sections by means of the range selector.

The intermediate-frequency amplifier consists of a Type 6SK7 tube in a single stage transformer-coupled circuit. The windings of all i-f transformers are resonated by fixed capacitors and are adjusted by moulded magnetite cores to tune to 455 kc.



Chassis Layout and Alignment Adjustments

Alignment Procedure

Cathode-Ray Alignment is the preferable method. Connections for the oscillograph are shown in the chassis drawing.

Output Meter Alignment.—If this method is used, connect the meter across the voice coil, and turn the receiver volume control to maximum.

Test-Oscillator.—For all alignment operations, connect the low side of the test-oscillator to the receiver chassis, and keep the output as low as possible to avoid a-v-c action.

Calibration Scale on Indicator-Drive-Cord-Drum.—The tuning dial is fastened in the cabinet and cannot be used for reference during alignment; therefore, a calibration scale is attached to the tuning drum. The setting of the gang condenser is read on this scale, which is calibrated in degrees. The correct setting of the gang in degrees, for each alignment frequency, is given in the alignment table.

As the first step in r-f alignment, check the position of the drum. The 240° mark on the drum scale must be vertical and directly above the center of the shaft of the tuning drum when the plates are fully meshed. The drum is held to the shaft by means of two set-screws, which must be tightened securely when the drum is in the correct position.

On the inner side of the tuning drum are two projections which serve as stops to prevent extreme rotation of the gang condenser. The tuning drum should be set so that the stop limiting clockwise movement of the drum takes effect just as the gang condenser plates are becoming fully meshed, thus preventing stress on the gang due to extreme rotation.

Pointer for Calibration Scale.—Improvise a pointer for the calibration scale by fastening a piece of wire to the chassis, and bend the wire so that it points to the 240° mark on the calibration scale when the plates are fully meshed.

Order of Alignment	Test Oscillator			Range Selector	Receiver Dial Setting	Circuit to Adjust	Adjustment Symbols
	Connection to Receiver	Dummy Antenna	Frequency Setting				
1	6SK7 2nd I.F. Grid	.001 Mfd.	455 kc	"A"	No Signal 550-750 kc	2nd I.F. Trans.	L21 & L22
2	6SA7 Det. Grid	.001 Mfd.	455 kc	"A"	No Signal 550-750 kc	1st I.F. Trans.	L19 & L20
3	Ant. Term	300 Ohms	6,100 kc	"49 M"	6.1 mc (95°)	"49M" Osc.	L11
4	Ant. Term	300 Ohms	6,100 kc	"49 M"	6.1 mc (95°)	"49M" Det.	C-11
5	Ant. Term	300 Ohms	6,100 kc	"49 M"	6.1 mc (95°)	"49M" Ant.	C-1
6	Ant. Term	300 Ohms	9,550 kc	"31 M"	9.55 mc (137°)	"31M" Osc.	L10
7	Ant. Term	300 Ohms	11,800 kc	"25 M"	11.8 mc (115°)	"25M" Osc.	L9
8	Ant. Term	300 Ohms	15,200 kc	"19 M"	15.2 mc (130°)	"19M" Osc.	L8
9	Ant. Term	200 Mmfd.	1,500 kc	"A"	1,500 kc (42°)	"A" H-F Osc.	C29
10	Ant. Term	200 Mmfd.	600 kc	"A"	600 kc (201°)	"A" L-F Osc.	L12
11	Ant. Term	200 Mmfd.	1,500 kc	"A"	1,500 kc (42°)	"A" Det.	C6
12	Ant. Term	200 Mmfd.	1,500 kc	"A"	1,500 kc (42°)	"A" Ant.	C3

NOTE:—Align the I.F. Circuits by means of the oscillograph, for a symmetrical curve. Peak R.F. stages of all bands.

Spread-Band Alignment. — The most satisfactory method of aligning or checking the spread-band ranges is on actual reception of short-wave stations of known frequency, by adjusting the magnetite-core oscillator coil for each band so that these stations come in at the correct points on the dial.

In exceptional cases, when the set is being serviced in a location where the noise level is high enough to prevent reception of short-wave stations, a test-oscillator may be used for alignment, but an extremely high degree of accuracy is required in the frequency settings of the test-oscillator, as a slight error will produce considerable inaccuracy on the spread-band dials. The frequency settings of the test-oscillator may be checked by one or both of the following methods:

1. Determine the exact dial settings of the test-oscillator (for frequencies at or close to the specified alignment frequencies) by zero-bearing the test-oscillator against short-wave stations of known frequency.
2. Use harmonics of the standard-broadcast range of a test-oscillator, first checking tthe frequency settings on this range by means of a crystal calibrator (RCA Stock No. 9572), or by zero-beating against standard broadcast stations.

When a test oscillator is employed for spread-band alignment, a final check should be made on actual reception of short-wave stations of known frequency, and the magnetite-core oscillator coil for each band should be re-adjusted so that the stations come in at the correct points on the dial.

NOTE:—All spread band adjustments should be made with the chassis fastened in the cabinet and the pointer accurately aligned to the dial.

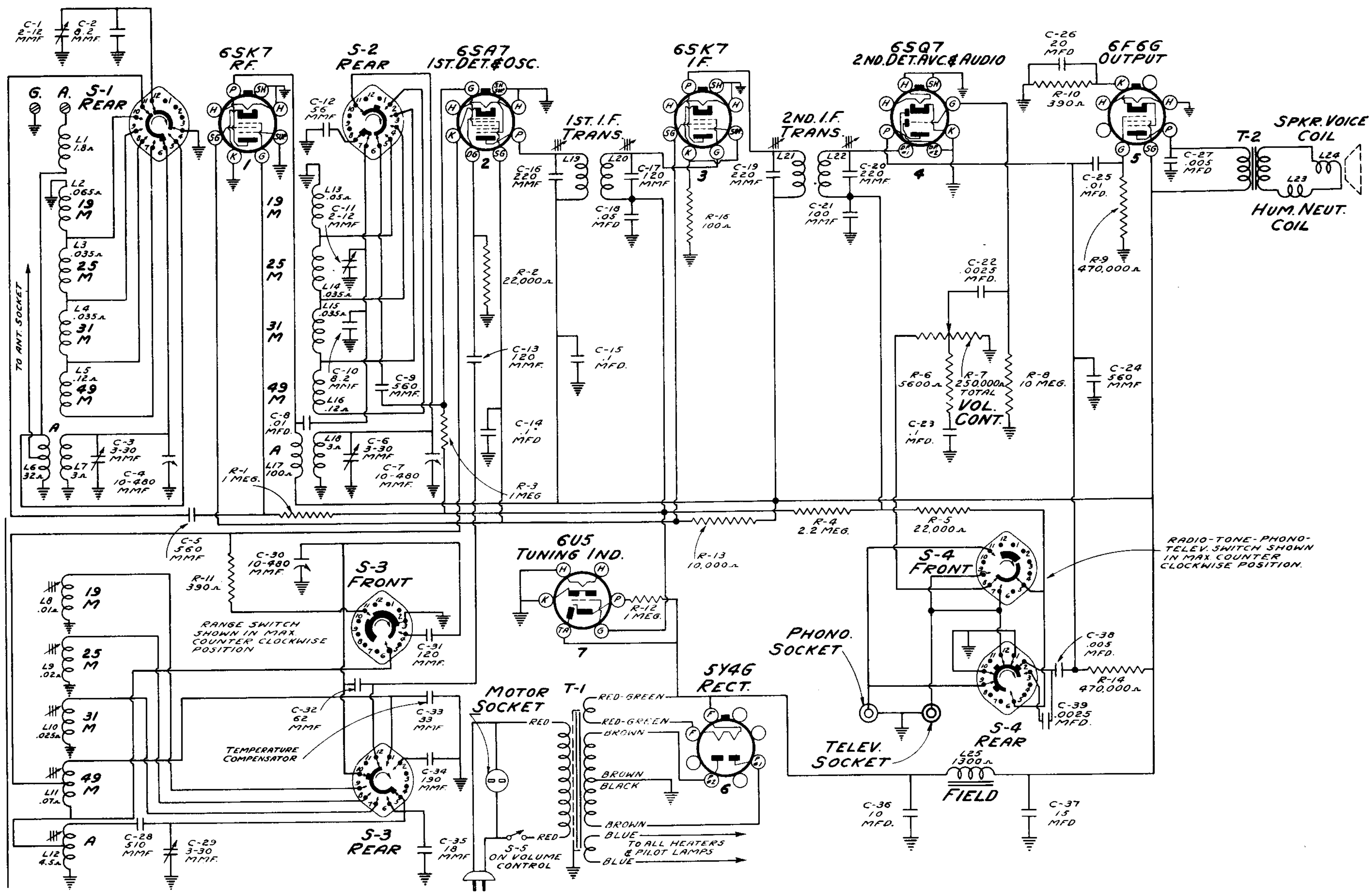
Spread-band Adjustments.—Bottom shield-pan must be in place before attempting spread-band alignment. Alignment of the spread bands requires special procedure since test oscillators used alone are not ordinarily sufficiently accurate for this purpose. The RCA Stock No. 9572 Crystal Calibrator aff ds a convenient and accurate alignment standard. Wrap a few turns of wire around the crystal calibrator and connect one free end to the antenna terminal of the receiver. Using the crystal calibrator to obtain the necessary accuracy, follow the tabulated alignment procedure for the "31M.", "25M.", and "19M." bands.

For the "49M." band, snap crystal calibrator "Hi-Lo" switch to "Hi", turn the range selector to "49M." band, and set receiver dial pointer to 6.0 mc. Adjust oscillator adjusting core L11 for minimum "Tuning Tube" opening. Use the peak indicated by the alignment table. Snap "Hi-Lo" switch to "Lo" and locate 6,100 kc (the first 100 kc harmonic above 6,000 kc) by slightly readjusting L11 with the dial pointer set at 6.1 mc. This method insures selection of correct crystal-calibrator harmonic.

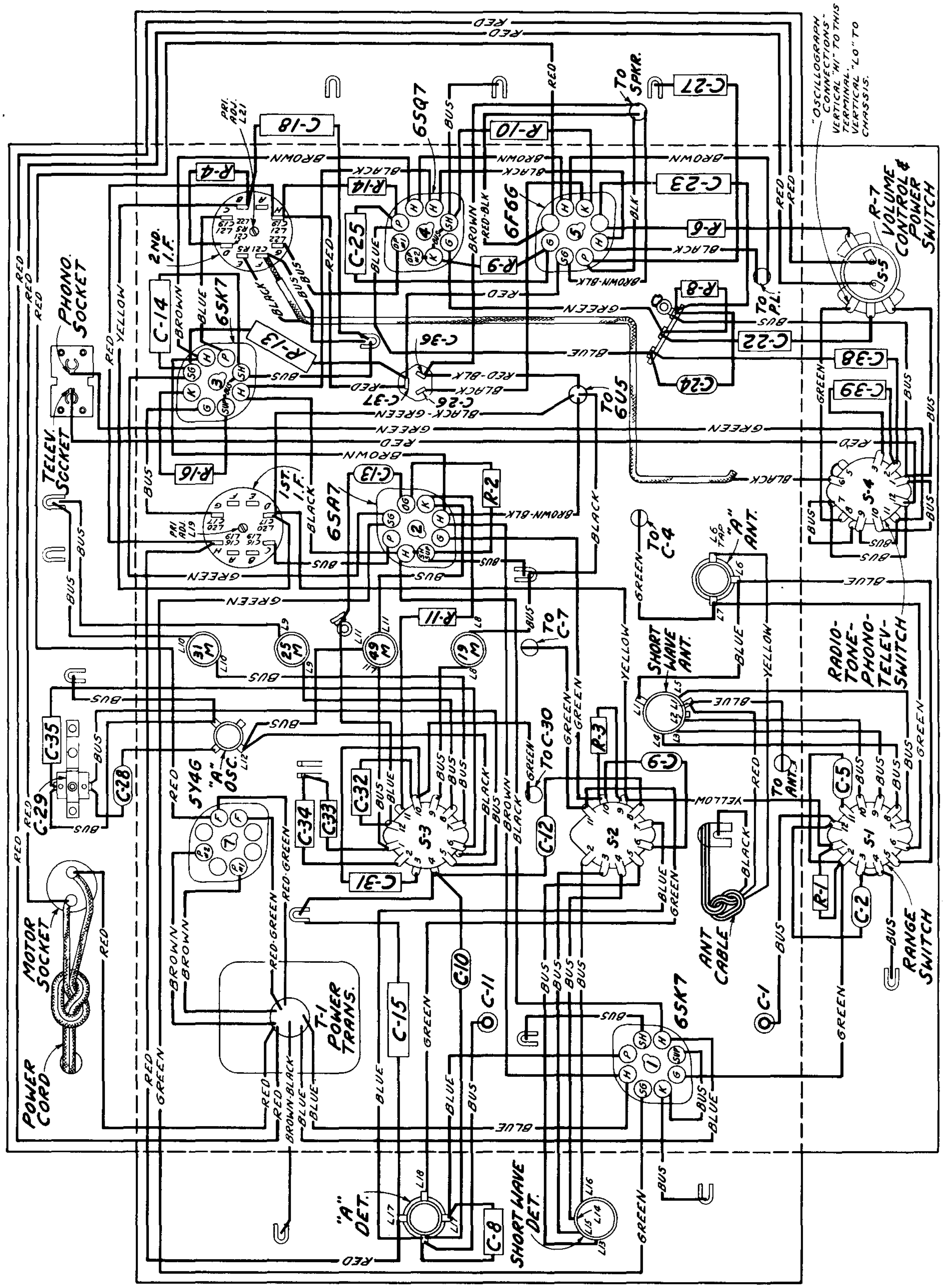
When aligning with the RCA Stock No. 150 Test Oscillator use the variable (unmodulated) oscillator† and "Magic Eye" indication of receiver output. Set test-oscillator dial 800 kc lower than the desired signal for the four lower frequency ranges and 800 kc higher than the desired signal for the two high ranges and use in same manner as TMV-97-C. Insert an open-circuit telephone plug in the test oscillator "Ext. Mod." jack, so the modulated fixed-frequency oscillator will be cut off, and align on the unmodulated variable oscillator signal, which will close the "Tuning Tube" and evidence itself by a rushing noise in the speaker.

If the crystal calibrator signals are weak, disconnect test oscillator while using the crystal calibrator.

† The No. 150 Test Oscillator employs a fixed-frequency (800 kc), modulated oscillator and a variable, unmodulated oscillator. The scale is calibrated to the sum frequency for the two higher frequency ranges and to the difference frequency for the four lower frequency ranges.



Schematic Circuit Diagram



Chassis Wiring Diagram

RADIOTRON SOCKET VOLTAGES

Type	Plate	Screen Grid	Cathode	Heater
6SK7 R.F.	250V	90V	......	6.6V
6SA7 Conv.	250V	90V	......	6.6V
6SK7 I.F.	250V	90V	......	6.6V
6SQ7 A.F.	90*V	......	......	6.6V
6F6G Output	240V	250V	17V	6.6V
6U5 Indicator	358V	......	......	6.6V
5Y4G Rectifier	345/345V	......	358V	5.0V

*Cannot be accurately measured with an ordinary voltmeter due to the high value of series resistance. All the above values hold within + 20% when measured with a 1000 ohm-per-volt type of meter, on a line voltage of 115 volts.

Precautionary Lead Dress

(1) Dress speaker cable leads against chassis side apron, away from 6SQ7 grid circuit leads.

(2) Twist red A.C. leads together—dress along chassis apron, below phono-television sockets, upwards to clamp on chassis side apron and across to power switch on volume control.

(3) Dress filament leads away from 6SQ7 tube.

(4) Dress 6SQ7 grid lead against chassis below all crossing leads. Remove any excess length of this lead.

(5) Dress 6SQ7 plate lead close to chassis.

Push Button Adjustments

The push buttons should be adjusted for six favorite stations after the receiver has had a brief warm-up period.

Any standard broadcast stations may be chosen. The preferable arrangement is to adjust for stations in the order of frequency, from low to high.

Proceed as follows:—

1. Set the accessory tone knob to "Radio" and turn the range selector to "A" band position.
2. Remove the six push buttons by inserting a small screwdriver blade in the slot provided on the under side of the button. Press the screwdriver blade upwards at the same time pull the button forward.
3. Loosen the push arm adjusting screws accessible through the push button openings.
4. Press in the tuning knob and accurately tune in the first station.
5. With station accurately tuned in, press in the first push button and tighten screw.
6. Proceed in a similar manner to adjust the remainder of the push buttons.
7. Replace push buttons by inserting in the escutcheon openings, spring side down. Press button in as far as possible to securely lock button in escutcheon.
8. Place call letter tabs in openings provided.

Note:—When difficulty is experienced in setting up the push buttons due to sticking cams, unscrew cam screw ½ turn and rotate gang back and forth until the cam plate moves freely.

RCA Victor "Magic Rodtenna"—The Model A4 receiver is designed for use with Stock No. S-2477 Rodtenna. A three prong plug is provided on the chassis for convenient connection of this antenna, wherever the conventional type of outdoor antenna, is not practical. It is not advisable to replace a conventional type of antenna with the Rodtenna. Read the instructions enclosed with the Rodtenna for complete details.

REPLACEMENT PARTS FOR MODELS A3 TABLE & A4 CONSOLE

7 TUBE, 5 BAND AC RECEIVER

Insist on genuine factory tested parts, which are readily identified and may be purchased from authorized dealers.

STOCK NO.	DESCRIPTION	
	RECEIVER ASSEMBLIES	
S-2524	Arm-Trip arm located on range switch shaft..............................	
14517	Board-Ant.-Gnd.terminal board.......	
14394	Cable-Tuning indicator cable assembly..........................	
30766	Cap-Tuning indicator rubber cap.....	
12714	Capacitor-Air-trimmer 2-12 mmfd. (C1,C11)..........................	
S-2578	Capacitor-Mica trimmer 3-30 mmfd. (C3,C6,C29)........................	
13001	Capacitor-8.2 mmfd. (C2,C10)........	
31350	Capacitor-18 mmfd. (C35)...........	
31354	Capacitor-33 mmfd. (Temp.Comp.)(C33)	
12723	Capacitor-56 mmfd. (C12)...........	
31349	Capacitor-62 mmfd. (C32)...........	
31352	Capacitor-120 mmfd. (C31)...........	
12724	Capacitor-120 mmfd. (C13)...........	
31351	Capacitor-190 mmfd. (C34)...........	
30608	Capacitor-510 mmfd. (C28)...........	
12537	Capacitor-560 mmfd. (C5,C9,C24).....	
5107	Capacitor-.0025 mfd.(C22,C39).......	
4838	Capacitor-.005 mfd.(C27,C38).......	
4937	Capacitor-.01 mfd. (C25)..........	
14393	Capacitor-.01 mfd. (C8)...........	
4886	Capacitor-.05 mfd. (C18)..........	
11414	Capacitor-0.1 mfd. (C14,C15,C23)..	
S-2579	Capacitor-Electrolytic capacitor consisting of one 10 mfd.,one 15 mfd., and one 20 mfd.sections (C26, C36,C37)..........................	
S-2585	Coil-Antenna "A" band coil (L6,L7)..	
S-2580	Coil-Antenna "Spread Band" coil (L1, L2,L3,L4,L5)......................	
S-2586	Coil-R.F. "A" band coil (L17,L18)...	
31266	Coil-R.F. "Spread Band" coil (L13, L14,L15,L16)......................	
S-2581	Coil-Oscillator "A" band coil (L12).	
S-2582	Coil-19M band oscillator coil (L8)..	
31254	Coil-25M band oscillator coil (L9)..	
31255	Coil-31M band oscillator coil (L10).	
31256	Coil-49M band oscillator coil (L11).	
S-2536	Control-Volume control & power switch (R7,S5)............................	
S-2529	Cord-Drive Cord.....................	
S-2530	Drive-Friction drive assembly.......	
34267	Drum-Drive cord drum complete with set screws and calibrator dial.....	
S-2531	Indicator-Station selector indicator pointer...........................	
11891	Lamp-Pilot lamp.....................	
5040	Plug-4 contact female speaker plug..	
14459	Resistor-100 ohm, 1/4 watt (R15,R16)	
12261	Resistor-390 ohm, 1/4 watt (R11)....	
31388	Resistor-390 ohm, 1 watt (R10)......	
S-2587	Resistor-10,000 ohm, 4 watt (R13)...	
S-1894	Resistor-5,600 ohm, 1/4 watt (R6)...	
13998	Resistor-22,000 ohm, 1/4 watt (R2,R5)	
12285	Resistor-470,000 ohm,1/4 watt (R9)..	
12013	Resistor-1 meg.,1/10 watt (R1,R3)...	
12679	Resistor-2.2 meg.,1/4 watt (R4).....	
13601	Resistor-10 meg., 1/4 watt (R8).....	
S-2446	Retainer-AC female socket retainer (Pkg.3)...........................	

STOCK NO.	DESCRIPTION	
32086	Roller-Drive shaft rubber roller...	
33438	Screw-Thumb screw for tuning indicator bracket (Pkg.2).............	
31364	Socket-Dial lamp socket............	
S-2447	Socket-AC input socket.............	
31251	Socket-tube socket.................	
33514	Socket-Phono-Television socket.....	
31418	Spring-Drive cord tension spring (Pkg.2)...........................	
S-2583	Switch-Range Switch (S1,S2,S3).....	
S-2584	Switch-Tone,Phono,Television Switch (S4).......................	
S-2534	Transformer-1st I.F. Transformer (L19,L20,C16,C17).................	
33761	Transformer-2nd I.F. Transformer (L21,L22,C19,C20,C21).............	
S-2535	Transformer-Power Transformer, 105-125 volts,25-60 cycles (T1)...	
S-2476	Transformer-Power transformer, 105-125 volts 50-60 cycles (T1)...	
	REPRODUCER ASSEMBLIES (RL79-1)	
32907	Cap-Dust cap for cone center (Pkg.5)...........................	
31647	Coil-Field coil (L25)..............	
32906	Coil-Hum neutralizing coil (L23)...	
32934	Cone-Reproducer cone & voice coil (L24)............................	
31302	Plug-4 contact male plug...........	
33078	Reproducer complete................	
32905	Transformer-Output transformer (T2).............................	
	REPRODUCER ASSEMBLIES(RL70H-1)	
13866	Cap-Dust cap for cone center - (Pkg. 5)..........................	
12012	Coil-Field coil (L25)..............	
11469	Coil-Hum neutralizing coil (L23)...	
31275	Cone-Reproducer cone & voice coil (L24)............................	
31302	Plug-4 contact male plug...........	
31592	Reproducer complete................	
14355	Transformer-Output transformer (T2).............................	
	MISCELLANEOUS ASSEMBLIES	
S-2537	Button-Station selector push button............................	
S-2576	Dial-Glass dial scale..............	
S-2539	Escutcheon-Station selector dial escutcheon........................	
S-2540	Knob-Volume,tone,range or tuning control knob.....................	
S-2541	Marker-Push button call letters markers (1 set)..................	
14270	Spring-Knob retaining spring - (Pkg. 10).........................	
S-2543	Spring-Push button retaining spring (Pkg.3)..........................	
S-2542	Tool-Push button adjusting tool..............................	

External Cross Modulation

By

Dudley E. Foster*

Some years ago reports began to be heard concerning a type of interference with broadcast reception which had never before been noticed. The interference occurred only in localities having high field strength from one or more local stations, and its new characteristic was that the program of the strong local station was heard when the receiver was tuned to one particular other station, but not to still others. The effect was not due to lack of selectivity because, when tuning the receiver, the local station could be tuned out and then would reappear when a certain other station was tuned in. Occasionally two local stations would be heard together on a frequency which was quite different from that of either one of them.

This type of interference also had other peculiarities. In the area in which it occurred, it would be found in one house whereas the house next door would be free from interference even when the same set was used. In those houses where it occurred, any make or model of receiver, including battery sets, experienced it. Still another puzzling factor was that the interference was not constant, being much more severe at some times than at others, and occasionally disappearing entirely for a period. In one case the interference was eliminated by opening the window through which the antenna lead-in passed, and in another case the interference was heard only when a certain bedroom light was turned on.

These characteristics led to the deduction that the interference was not caused in the radio receiver, but by some agency external to the receiver itself. This was further proved by laboratory experiments with two signal generators simulating the desired and interfering stations. In the laboratory, inputs of three or four volts applied to the receiver did not cause interference, whereas, in the field at those locations having this type of interference, field strengths causing less than half a volt signal to be impressed on the receiver were present. Furthermore, decreasing the length of antenna did not eliminate the interference.

A survey was made to determine whether interference of this nature had been noticed in other parts of the country. Reports as a result of this survey showed it to be present in certain areas in or near metropolitan centres.

Since by this time it was evident that the trouble was some form of cross modulation, and since it was exterior to the receiver, this type of interference was designated "external cross modulation."

A location was found where the cross modulation existed consistently and a study was made to determine the fundamental cause and a remedy. In this location, a battery receiver with a short antenna exhibited cross modulation inside the house, but when the receiver was a few feet outside the house, cross modulation ceased. A trap circuit in the antenna was of no benefit, which was further proof that the difficulty was external to the receiver. It was observed that at this location, as well as at others where the effect was serious, that the house wiring was of the knob and tube type and the service mains from the distribution transformer were overhead. A filter near the receiver, consisting of two 0.1 mfd. condensers across the line with the center point grounded had only a slight effect on the interference, but an additional condenser across the line where it entered the house greatly decreased the cross modulation. It was further found that by placing the antenna at a distance from the power lines and using a shielded lead-in, the external cross modulation disappeared.

This experience showed that the cross modulation was due to rectification of radio frequencies in the power wiring, with resultant new, spurious frequencies being induced in the antenna or lead-in. Radio signals were picked up by the power wiring or other metallic conductors near the receiving antenna and at some point along the conductor were impressed on a rectifier or non-linear circuit element. The characteristic giving the output current of a rectifying element is commonly expressed as a series expansion in ascending powers of the applied voltage, the applied voltage in this case being the radio-frequency signals present on the power wiring or other conductor. The power-series representation of the rectifier characteristic discloses the new harmonic and combination frequencies which result from the rectification process. A simple laboratory test confirmed the observations. Two antennas were placed a few feet apart and to one of them a radio receiver was connected. An impedance was connected between the other antenna and ground, and when a simple diode was connected across this impedance, cross modulation of the signals in the first antenna occurred.

The question arises as to where the rectifier may exist in the field. Wherever there is a poor connection between any two metallic bodies, especially if oxidation is present, rectification can take place. **The poor contact may be in the lighting lines, in piping, or even in the antenna itself.** In one case the trouble was located at a point where a pipe passed through metal wall lathing. Bonding the pipe and lath together eliminated the interference. In another case two pipes were found to be touching and insertion of a block of wood between them cleared up the cross modulation. When such a rectifier exists and one or more powerful signals are present, new frequencies are generated by the rectifier. Where only one powerful signal is present, the only new frequencies made by the rectifier are multiples of the fundamental, that is the second harmonic, third harmonic, etc. of the signal frequency. Where two strong signals exist, a number of cross modulation combinations take place. Let us call the frequency of one of the strong stations a, and that of the other b, then the rectifier generates the following frequencies:

a+b	2a—b
a—b	2b+a
2a	2b—a
2b	3a
2a+b	3b

An effect also takes place whereby the modulation of station with frequency a is heard on station b, and the modulation of station b is heard on a.

It should be noted that these spurious frequencies do not depend upon the presence of a second harmonic from either of the stations. If both stations are entirely free from harmonic radiation these same frequencies are generated if a rectifier is present.

Let us suppose that two stations are so located that in the region between them signal strengths of 0.1 volt per meter occur from both, and that one station is on 650 kc. and the other on 750 kc. Then the following table shows the frequencies produced.

a = 650 kc.	2a+b = 2,050 kc.
b = 750 kc.	2a—b = 550 kc.
a+b = 1,400 kc.	2b+a = 2,150 kc.
a—b = 100 kc.	2b—a = 850 kc.
2a = 1,300 kc.	3a = 1,950 kc.
2b = 1,500 kc.	3b = 2,250 kc.

In this example these two stations would produce five new frequencies in the broadcast band and five new frequencies outside the broadcast band where one or both the stations together would be heard. It can be appreciated readily that a large amount of interference will be produced in this manner. The interference produced by station of frequency (a) on frequency (b) and vice versa has been found to be serious only when the rectifying action is particularly severe because the modulation of the strong desired station usually masks the interfering modulation.

It may be seen also that there is a possibility of hum modulation being introduced when a rectifying condition exists in the power wiring. In this case, one of the frequencies is that of the signal carrier and the other that of the lighting system, which is usually 60 cycles. The rectifying action then imposes a 60-cycle modulation on the carrier. Some instances of modulation hum in receivers at certain locations have been traced to this source. Hum of this type would be present in a battery receiver at the same location. The remedy is the same as for interference between stations, namely elimination of the rectifying condition or changed installation of the antenna to avoid pickup of resultant spurious frequencies.

Knowledge of the frequencies produced is helpful in determining whether a case of interference is due to external cross modulation or not. Most of the combination frequencies are readily calculated when the frequencies of the two stations having high field strength are known. The combination 2a—b and 2b—a are usually in the broadcast band and for that reason are troublesome.

In investigating a situation where interference exists, the first step should be to determine whether or not it is due to external cross modulation by observing the frequencies at which interference exists.

For example, with the two strong signals at 650 kc. and 750 kc., if the program from both is heard at 550 kc., 850 kc. and 1,400 kc., it may be safely assumed that the trouble is due to external cross modulation. If the interference is not due to external cross modulation, shortening the antenna or installation of a wave trap

(Continued on page 22)

Abstracted from RCA REVIEW—April, 1937

***RCA License Division Laboratory**

External Cross Modulation

(Continued from page 16)

tuned to the interfering signal, or both, will remedy the situation.

Cross modulation may, of course, be produced in the radio-frequency or first-detector stage of the receiver if the tubes are not of the remote cut-off or variable-mu type or if the operating bias is, for any reason, incorrect. Cross modulation occurring in the receiver can be differentiated from that due to external causes by use of a short antenna, a wave trap tuned to the strongest interfering station, or by substituting another receiver. These expedients will eliminate, or greatly reduce, cross modulation which takes place in the receiver, but will not affect external cross modulation.

As seen from some of the cases, the rectifying element may be in the power wiring, piping, or in the antenna itself. *Therefore, the first step in eliminating the trouble should be to make sure that the antenna and ground connections to the receiver have secure, tight joints throughout, soldered joints in the antenna being preferable. If this does not cure the interference, the next step is to endeavor to find the rectifying element elsewhere.* If the rectifier is in the power wiring, connection of two 0.1 mfd. condensers across the lighting lines, with the center point going as directly as possible to a good ground, should produce at least some decrease in the cross modulation. In this connection it should be remembered that steam or gas piping, and in some cases water piping, may have joints which are electrical rectifiers, and in this event use of such piping as a ground for the receiver will intensify cross modulation. The house should be examined for indications of pipes or electrical conduits which touch each other. If such points are found they should be separated by a block of wood or else bonded together securely.

If the source of rectification cannot be located, it still is usually possible to secure interference-free reception by the proper type of antenna installation. The location for an antenna which is free from cross modulation can be readily found by the use of a portable battery receiver equipped with a short antenna. It will be found that the cross modulation occurs in the battery receiver when it is within the house, but disappears a few feet outside the house. By this exploration means, a location for the antenna is to be found where cross modulation does not exist. The spurious frequencies will, however, be picked up on the lead-in unless it is thoroughly shielded. In some cases metallic braid shielding may not be good enough and concentric transmission line cable, which is now available in small sizes, must be used. Since the shielded cable is low in impedance, it is necessary to use matching transformers at the antenna and at the receiver to obtain maximum efficiency. If such transformers are used, they should be examined for possibility of poor connections which will cause rectification and resultant cross-modulation interference. It must be remembered also that the ground lead of the receiver is capable of picking up radio-frequency energy so that it should be as short and direct as possible. The receiver should be relocated to accomplish this if necessary.

The steps involved in eliminating external cross-modulation interference area:

1—Calculate the frequency combination values to make sure the interference is external cross-modulation.

2—Examine antenna and ground for poor connections.

3—Try capacity filter across light lines.

4—Look for and eliminate rectifying contacts in piping or wiring.

5—Find antenna location free from cross modulation and install antenna there with shielded lead-in to set.

By following this procedure it should be possible to clear up even stubborn cases of interference due to external cross modulation.

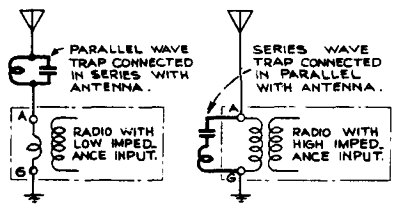
RCA WAVE TRAP DATA

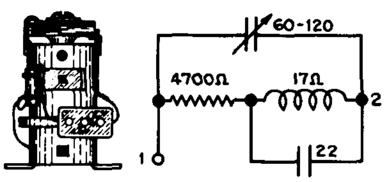
Complete electrical specifications for all available RCA wave traps are given below.

On sets with a low-impedance input (few turns on primary of antenna coil, with a d-c resistance usually less than 10 ohms) the trap should be connected in series with the antenna.

On sets with a high-impedance input (large number of turns on primary of antenna coil, with a d-c resistance of 10 ohms or more) the trap should be connected in parallel with the antenna.

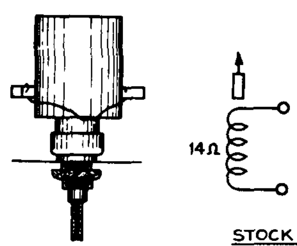
Frequency ranges and "Q" are approximate.





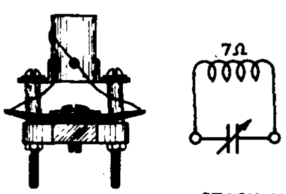
IND. 1 MILLIHENRY
CAP. 60-120 MMF.
RANGE 400-520 KC
Q=50
IMPEDANCE 150,000Ω
(WITH 4700Ω RESISTOR SHORTED)

STOCK No. 11649



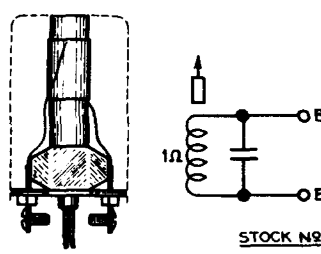
IND. 1.55 MILLIHENRY MIN.
2.35 MILLIHENRY MAX.
USUALLY USED WITH 56 MMF. CAP.
RANGE 400-520 KC
Q=110
IMPEDANCE PARALLEL 660,000Ω
SERIES 58Ω

STOCK No. 12654



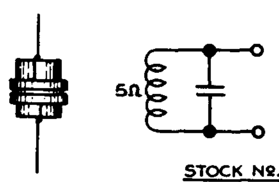
IND. 106 MICROHENRIES
CAP. 800-1300 MMF.
RANGE 440-560 KC.
Q=50
IMPEDANCE 17,500Ω

STOCK No. 11667



IND. 14 MICROHENRIES MIN.
40 MICROHENRIES MAX.
CAP. 750 MMF.
RANGE 920-1550
Q=110
IMPEDANCE 25,000Ω

STOCK No. 32189



IND. 280 MICROHENRIES
CAP. 400 MMF.
RANGE 460 KC.
Q=80
IMPEDANCE 64,000Ω

STOCK No. 13838

Stock No. 13467 Universal Wave Trap

The RCA Universal wave trap (not illustrated) is designed for use in localities where unusual interference is caused by intense signals from local transmitting stations.

This trap uses a magnetite core transformer providing a high "Q" circuit. Adjustment to the interfering signal is made by means of a low-loss air dialectric variable condenser.

Attenuation is minus 30 db. or 32-1 voltage reduction. Range 435 to 1700 kilocycles.