

# SUPPLEMENT No. 3

## Index and Incidental Information

The index which follows includes all diagrams in the 1931 Manual, the supplements to the 1931 Manual, the 1932 Manual, and the first three supplements to the latter. You will note that the sets are listed in numerical or alphabetical order, and are very easy to find.

Please read the notice at the top of each index page. Note carefully that diagrams in the 1931 Manual are listed with one asterisk (\*) before the page number; diagrams in the 1931 supplements are listed with two asterisks (\*\*); and diagrams in the 1932 Manual or its supplements have no asterisks at all. It is not necessary to distinguish between the 1932 Manual and its supplements because the latter were issued free to everyone who bought the original Manual. The supplements to the 1931 Manual were sold separately, and therefore the diagrams in them are specially marked with the two asterisks.

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Table listing Midwest Radio Corp. products: AC-9 (550, 562), AC-11 (560), Ultra 5 (552), Ultra 6 (554), Ultra 7 (554), Ultra 8 Battery (558), Unitune 5 (552), Unitune 8 (556).

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Table listing Power Units: AB-423 (\*\*226A), AB-463 (\*\*226A), AB-623 (\*\*226A), AB-663 (\*\*226A), B-253 (\*\*226A), B-603 (\*\*226A), DAB (\*\*226A), DB (\*\*226A), 180 Volt "B" (\*\*226A), Battery Life Chart 308, (\*\*76-O).

By-Pass Condenser Data

Table listing By-Pass Condenser Data: 326E, 326F, 326G, 326G (\*\*76O).

Chassis Data

Table listing Chassis Data: 307, TR-106 (\*75), NR-109 (\*75).

PIERCE AIRO, Inc.

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PILOT RADIO & TUBE CORP.

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Table listing various radio models and their page numbers, including entries like 16, 17, RE-17, 18, 18 DC, 20, R-20, R-21, 22, 24, 25 AC, 25 Battery, 26, 28, 30, 30A, M-30, R-32, 33, 33-DC, R-35, R-39, 41, 41 DC, R-42, R-43, 44, RE-45, 46 DC, 47, R-50, 51, 51 DC, R-55, RE-57, RAE-59, 60, 62, 64, 66, 67, RAE-68, 82, RE-75, R-80, 86, 100A Speaker, 100B Speaker, 103 Speaker, 104, 104 RPA, 105, 106, AP-736, AP-777C, AP-810, AR-812, AP-935, AP-937, AP-947, AP-951, AP-952, AP-974A, AP-997, AP-997A, AP-997C, AR-1145, II, III, IIIA, IV, V, VI, VII, VIIIB, VIII, IX, Alhambra I, Alhambra II, Borgia 11, Electrola Cromwell, Florenza, Radiola AR, Radiola RS, Radiola Grand, Radiola Senior, Auditorium Phonograph, Theremin, CENTRALIZED RADIO: RF Distribution System.

Table listing various radio models and their page numbers, including entries like ER-1240, ER-1240A, RF-5100 DC, RF-5600, AF-6100, AF-6175 Speaker, READRITE METER WORKS, 245 Set & Tube Tester, 400 Tube Tester, 450 Short Checker, 550 Oscillator, 600-700 Tester, REMLER COMPANY, Ltd., 14, 15, 19, 21, 45 kc. Super, ROBERTSON-DAVIS CO., Melo-Heald, 11 Tube Super, ROLA COMPANY, 80, 90, SAMSON ELECTRIC COMPANY, PAM-5, PAM-9, PAM-16, PAM-16N, PAM-17, PAM-17M, PAM-19, PAM-25, PAM-M1K1, SANGAMO ELECTRIC CO., 250 Amplifier, 3 Stage Amplifier, E. H. SCOTT RADIO LABORATORIES, All-Wave Super, SEARS, ROEBUCK & CO., 36, 36P, 37, 37P, 37, 41, 41P, 44, 47, 48, 50 AVC, F, FF, G, H, J, SHORT WAVE AND TELEVISION LAB., Baird Television Receiver, SILVER-MARSHALL, Inc., SMD-1, 9 Tube Super, 1929, 30, 30-B, 33-A, 34-A, 35-A, 36-A, 37, 38, 39, 60, 75, 95.

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Table listing various radio models and their page numbers, including entries like 630, 677B, 679, 679B, 683, 684, 686, 690, 692, 712, 714, 716, 720, 722 AC, 722 DC, 724, 726 SW, 737, 738, 739, 782-16, A, D, F, G, SIMPLEX RADIO CO., H, K, L, SONORA PHONOGRAPH CO., Inc., E-AC, 2-RL-25, 3-R, 3-RL, 4-R, 5-R, 7-P, B-31, A-36, SPARKS-WITHINGTON COMPANY, 5, 5-15, 5-26, 6-15, 6-26, 9, 9A, 9-30, 10, 15, AR-19, 25, 26, 30, 31, 39, 40, 49, 51, 52, 89, 89A, 103, 109, 110, 235, 301 AC, 301 DC, 410 AC, 410 DC, 420 AC, 420 DC, 564, 570, 574, 578, 589, 591, 593, 600 AC, 600 DC, 610 AC, 610 DC, 620 AC, 620 DC, 737, 740, 740 DC, 750.

Table listing various radio models and their page numbers, including entries like 750 DC, 870, 931 AC, 931 DC, Sparks Ensemble, SPIEGEL, MAY, STERN CO., Melrose, same as Apex, SPLITDORF ELECTRIC MFG. CO., Abbey, PAD-4, M-5, M-6, R-100, 171, R-200, RV-695, Inherently Electric, STAIRS-WINTERS CO., Television Receiver, STANDARD RADIO CORP., 29, STANDARD MFG. CORP. Ltd. (Rogers), Advanced Chassis, 220, 250, 400, 451, 545, 640, 831, STEINITE RADIO CO., 10, 15, 20, 26, 28, 40C Power Pack, 50A, 60 Power Pack, 70, 88, 95, 102A, 102C Power Pack, 261, 262, 991, 992, 993, STENODE CORPORATION OF AMERICA, Stenode Receiver, STERLING MFG. CO., B, 4, 5 D3A Receiver, 517 Mutual Conductance Tester, Miniature Receiver, Midget, STEWART WARNER CORP., R-100 All Lettered Models, R-101A, R-101B, 202A, 202B, 202E, 300, 301A, 301B, 301E, 305, 310, 315, 320, 325, 330, 335, 340, 345, 350, 355, 360, 385.

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Table listing page numbers for various components, including 390, 500, 520, 525, 530, 535, 700, 705, 710, 715, 720, 750, 801, 802, 806, 900, 950 Battery, 950 DC, and SW Converter.

STORY & CLARK RADIO CORP.

Table listing page numbers for STORY & CLARK RADIO CORP. components, including 36, 42, and 51.

STROMBERG-CARLSON TELEPHONE MFG. CO.

Table listing page numbers for STROMBERG-CARLSON TELEPHONE MFG. CO. components, including 1A, 1B, 10, 11, 12, 14, 16, 19, 20, 22, 25, 26, 27, 29, 403, 403A, 403AA, 403B, 404RA, 404RAC, 501, 502, 523 DC, 524 DC, 601, 602, 633, 634, 635, 635 DC, 636, 638A, 638B, 638 DC, 641, 642, 645, 652, 654, 734B, 744B, 846, and D-968.

STUDEBAKER LABORATORIES

Table listing page numbers for STUDEBAKER LABORATORIES components, including 31 and 42.

SUPREME INSTRUMENTS CORP.

Table listing page numbers for SUPREME INSTRUMENTS CORP. components, including AAA-1, 70 Oscillator, 90 Tester, Ohmmeter, and Tube Checker.

T

TELEPHONE MAINTENANCE CO.

Table listing page number for TELEPHONE MAINTENANCE CO. component, including Telmaco P-1.

TEMPLE CORPORATION

Table listing page numbers for TEMPLE CORPORATION components, including 8-60, 8-61, 8-80, and 8-81.

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Table listing page numbers for TRANSFORMER CORP. OF AMERICA components, including 25-51, 25-52, 25-55, 25-90, 25-91, 25-94, 40, 51, 53, 55, 60, 61, 70, 80, 83, 90, 91, 91A, 92, 94, and 160AVC.

TRAV-LER MFG. CO.

Table listing page numbers for TRAV-LER MFG. CO. components, including SG-AVC Super, SG-AC, SG-DC, K, 6, 7, 8 Super, Trav-lette, AC Power Pack, and DC Power Pack.

U

UNITED AIR CLEANER CO.

Table listing page numbers for UNITED AIR CLEANER CO. components, including 7 Tube Band Pass, 7 Tube Super, 8 Tube Super, 8, 9, 11, 12, 15, 16, 31, 33, 104, 444, 660, and 666C.

UNITED REPRODUCERS CORP.

Table listing page numbers for UNITED REPRODUCERS CORP. components, including 20 Electrostatic, 45 Arborphone, 65 Electrostatic, 65 Chassis, K-70, 868, 880, and 890.

U. S. ELECTRIC WORKS

Table listing page numbers for U. S. ELECTRIC WORKS components, including M Genemotor and U Genemotor.

U. S. RADIO & TELEVISION CORP.

Table listing page numbers for U. S. RADIO & TELEVISION CORP. components, including 3, 6 Tube Battery, 8, 10, 20, 26, 26P, 27, 27P Motor Board, 30, 31, 32, 36, 37, 41, 42, 43, and 44.

Table listing page numbers for components 46, 46A, 47, 47A, 48, 48A, 80, 90, 99, and 99X.

W

WEBSTER ELECTRIC CO.

Table listing page numbers for WEBSTER ELECTRIC CO. components, including 35TA, B-37-50, 6005, 6009, 6013, 6025-JD, and 6030-JE.

WELLS GARDNER & CO.

Table listing page numbers for WELLS GARDNER & CO. components, including 5 Tube DC, 8T-AC, 9 in Line, C, AC-9, 10, 60, 63, 80, and 80A.

WEXTARK RADIO STORES

Table listing page number for WEXTARK RADIO STORES component, including Knight 8-9.

WESTINGHOUSE ELECTRIC & MFG. CO.

Table listing page numbers for WESTINGHOUSE ELECTRIC & MFG. CO. components, including WR-4, WR-5, WR-6, WR-6-R, WR-7, WR-7-R, WR-8, WR-8-R, WR-10, WR-10A, WR-14, and WR-15.

WESTON ELECTRICAL INSTRUMENT CORP.

Table listing page numbers for WESTON ELECTRICAL INSTRUMENT CORP. components, including 566 Type 3 Analyzer and Test Panel.

WHOLESALE RADIO SERVICE CO., Inc.

Table listing page numbers for WHOLESALE RADIO SERVICE CO., Inc. components, including 10, 20, and Mighty Atom.

WILCOX LABORATORIES

Table listing page number for WILCOX LABORATORIES component, including Inc. 6.

WILLARD STORAGE BATTERY CO.

Table listing page numbers for WILLARD STORAGE BATTERY CO. components, including "A" Units, "B" Units, and "A-B" Units.

WURLITZER RADIO CO.

Table listing page number for WURLITZER RADIO CO. component, including B.

Z

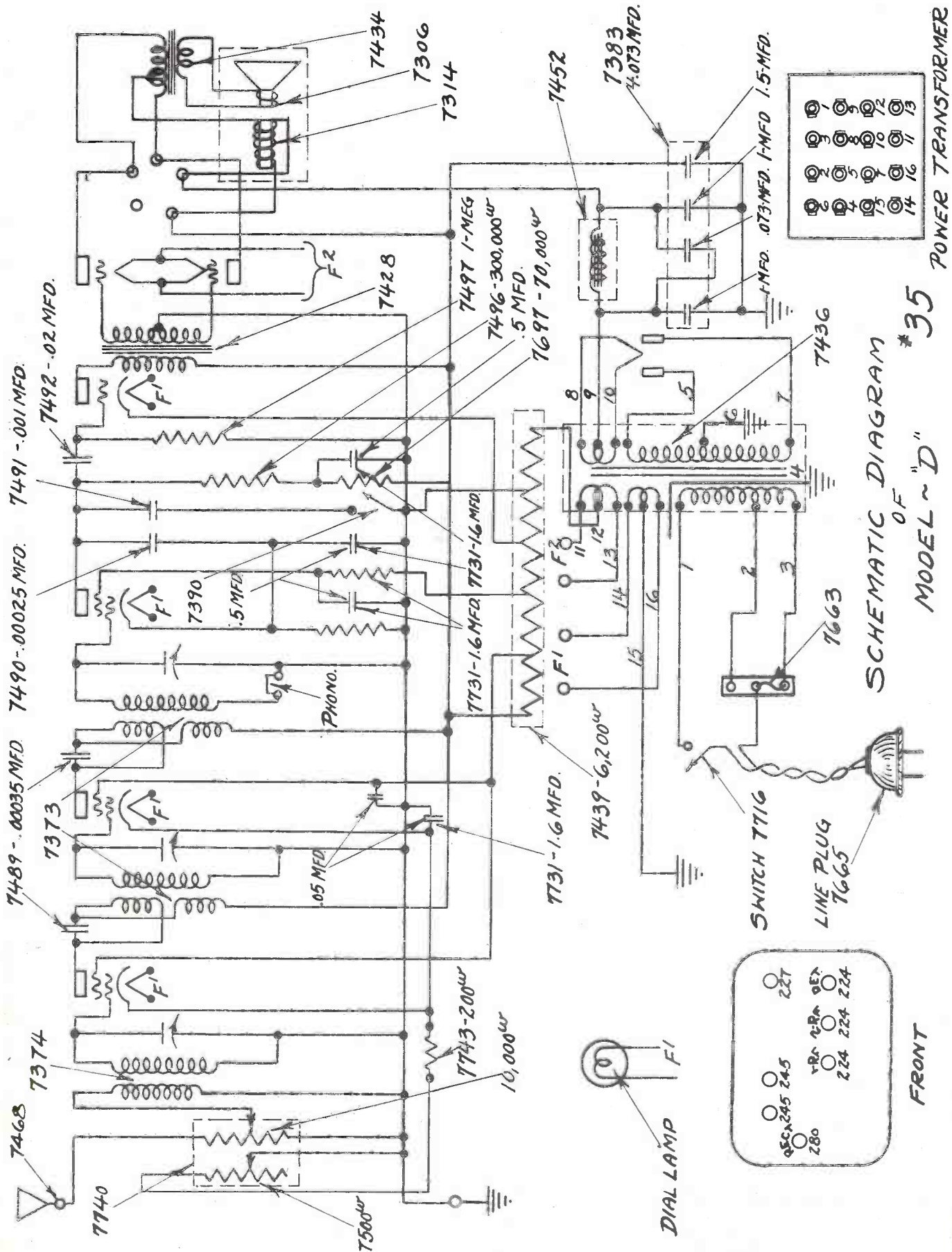
ZANEY GILL CO.

Table listing page number for ZANEY GILL CO. component, including Midget Receiver.

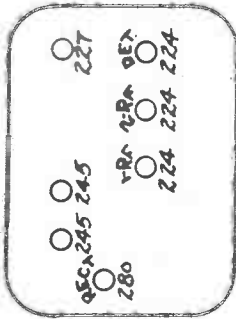
ZENITH RADIO CORPORATION

Table listing page numbers for ZENITH RADIO CORPORATION components, including ZE-3 Power Supply, 4-R, ZE-4, 5 Tube Zenette, ZE-5 Power Unit, 6-EP, 6 Tube Zenette, ZE-6 Filter Unit, ZE-7 Power Supply, ZE-8 Filter Unit, ZE-8P Filter Unit, ZE-9 Power Supply, ZE-10 Power Supply, 10, 11, 11E, ZE-11 Power Supply, 12, ZE-13 Power Supply, 14, 14E, ZE-14 Power Supply, ZE-15 Power Supply, 15, 15E, 15EP, 16, 16E, 16EP, ZE-17 Power Supply, ZE-18 Power Supply, ZE-19 Power Unit, ZE-20 Audio Unit, 27, 31 Battery, 32 Battery, 33, 33X, 34, 34P, 35, 35A, 35 AP, 35APX, 35P, 35PX, 37A, 39, 39A, 40A, 41, 42, ZE-50 Power Unit, 52, 53, 54, 60, 61, 62, 64, 67, 70, 80, 102, 112, 122, 333, 342, 342P, 352, 352A, 352AP, 352APX, 352P, 352PX, 353A, 362, 362X, 392, 392A, 412, 422, 602, 612, 622, 642, 672, Model VII, and Record Changer.

# ALL-AMERICAN MOHAWK CORP.

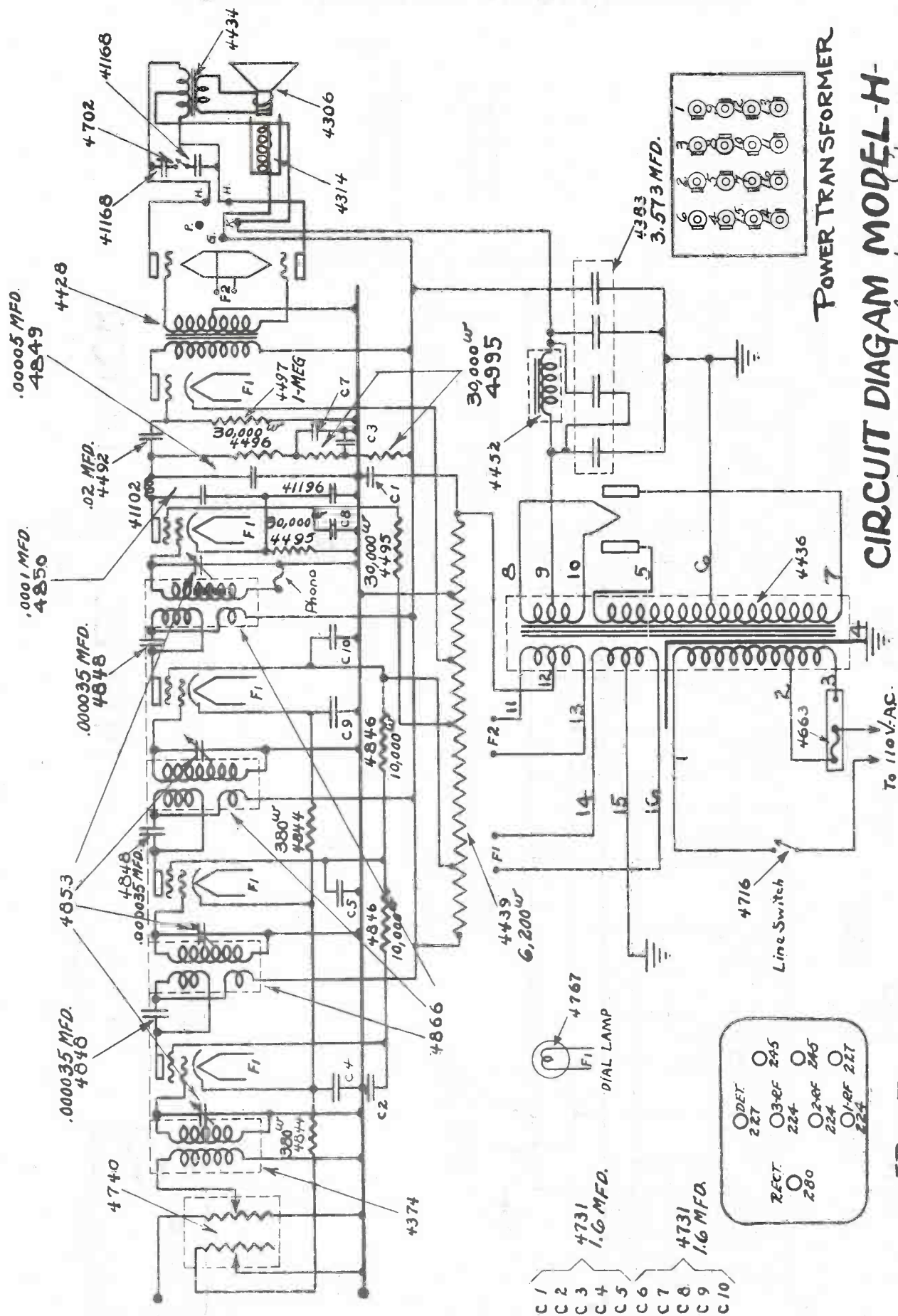


SCHEMATIC DIAGRAM #35 OF MODEL "D" POWER TRANSFORMER





# ALL-AMERICAN MOHAWK CORP.



POWER TRANSFORMER

CIRCUIT DIAGRAM MODEL-H-36  
 L.S. 11/3/30  
 MS. Leonard

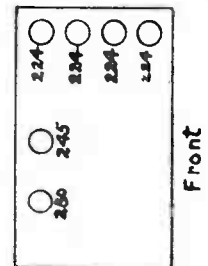
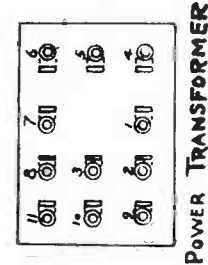
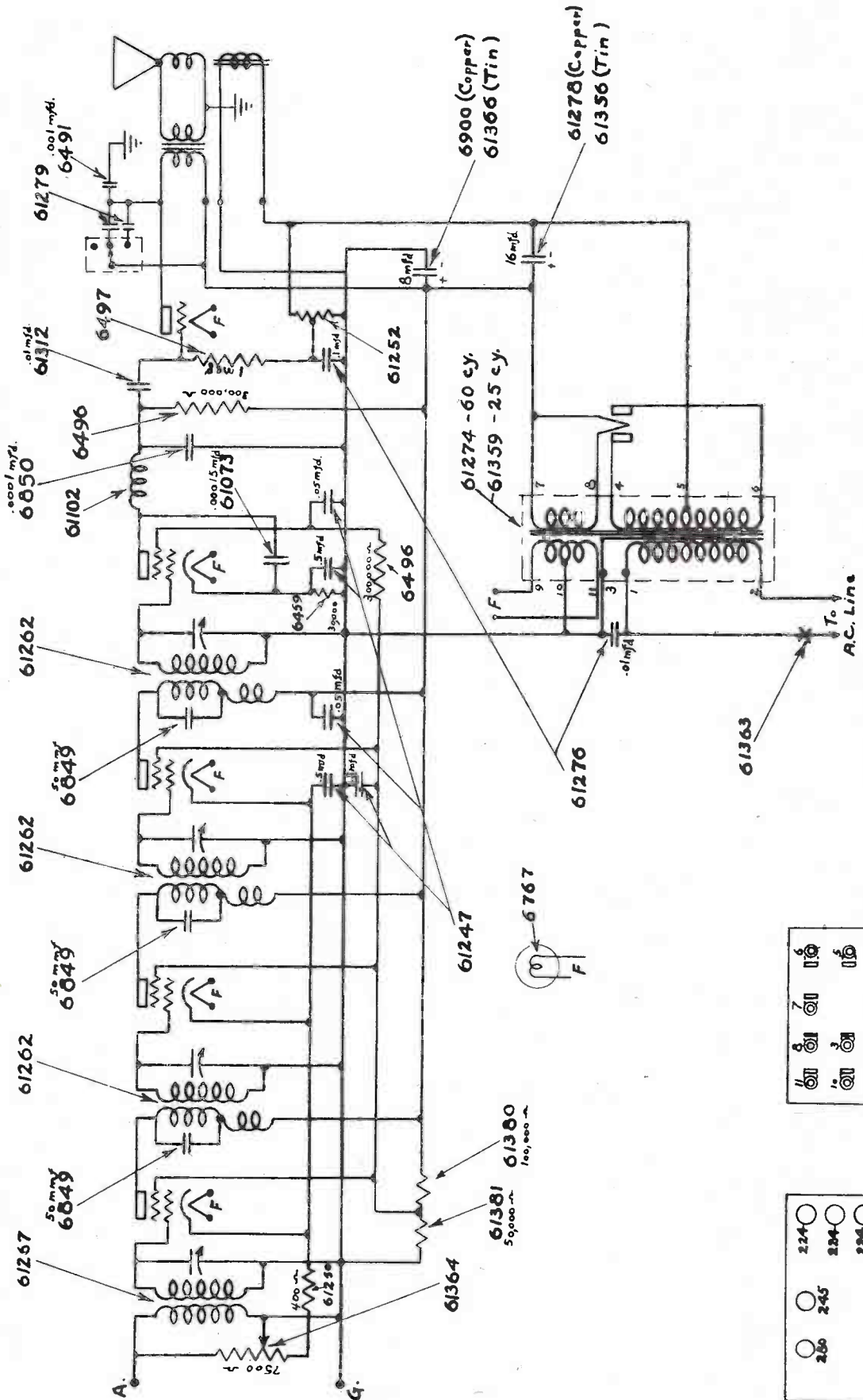
- C 1
- C 2
- C 3
- C 4
- C 5
- C 6
- C 7
- C 8
- C 9
- C 10

ODET. 227	○	245
RECT. 280	○	245
	○	224
	○	224
	○	227
	○	224

FRONT

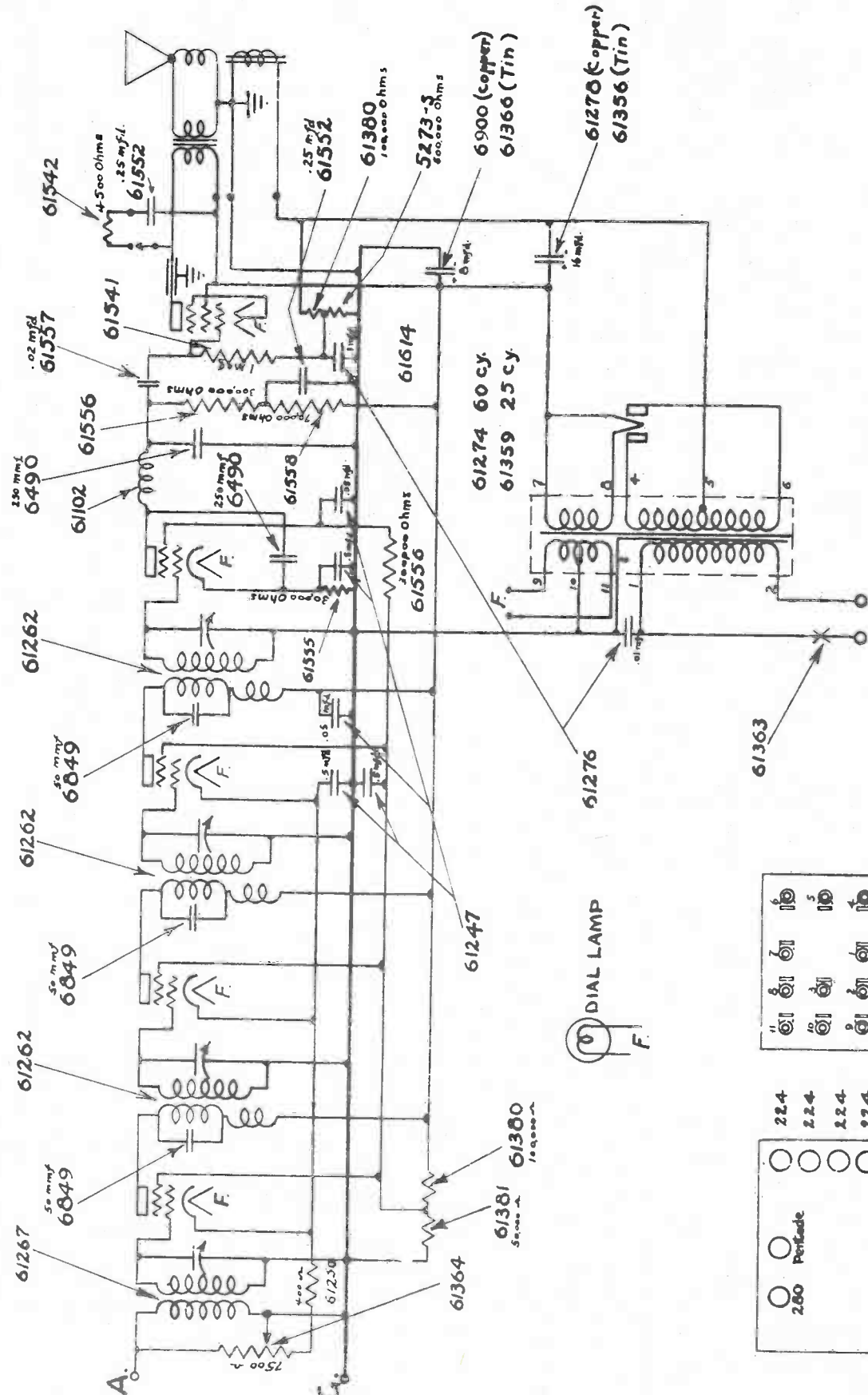
# ALL-AMERICAN MOHAWK CORP.

## MODEL J JUNIOR # 39

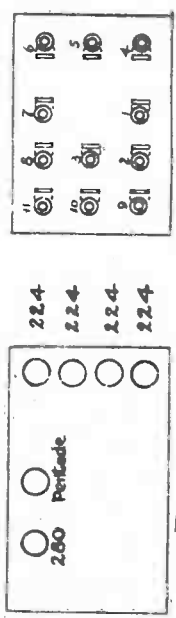




# ALL-AMERICAN MOHAWK CORP.



## MODEL "P" #40



POWER TRANSFORMER

Front

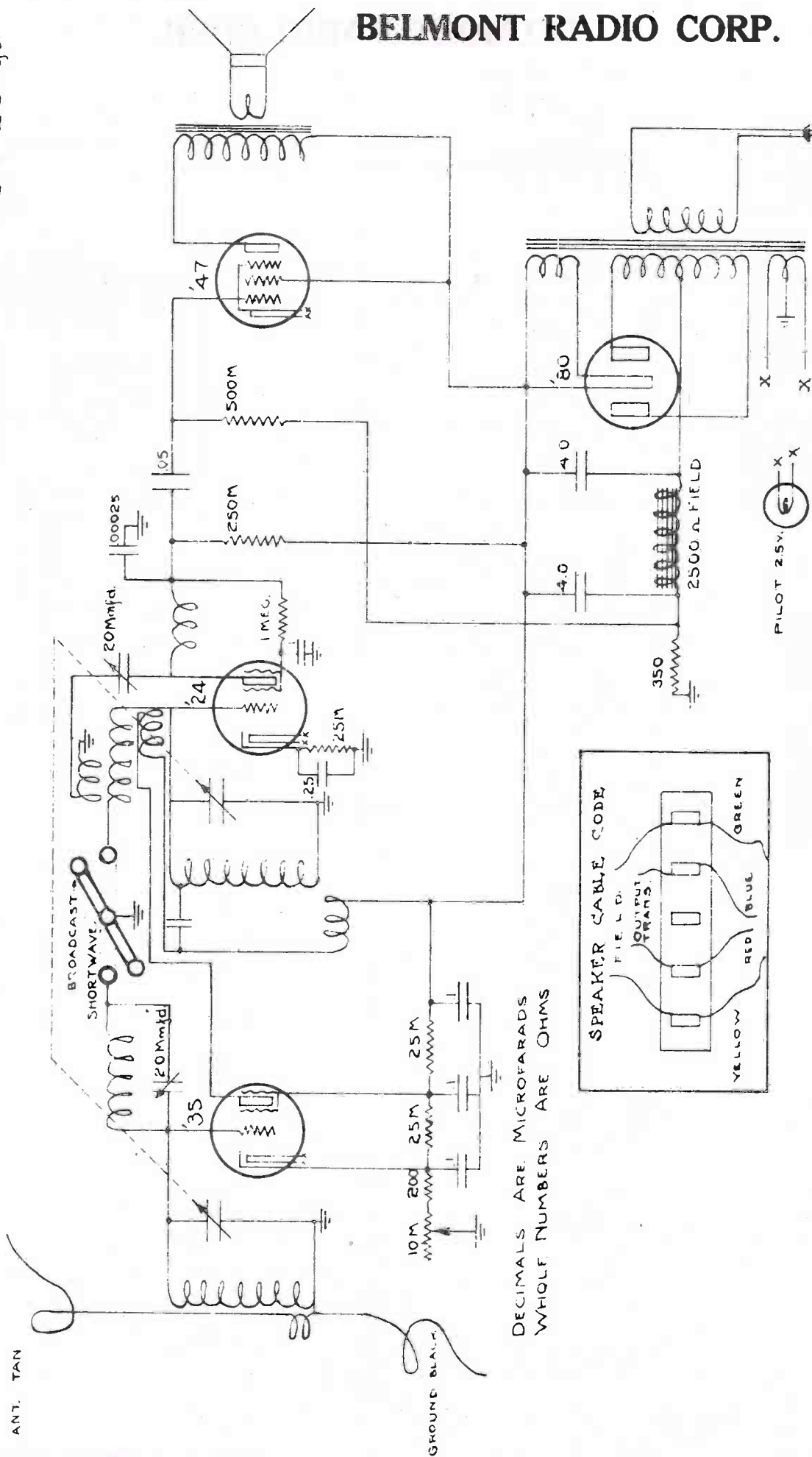




# BELMONT RADIO CORP.

## SERIES 40

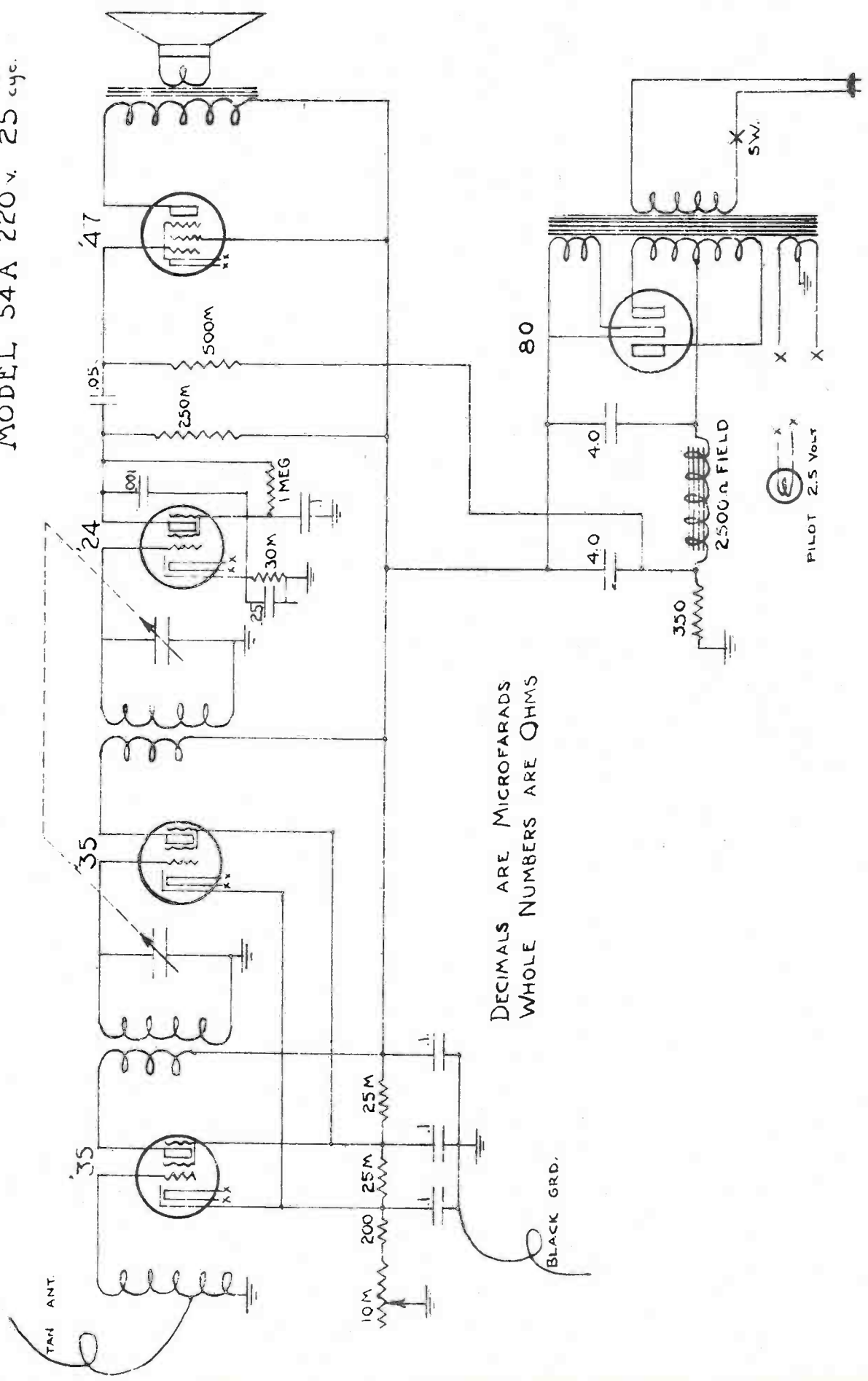
MODEL 47	110 v.	60 cyc.
MODEL 48	110 v.	25 cyc.



# BELMONT RADIO CORP.

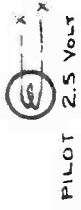
## SERIES 50A

MODEL 51A	110 v.	60 cyc.
MODEL 52A	110 v.	25 cyc.
MODEL 53A	220 v.	60 cyc.
MODEL 54A	220 v.	25 cyc.



DECIMALS ARE MICROFARADS  
WHOLE NUMBERS ARE OHMS

BLACK GRD.



PILOT 2.5 Volt

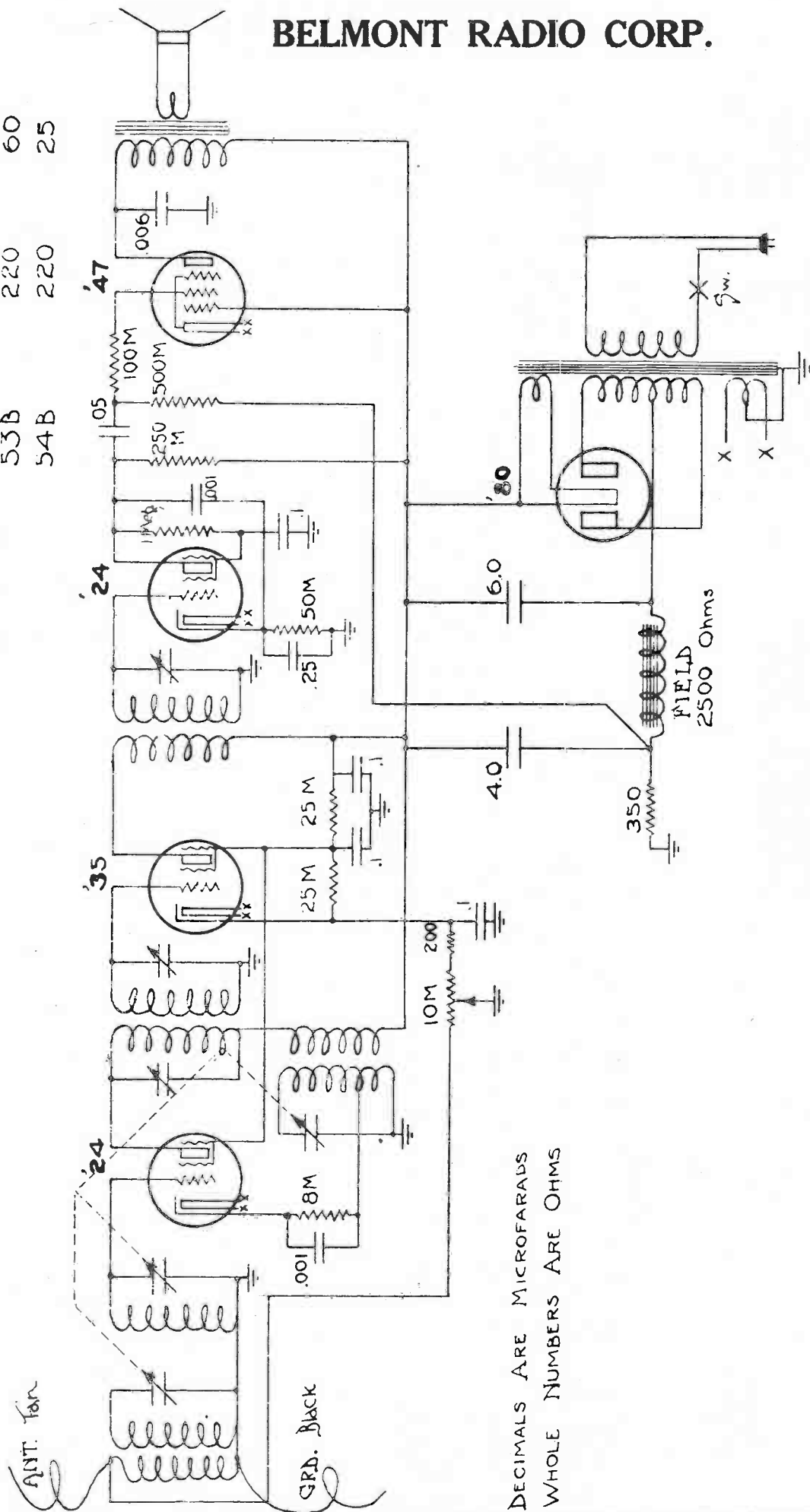
SW.



**BELMONT RADIO CORP.**

MODEL	VOLTS	FREQ.
51B	110	60 cyc.
52B	110	25
53B	220	60
54B	220	25

**SERIES 50B**

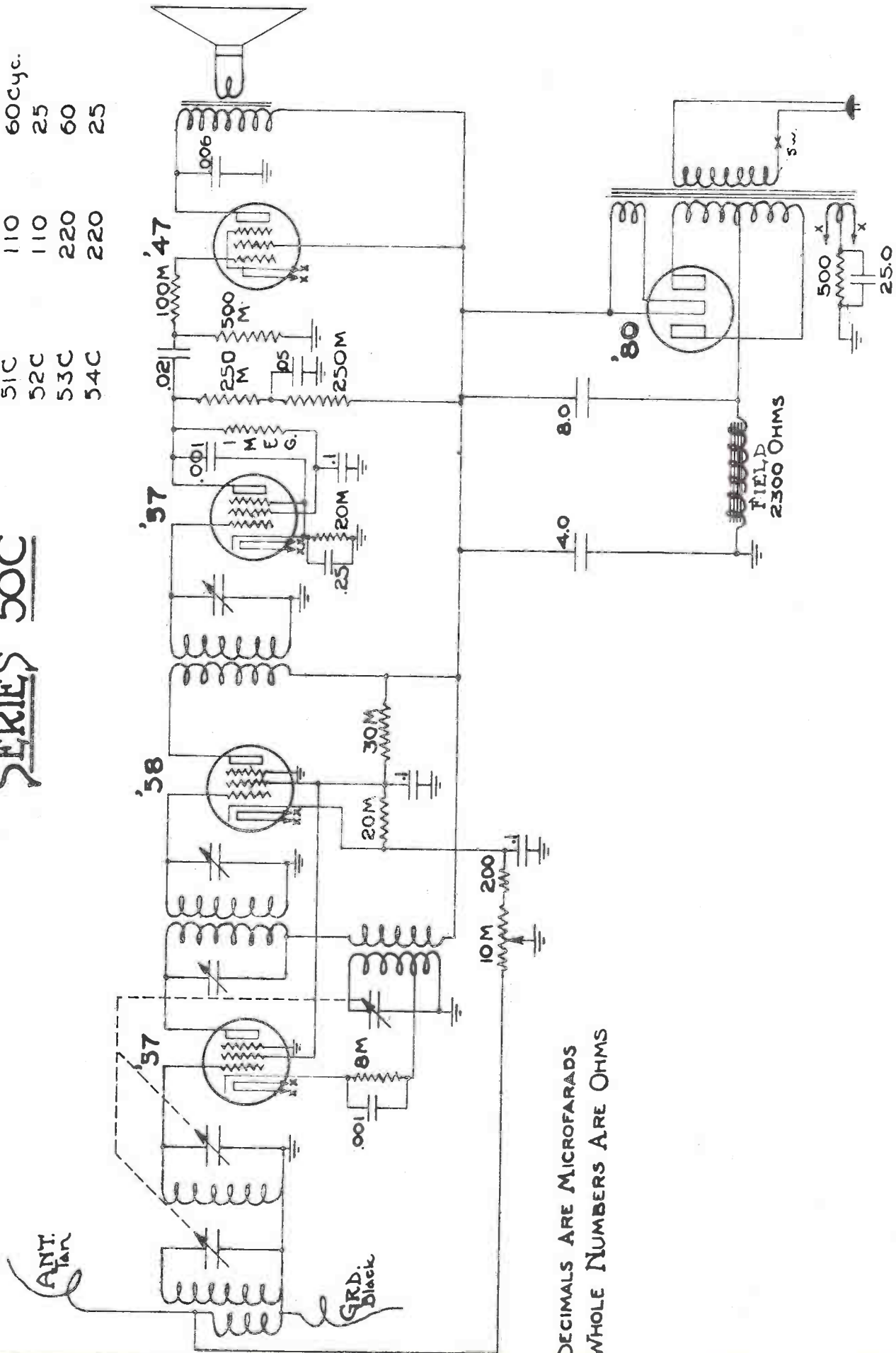


DECIMALS ARE MICROFARADS  
 WHOLE NUMBERS ARE OHMS

# BELMONT RADIO CORP.

## SERIES 50C

MODEL	VOLTS	FREQ.
51C	110	60cyc.
52C	110	25
53C	220	60
54C	220	25

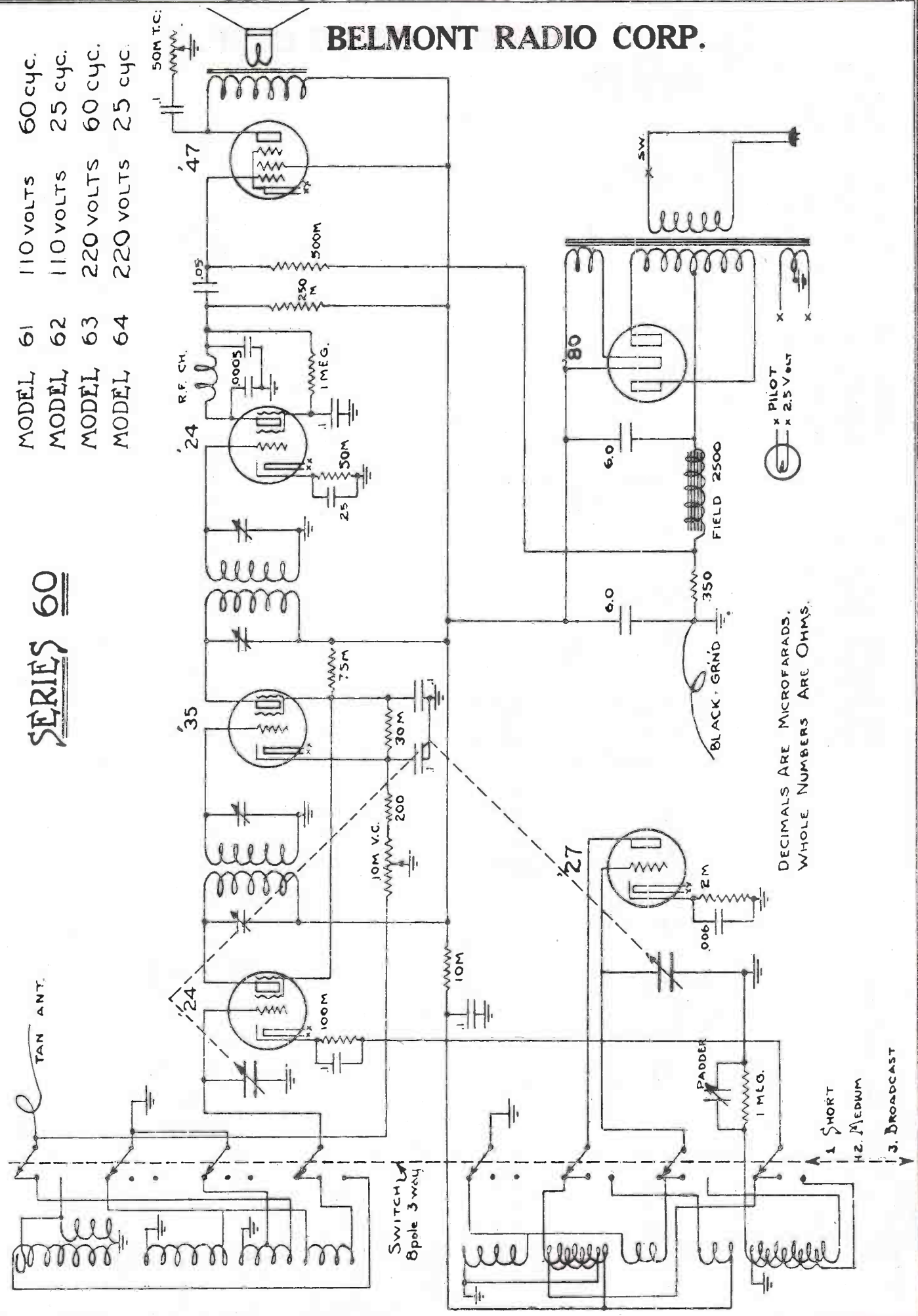


DECIMALS ARE MICROFARADS  
WHOLE NUMBERS ARE OHMS

MODEL 61	110 VOLTS	60 cye.
MODEL 62	110 VOLTS	25 cye.
MODEL 63	220 VOLTS	60 cye.
MODEL 64	220 VOLTS	25 cye.

**SERIES 60**

**BELMONT RADIO CORP.**



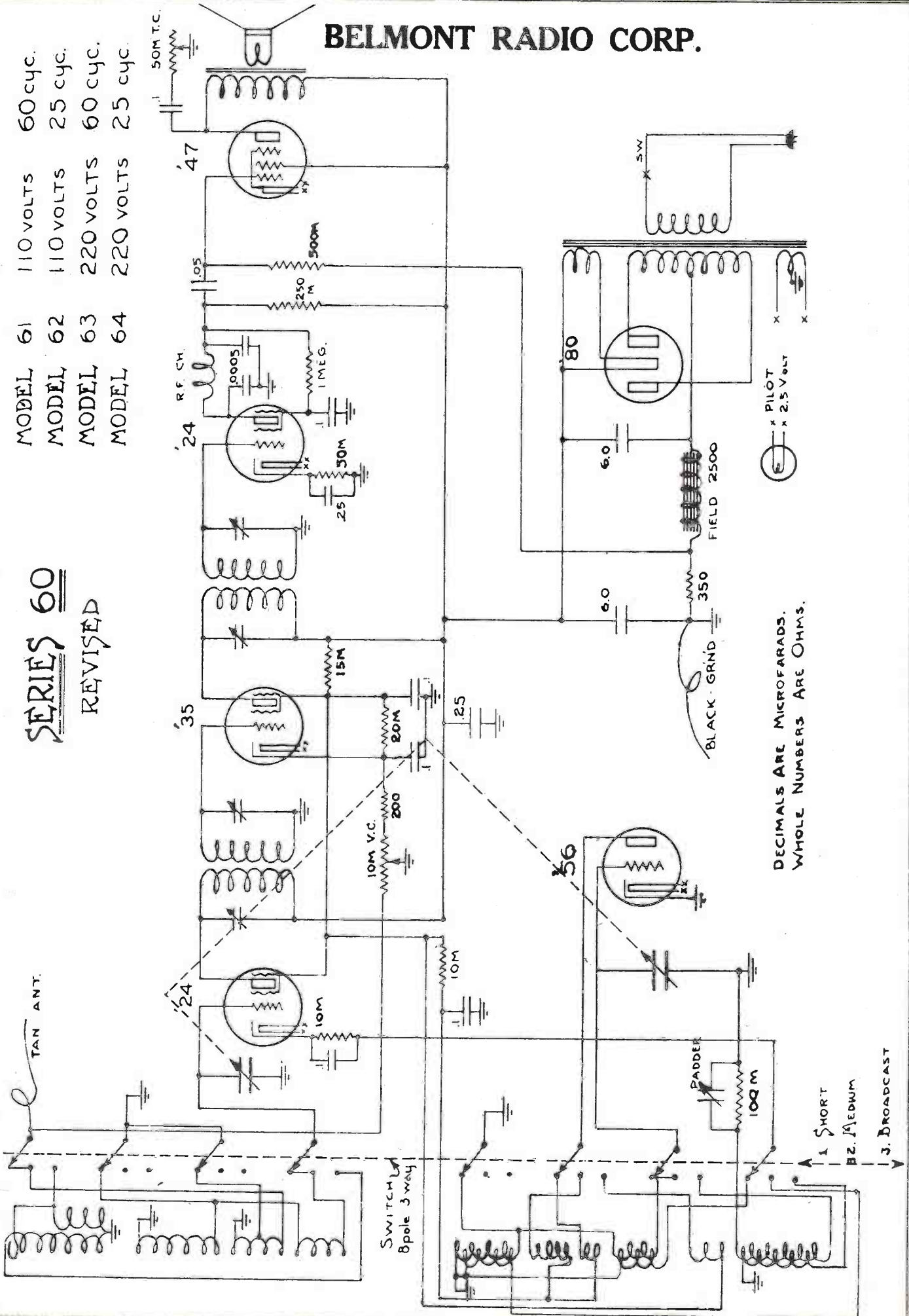
DECIMALS ARE MICROFARADS.  
WHOLE NUMBERS ARE OHMS.

1. SHORT  
2. MEDIUM  
3. BROADCAST

BELMONT RADIO CORP.

**SERIES 60**  
REVISED

MODEL 61	110 VOLTS	60 cyc.
MODEL 62	110 VOLTS	25 cyc.
MODEL 63	220 VOLTS	60 cyc.
MODEL 64	220 VOLTS	25 cyc.

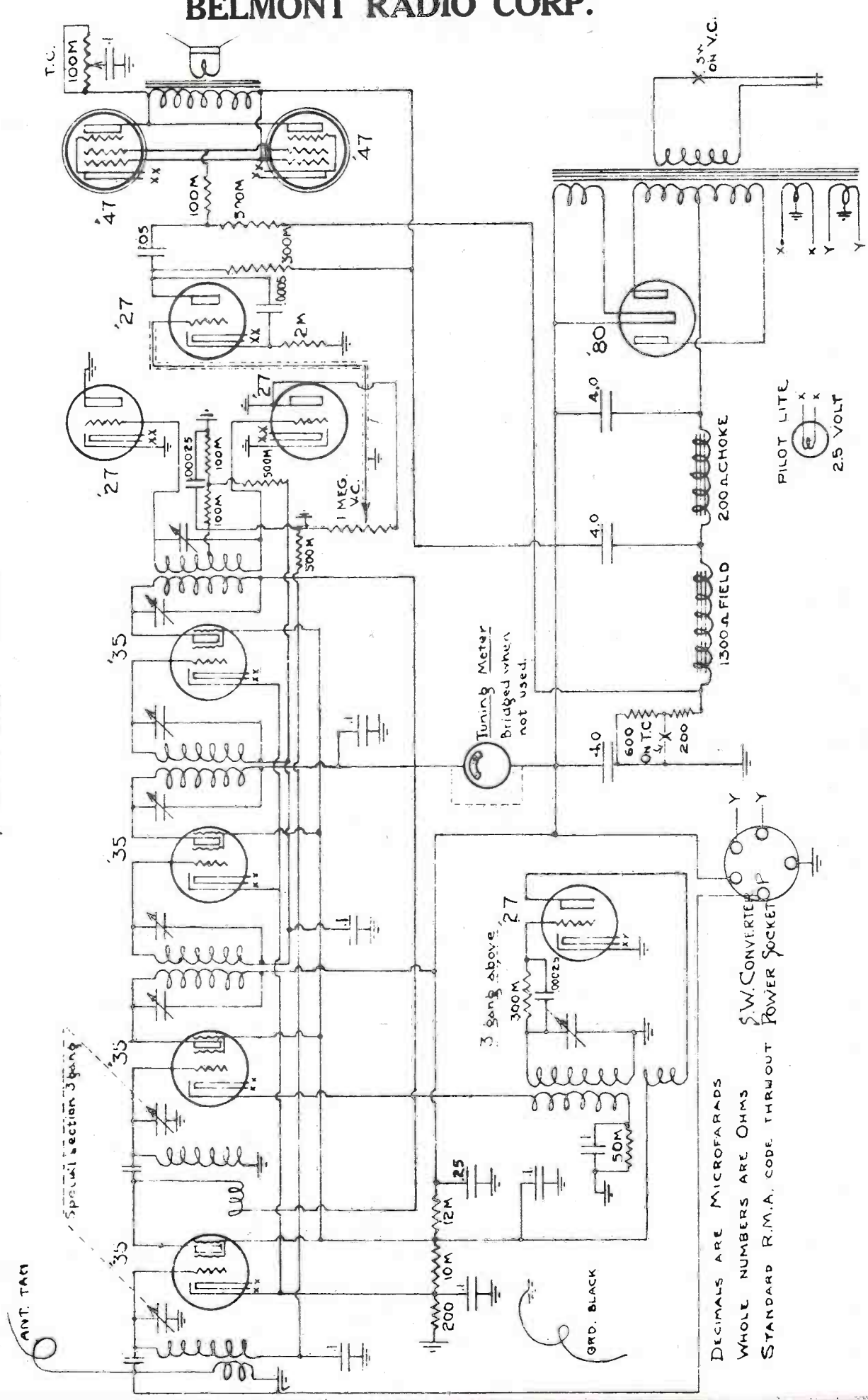


DECIMALS ARE MICROFARADS.  
WHOLE NUMBERS ARE OHMS.

1 SHORT  
B2. MEDIUM  
J. BROADCAST

SERIES 110

BELMONT RADIO CORP.



DECIMALS ARE MICROFARADS  
 WHOLE NUMBERS ARE OHMS  
 STANDARD R.M.A. CODE THROUGHOUT

3 GANG ABOVE  
 300M  
 1000Z

5 M. V.C.  
 2.5 VOLT  
 PILOT LITE

200 Ω. CHOKE  
 1300 Ω. FIELD

Tuning Meter  
 Bridged when  
 not used.

ANT. TAN

Special section 3 gang

GRD. BLACK

PILOT LITE  
 2.5 VOLT

3 GANG ABOVE

5 M. V.C.  
 2.5 VOLT  
 PILOT LITE

200 Ω. CHOKE  
 1300 Ω. FIELD

Tuning Meter  
 Bridged when  
 not used.

ANT. TAN

Special section 3 gang

GRD. BLACK

# GRIGSBY-GRUNOW CO.

## MAJESTIC MODEL 11 SHORT-WAVE CONVERTER (No. 10 CHASSIS)

(This chassis is incorporated in the Viking, Explorer and Number 11 all-wave receivers).

Short-wave reception has become the high-light of 1932 radio business; and among the foremost instrument designs with which the Service Man must familiarize himself are the Majestic models Viking, Explorer, and Number 11 all-wave receivers. These radio sets incorporate two chassis; one is a standard broadcast receiver, (No. 55 chassis), and the other is a short-wave converter (No. 10 chassis) whose output feeds into the broadcast receiver when it is tuned as an I.F. amplifier at 1,000 kc. (300 meters).

Volume is controlled by the volume control of the broadcast receiver operating in the usual manner.

The numbers on the dial of the converter give the frequency reading in "megacycles" (millions of cycles); therefore, to obtain a reading in "kilocycles" it is necessary to multiply the numbers on the dial by 1,000. The three sets of numbers on the dial of the converter indicate band frequencies as follows: outer circle, 37½ to 15 meters; center circle, 85 to 37½ meters; inner circle, 200 to 85 meters.

The values of the components of this converter are as follows: Condenser C1, 100 mmf.; C2, C3, C4, 0.1-mf.; C5, .01-mf.; C6, C7, 360 mmf.; C8, C9, 5 to 30 mmf.; C10, C11, 50 to 100 mmf.; C12, C13, 200 to 600 mmf.; C14, .001- to .0015-mf.; C15, .0041- to .0047-mf.; C16, C17, .03-mf.; C18, C19, 4 mf.

Resistors R1, R7, 20,000 ohms; R2, R4, R6, 10,000 ohms; R3, 1,000 ohms; R5, 30,000 ohms.

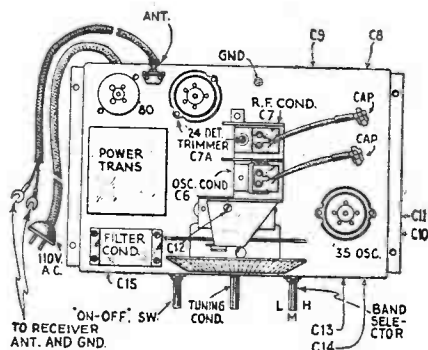
Operating voltages read to ground (except A.C. potentials), with a 115-volt line and band-selector switch in "medium" position, are as follows. Filament potential, V1, V2, 2.5 volts; V3, 5 volts. Plate potential, V1, 250 volts; V2, 170 volts. Plate current, V1, 0.1 ma.; V2, 7.5 ma.; V3, 20 ma. (total). Screen-grid potential, V1, 135 volts; V2, 75 volts. Screen-grid current, V1, .02-ma.; V2, 1. ma. Filament-to-ground D.C., V3, 275 volts. Cathode-to-ground D.C., V1, V2, 8 volts.

For purposes of reference the variable condensers in the model 10 converter are given designations as follows: C6, oscillator tuning condenser; C7, R.F. tuning condenser; C7A, R.F. trimmer; C8, coil L1A "low frequency" padder; C9, L1B "medium frequency" padder; C10, coil L2A "low frequency" padder; C11, coil L2B "medium frequency" padder; V12, "low frequency" oscillator series-aligner; C13, "medium frequency" oscillator series-aligner; C14, "high frequency" oscillator series-aligner; C15, wavetrap tuning condenser.

If low sensitivity is encountered, check the condition of the tubes in the converter and the broadcast receiver. Do not realign the model 10 chassis except as a last resort; authorized Majestic dealers and distributors are best equipped for this service. Since the converter chassis does not in itself amplify, it is necessary to maintain the receiver chassis at maximum efficiency in order to realize the desired gain in signal strength. The model 10 chassis normally is selective.

In the model 10 converter chassis there are eight alignment adjustments; each of these must be made accurately in order to obtain maximum efficiency from the converter. To align these circuits it will be necessary to use two A.F. modulated service oscillators; one, the standard 550 to 1,500 kc. broadcast type of service oscillator, and the other a special 3,000 to 16,000 kc. "short-wave" type of service

oscillator. If realignment becomes necessary, every circuit of the converter should be adjusted.



The first step in realignment is to tune the associated broadcast receiver (the I.F. amplifier portion of the complete short-wave superheterodyne) to 1,000 kc. and adjust the volume control to minimum position; then insert the receiver line plug into the receptacle provided on the converter chassis, and check the off-on switch to determine whether it correctly connects the antenna either to the receiver or the converter and at the same time controls the power line connection of the converter.

Now turn up the volume control on the broadcast receiver, adjust all the converter "padding" variable condensers C8, C9, C10, C11 and R.F. trimmer C7A to minimum position, and the series-aligners C12, C13, C14 to maximum position; then set the selector switch for "medium" range, adjust the converter tuning condenser for about 50% rotation, and connect to the input of the converter a broadcast service oscillator tuned to 1,000 kc. Turn this oscillator "on," and tune the wavetrap condenser C15 for minimum indication on an output meter.

Next, readjust the converter tuning gang to an extreme right position, loosen the set screws on the hub of the dial and adjust for alignment with the indicator and long line at the extreme left of the dial.

Except for the final step, the remaining adjustments will require the use of the

short-wave service oscillator.

Set this oscillator at 16,000 kc. (modulation off), turn band-selector switch to "high frequency" position, and rotate the converter tuning control until a beat note is heard; then, turn the modulation "on" and adjust trimmer C7A for maximum output.

Proceed to tune the service oscillator to 9,000 kc. (modulation on), and tune the converter to this frequency. Turn the modulation "off" and adjust series-aligner C14 for zero beat.

Tune the service oscillator to 8,400 kc., place the band-selector switch in "medium" position (modulation on), and with the gang condenser on the converter turned all the way out first adjust padding condenser C11, and then padding condenser C9 for maximum output.

Next, tune the service oscillator to 7,400 kc. (modulation on), and tune in this signal; and then turn the modulation "off" and adjust padding condenser C11 for zero beat.

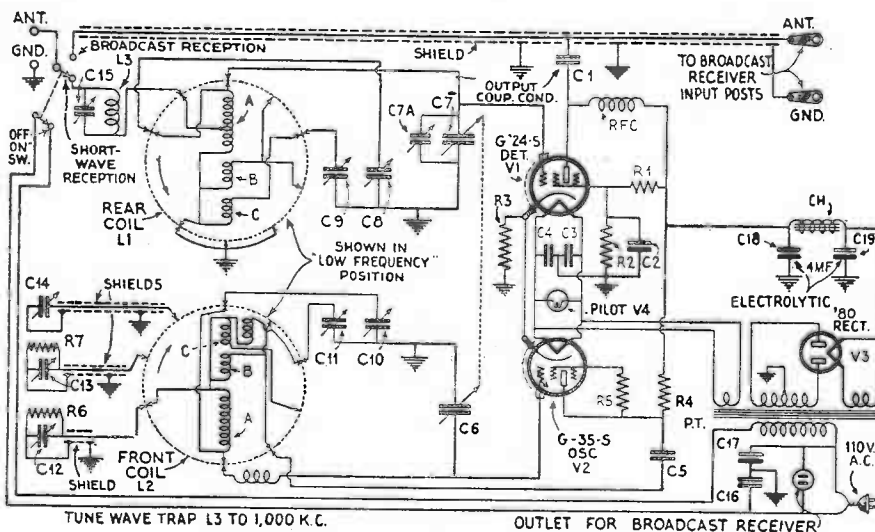
Tune the service oscillator to 4,900 kc. (modulation on), and tune in this signal; then, turn the modulation "off" and adjust series-aligner C13 for zero beat.

With the service oscillator tuned to 3,000 kc. (modulation on), and the band-selector switch in the "low" position, rotate the converter tuning condenser gang to the extreme left, and first adjust padding condenser C10 and then padding condenser C8 for maximum output.

The final adjustment requiring the short-wave service oscillator calls for a setting of 3,400 kc. (modulation on). Tune in this signal. Then, turn the modulation "off" and adjust padding condenser C10 for zero beat.

Finally, set the converter at 1.5, adjust the broadcast service oscillator for 1,500 kc. and start it operating, and adjust series-aligner C12 for maximum output.

Note that when adjusting for a peak with the modulation "on," the volume of the receiver (now the I.F. amplifier) should be kept low as possible—just enough to obtain a reading on the scale of the output meter. In this way the peak will be sharpest. Also, it will help to determine whether the signal heard is a harmonic or the desired fundamental.



# GRIGSBY-GRUNOW CO.

## MAJESTIC MODELS FAIRFAX AND SHEFFIELD 8-TUBE SUPERHETERODYNES

(Model 200 Chassis; with automatic volume control and duodiode detector)

New radio receivers are adding responsibilities to the Service Man, but if he knows his business he will experience no difficulty in clearing the normal troubles he may find in such sets. He must merely acquaint himself with the design variations of each new model. For instance, the Grigsby-Grunow Company's Majestic Model 200 chassis uses a new type of tube in the dual role of second-detector and automatic volume control. This is indicated in the schematic circuit.

The parts values are: Resistor R1, 7,000 ohms; R2, 3,500 ohms; R3, 3,000 ohms; R4, 110 ohms; R5, 180 ohms; R6, R8, R13, 0.1-meg.; R7, R9, 0.25-meg.; R10, R11, R12, R18 (manual volume control), 0.5-meg.; R14, 0.3-meg.; R15, 1. meg.; R16, 0.2-meg.; R17 (hum balancer), 20 ohms; R19 (tone control), 50,000 ohms; R20, 700 ohms.

Condensers C1, C4, 0.1-mf.; C2, C3, C5, .25-mf.; C6, C11, .05-mf.; C7, C8, C12, C-13, C14, C15, .01-mf.; C9, .03-mf.; C10,

necessary to readjust this unit unless pentode V7 is replaced.

The length of the antenna recommended for various receivers varies with the design of each model; the Model 200 chassis is designed to work best with an antenna of about 30 to 40 feet, for normal urban localities, and a somewhat greater length, up to 100 feet, in rural sections.

Due to the fact that the diode second-detector V5 also forms part of an automatic volume-control circuit, the tube ordinarily required for this service is eliminated. Since there is an A.V.C. circuit in the Model 200 chassis, and a visual tuning meter has not been provided, it is essential that stations be tuned in for maximum volume and clarity; if the tuning is slightly off the correct point, noise and poor tone will result. In fact, it is best to carefully note the dial marking while tuning in a desired program, to rock the dial back and forth until the signal drops out at equal points on either side of good reception, and then to leave the dial at a position halfway between these two settings.

Looking at the front of the set, the knob on the left controls the combined tone control ("static modifier and acoustic control") R19 and on-off switch SW-1, and the one on the right varies the manual volume control, R18. Note that the automatic volume-control action is independent of the other portions of the circuit, being adjusted to operate at a volume level predetermined in the design of the chassis. The manual volume control only varies the audio input

to the voltage-amplifier V6, and the succeeding power-amplifier pentode V7.

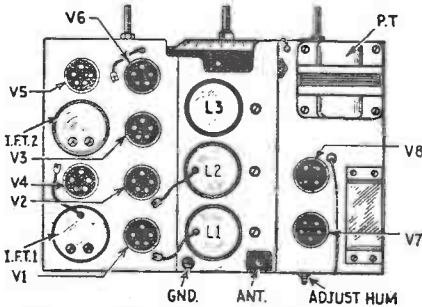
The duodiode full-wave rectifier V5 is used specifically because of its increased sensitivity over the diode (or "two-element") half-wave connection ordinarily employed, its sturdier construction, better fidelity, better definition on the higher frequencies, and its ability to handle more power. The duodiode is a full-wave rectifier, as compared to the diode, which is a half-wave rectifier.

A tone control is included in the instrument, not as a means of correcting faults in the receiver design, but to accommodate variations in conditions external to the radio set. For instance, as a means of matching the acoustic properties of the room, in order to obtain the most realistic reproduction; also, to reduce the proportion of static and background noise during local electric storms or when receiving distant programs.

The output of the oscillator is coupled into the cathode circuit of first-detector V2 by means of a small coupling coil which forms part of inductance L3.

The Model 200 chassis is used in the Sheffield Model 201 receiver and the Fairfax Model 203 receiver. The power consumption is 85 watts.

Line-filter condensers C7 and C8 prevent clicking sounds in the loud speaker when electric lights on the same circuit are turned on or off, and also reduce noises incidental to the operation of other electrical devices on the same line.



.005-mf.; C16, 50 mmf.; C17, C19, 4 mf.; C18, 500 mmf.; C20, 8 mf. Condenser C is the oscillator padding component.

The tubes specified for this receiver carry the following Majestic numbers: Type G-35-S spray shield multi-mu screen-grid tube, as R.F. amplifier V1; Type G-35-S spray shield multi-mu screen-grid tube as first-detector V2; Type G-27-S spray shield tube as oscillator V3; Type G-35-S spray shield multi-mu screen-grid tube as I.F. amplifier V4; Type G-2-S spray shield duodiode tube as second-detector and automatic volume control V5; Type G-35-S spray shield multi-mu screen-grid tube as first A.F. V6; Type G-47 pentode as second A.F. power tube V7.

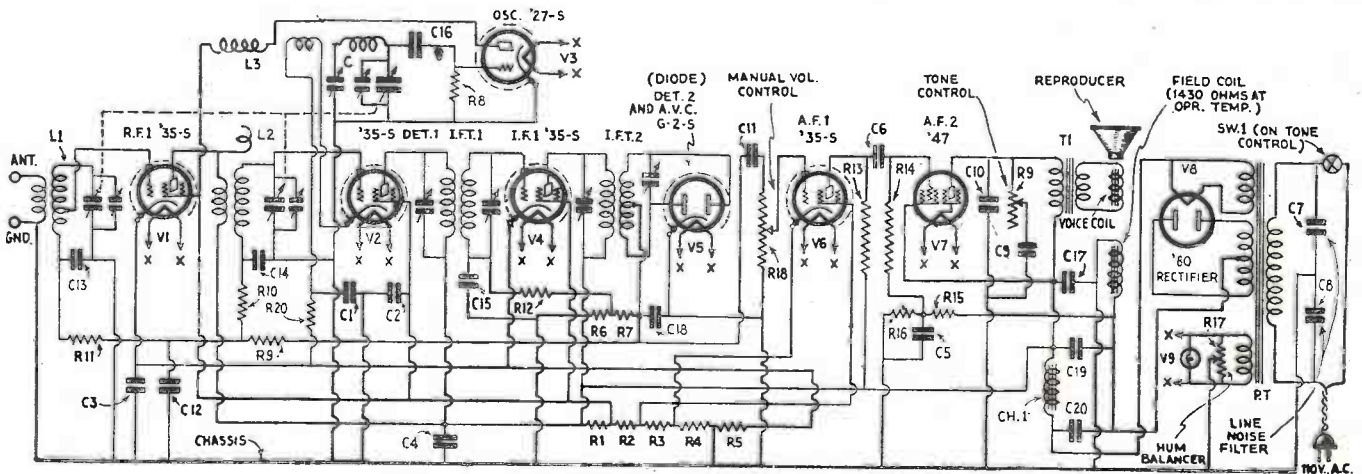
To obtain correct balance in the filament circuit, to reduce hum, there is provided a hum balancing potentiometer R17. Adjust this, right or left, by means of a screwdriver, for minimum hum. It is seldom

### MODEL 200 CHASSIS

#### TABLE OF VOLTAGE AND CURRENT READINGS

All D.C. Voltage Readings are to Ground.

Tube Purpose	Type Tube	Filament Voltage A.C.	Plate Voltage D.C.	Filament To Ground D.C.	Cathode To Ground D.C.	Plate Current M.A. - D.C.	Screen Voltage D.C.	Screen Current M.A. - D.C.
R.F. Amp.	G-35-S	2.5	255	.5	3	5.	96	1.
1st Det.	G-35-S	2.5	255	.5	11	4.	96	.4
Oscillator	G-27-S	2.5	98	.5	0	9.5	—	—
I.F. Amp.	G-35-S	2.5	255	.5	3	1.	96	.8
2nd Det.	G-2-S	2.5	0	.5	0	0	—	—
1st Audio	G-35-S	2.5	100	.5	2	2.	44	.4
Power Amp.	G-47	2.5	250	.5	—	25	260	6.
Rectifier	G-80	5.	—	290	—	75 Total	—	—



# TRANSFORMER CORPORATION OF AMERICA

## CLARION "REPLACEMENT" CHASSIS, MODEL AC-160 A.V.C. SUPERHETERODYNE

(Push-Pull Pentodes, Variable-Mu Tubes, Tone Control and A.V.C.)

Of the estimated 17 million radio sets now in use in the United States, the chassis of approximately 11 million are now obsolete, due to the rapid advance in receiver design. At the same time, the cabinets in which these chassis are housed are just as much in vogue as the day they were bought; and they still represent a considerable portion of the cost of the ensemble.

To offset this discrepancy, a western manufacturer has brought out a 10-tube superheterodyne receiver chassis, complete in every respect, and modern in design, which is to be used as "replacement" for the older set models. The diagram of this receiver, the model AC-160, is shown. The chassis is available without tubes.

The electrical values of the components are as follows: Resistor R1, volume control, 1,150 ohms; R2, tone control, 0.1-meg.; R3, 8,000 ohms; R4, 0.1-meg.; R5, 2,000 ohms; R6, 400 ohms; R7, 0.5-meg.; R8, 40,000 ohms; R9, R12, 10,000 ohms; R10, 30,000 ohms; R11, 0.2-meg.; R13, 300 ohms; R14, 700 ohms; R15, 175 ohms; R16, 2,900 ohms; R17, 4,300 ohms; R18, 3,800 ohms; R19, R20, 1,000 ohms.

Condensers C1, C2, C3, are tuning units; C4, C18, .0008-mf.; C5, C7, .02-mf.; C6, C12, C14, C21, C25, 0.1-mf.; C8, 0.7-mf.; C9, C10, C22, .05-mf.; C11, .00005-mf.; C13, .01-mf.; C16, C23, 8 mf.; C19, C20, 0.35-mf.; C24, 1. mf.

Operating voltage and current characteristics are taken with the volume control set "full on," and the "supersensitive" switch turned "to right."

Filament potential, V1, V2, V4, V9, 2.2 volts; V3, V5, V6, 2.1 volts; V7, V8, 2.3 volts; V10, 4.9 volts. Plate potential, V1, V4, 151 volts; V2, 140 volts; V3, 115 volts; V5, 192 volts; V6, 230 volts; V7, V8, 250 volts; V9, 15 volts; V10, zero. Control-grid potential, V1, V4, 0.2-volt; V2, 5.7 volts; V3, V5, V10, zero; V6, 8 volts; V7, V8, 16.5 volts; V9, 20 volts. Cathode potential, V1, V4, 3 volts; V2, 9 volts; V3, V5, V7, V8, V10, zero; V6, 15 volts; V9, 45 volts. Screen-grid potential, V1, V4, 75 volts; V2, 70 volts; V3, V5, V6, V9, V10, zero; V7, V8, 255 volts. Plate current, V1, 3 ma.; V2, 1.2 ma.; V3, 9.5 ma.; V4, 2.5 ma.; V5, 0.5-ma.; V6, 5.5 ma.; V7, V8, 27 ma.; V9, zero; V10, 47 ma.

Do not connect the ground wire to the "Ant." post unless a fixed condenser is connected in series, to prevent a burnout of the antenna coil in the event that a ground may have occurred in the power transformer.

A good ground is important to satisfac-

tory operation; selectivity and circuit stability depend upon this consideration. The ground connection is conveniently tested by grounding one side of a 110-volt lamp, noting the brilliancy when each side of the light-line is connected to the remaining lead of the lamp; a dim light indicates a poor radio ground. An entire absence of light in this test usually indicates a lack of ground at the main power transformer; in this case the local power company should be notified.

Switch SW.2 should not be thrown to the "Phono." position unless a pickup is in the circuit; otherwise, noise and fluttering will result.

Poor sensitivity may be due to mis-alignment of the tuning condensers, but the trimmers of these units should not be adjusted except as a last resort.

Since this receiver has automatic volume control, poor tone quality will result if the set is adjusted slightly off-tune. Therefore, it is recommended that the volume first be reduced to low audibility, the set tuned for a point mid-way between the two extreme dial points of reception, and then the volume brought up to normal.

Another method of checking tone quality at this point is to substitute for the regular antenna, a very short piece of wire, so that the volume control must be adjusted to the "full on" position, when the A.V.C. feature no longer holds, tuning being "peaked" as in the ordinary types of sets.

A poor type 27 tube used as the second-detector V5, or A.V.C. V9, will result in poor operation. Note that tubes unsuited to use in these positions may test "okay" on a tube checker.

In "noisy" localities it may be well to shunt the power line by a filter system of the usual type—two 0.1-mf. fixed condensers, connected in series, the two free ends connecting to the two line-leads, and the center-tap being grounded.

Due to the high audio gain of this receiver, special precautions in the design were taken to eliminate hum beyond the normal, slight degree existing in practically all sets. Consequently, should a complaint of hum arise, after eliminating the usual possible causes check the position of A.F. transformer T1. The angle of its mounting bracket has been carefully calculated to eliminate hum and if for any reason T1 must be replaced, be sure to retain the bracket and see that it is not accidentally twisted out of its original angle.

The tuning condenser nearest the front-panel is C1, followed by C2, and C3, (in this

order); the trimmer for each of these circuits is located on top of the respective tuning unit. Padding condenser C4A is located on the front skirt of the chassis, alongside unit R1-SW.2. Trimmers of the I.F. circuits are located on the left-hand side of the respective I.F. transformers, the top adjusting screw of the two being the grid-circuit tuning control; I.F. transformer I.F.T. 1 is the one nearest the front-panel.

Connect the 175 kc. service oscillator to the control-grid cap of V2, and to ground. Do not remove any of the tubes from the sockets; also, it is unnecessary to disconnect the control-grid cap connection from V2.

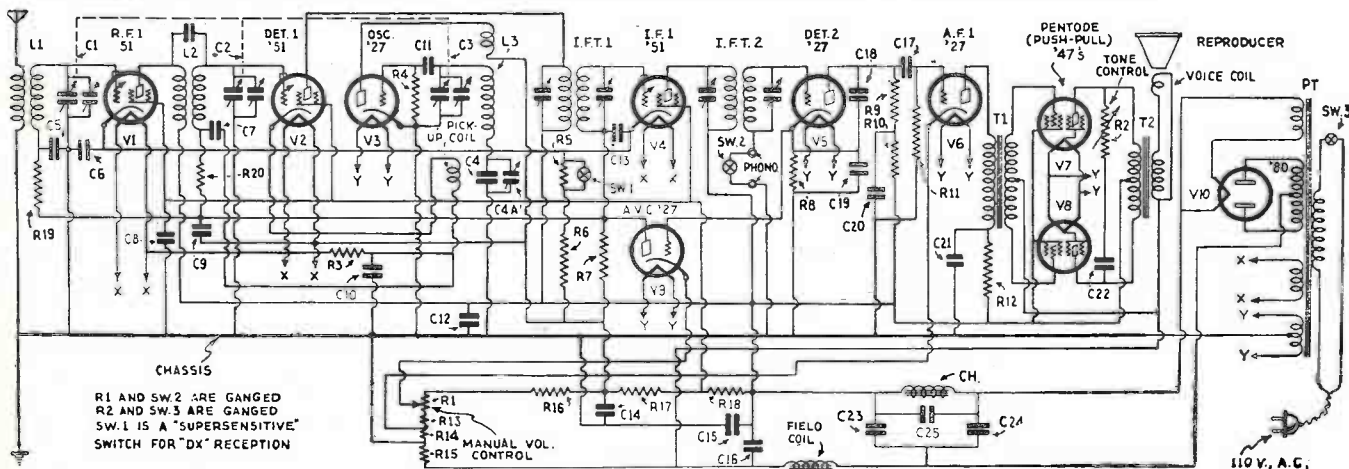
After adjusting the I.F. circuit, connect a broadcast-frequency service oscillator to the input posts of the radio set, and tune in its signal at 1400 kc. Now adjust the trimmers of C1 and C2, respectively, for maximum output.

To check the calibration of the receiver, whether it is high or low, the trimmer in shunt to C3 should be adjusted until a crystal-controlled station of known high frequency is brought in, at the correct dial marking, with peaked tuning and maximum volume. If the broadcast-frequency service oscillator is accurately calibrated, it might be used in place of the broadcast station's signal which, however, is held within about 50 cycles by reason of the crystal-control. In this adjustment a test frequency of 1400 kc. should be used. Note that at this frequency the setting of the trimmer of C3 will be exceedingly critical.

Now comes the problem of balancing the oscillator to the R.F. and detector circuits so that perfect tracking will be obtained over the entire tuning range.

Tune the external broadcast-frequency test oscillator and the receiver both to 600 kc., then slowly increase or decrease the capacity of C4A, at the same time continuously tuning back and forth across the signal with the receiver tuning condenser gang. The output meter needle will now be swinging up and down in step with the variation in tuning. Watch the peak of this swinging closely and readjust C4A until the swinging needle reaches its highest peak.

Retune the receiver and broadcast-frequency service oscillator to 1400 kc. and re-check the trimmer of C3 to make sure that the adjustment of C4A has not thrown the receiver out of calibration. Should this have occurred, readjust the trimmer of C3 until the calibration is correct, and then check on the trimmers of C2 and C1 to make sure that the adjustment of C4A has not reduced the sensitivity.



Schematic circuit, Clarion "Replacement" Chassis, Model AC-160 A.V.C. Superheterodyne. Condenser C17 is .05-mf.



# MONTGOMERY WARD & CO.

## General Description

This receiver is a 5 tube Super-Heterodyne using one 224 tube as oscillator and first detector, one 235 as I. F. amplifier, one 224 second detector, and a 247 power tube as an audio amplifier.

## The Preselector

The primary winding is on a small bobbin inside the coil form. This winding is concentric with the secondary winding with resulting inductive coupling. Capacitive coupling is obtained by an extra turn of wire connected to the primary and wound on the coil form alongside one end of the secondary winding.

The second transformer in the preselector unit is coupled by a very small primary connected directly to the secondary of the first transformer. The secondary of the second transformer is tapped, the tap connection going to the grid of the 224 1st detector.

## First Detector and Oscillator

The first 224 tube functions both as an oscillator and the 1st detector. Referring to Fig. 1 there are four coils shown to the right of this tube, all of these coils being in an inductive relation. These coils and the two I. F. tuning condensers make up the oscillator first I. F. assembly.

The first 224 tube is of the bias type. Bias voltage for this tube is established by the plate current returning to the cathode through the 3,000 ohm resistor. This resistor is bypassed with a .01 Mfd. condenser. The bias voltage is influenced to some extent by the oscillatory current and will vary within a range of about  $\frac{3}{4}$  volt, depending on the frequency setting to which the receiver is tuned.

## Power Supply

The power system consists of a power transformer, two filter condensers, a voltage divider resistor and the speaker field which serves as the filter choke. This field is connected between the positive side of the two filter condensers. The voltage divider resistor is tapped to secure the required grid, plate and screen voltages.

## Method of Aligning

These receivers are aligned on an oscillator at the factory, so that only in rare cases will you find the condensers need realigning. If you are quite sure the condensers are out of alignment, then proceed as follows:

Tune in a local station at approximately 1400 Kilocycles. Tune in the station selector knob until you have the signal tuned exactly in resonance, or in other words "right on the head." Then adjust the volume control for average room volume. Turn to Figure 2 of this manual and adjust the trimming condenser of the R. F. stage condenser slowly to the right or left until the signal is at maximum. Adjust the detector trimmer in the same manner. These adjustments will align the receiver perfectly in most cases. However, if the receiver still lacks volume or sensitivity, the oscillator adjustment may be checked by turning the trimmer located on top of the oscillator condenser to the right or left, not more than one-third of a turn from its present setting. This adjustment is very critical so that extreme care should be taken in order not to throw the oscillator adjustment completely out of alignment. The station selector knob may then be turned to a local station of approximately 600 Kilocycles, and the 600 Kilocycle oscillator trimmer carefully adjusted, a half turn in either direction until the maximum signal is obtained.

## No Signals

Under this condition, first test all tubes either in a tube tester or by replacing each tube in the set with a new

The 1400 K. C. trimmer condenser is located on top of the tuning condenser and is connected across the oscillator tuning condenser. The 600 K. C. trimmer condenser is connected between the coil and the tuning condenser. The adjusting screw is in back of the tuning condenser on top of the chassis.

## I. F. Amplifier and Volume Control

A 235 tube is used as the I. F. amplifier. Bias voltage for this tube is variable and depends on the setting of the volume control arm. As indicated in Fig. 1, the resistance between the cathode and ground will vary between 350 and 8,350, depending on the setting of the arm.

## Second Detector

A 224 tube is used as the 2nd detector or demodulator tube. This detector is also of the bias type. The tube is self-biased, the bias voltage being obtained by connecting the cathode through a 100,000 ohm resistor to the low potential end of the voltage divider resistor. Bias voltage for the detector in this case is established by the difference in drop across the 100,000 ohm resistor and the 300 ohm section of the voltage divider since these two voltages are in opposition with reference to the detector cathode.

## Audio System

The audio stage is resistance coupled to the 2nd detector. The .001 Mfd. condenser in the plate circuit of the 2nd detector and the 60,000 ohm resistor acts as an I. F. filter.

A 400,000 ohm grid leak resistor is used in the grid circuit of the 247. Bias voltage for this tube is obtained by connecting the grid through the grid leak resistor to the low potential end of the voltage divider resistor.

one. The 224 used in the first detector and oscillator stage is very critical and if this tube does not oscillate properly the receiver will be absolutely dead. Try a number of 224's in this position. Check the aerial and ground connections. Also see that the wall plug is making contact and that all of the tubes light. Look at the 280 rectifier tube. If the plates are red hot or heating badly this is an indication of a shorted filter condenser. Take all of the voltage readings as shown on the voltage chart and check any particular part of the circuit which does not give the proper voltage readings.

## Weak Signals

Weak signals may be due to defective tubes, poor antenna or ground installation, grounded antenna system or an antenna erected in a shielded location. Try the set on another antenna. Check the tubes carefully. Take the voltage readings of the set and compare them with the readings given in the voltage chart. Also test the field, voice coil and output transformer of the speaker for open circuit. Check the alignment as described under "Method of Aligning."

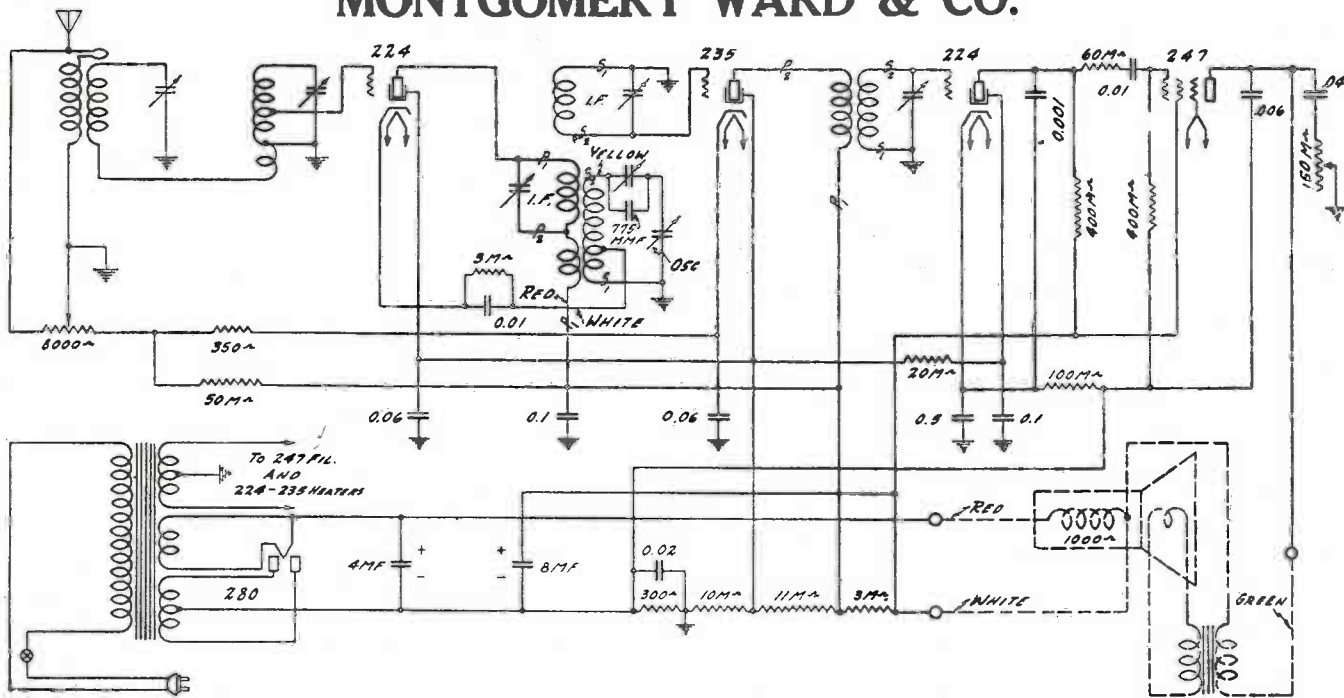
## Broad Tuning

Poor selectivity is usually due to the antenna and lead-in being too long. Shorten the antenna. In some localities an antenna and lead-in of twenty-five to thirty feet is sufficient. Test all of the tubes. If the receiver still lacks selectivity carefully check the alignment as described under methods of aligning.

## Oscillation

Oscillation may be due to a defective 224 or 235 tube, an improperly grounded chassis or a shield that is not properly grounded, an open .01 or .06 by-pass condenser, or to high line voltage. The remedy in each instance is of course to replace the defective part. In the case of high line voltage, use one of our voltage regulators.

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DOTTED LINES SHOWN ARE IN SPEAKER

Figure 1—Schematic Diagram

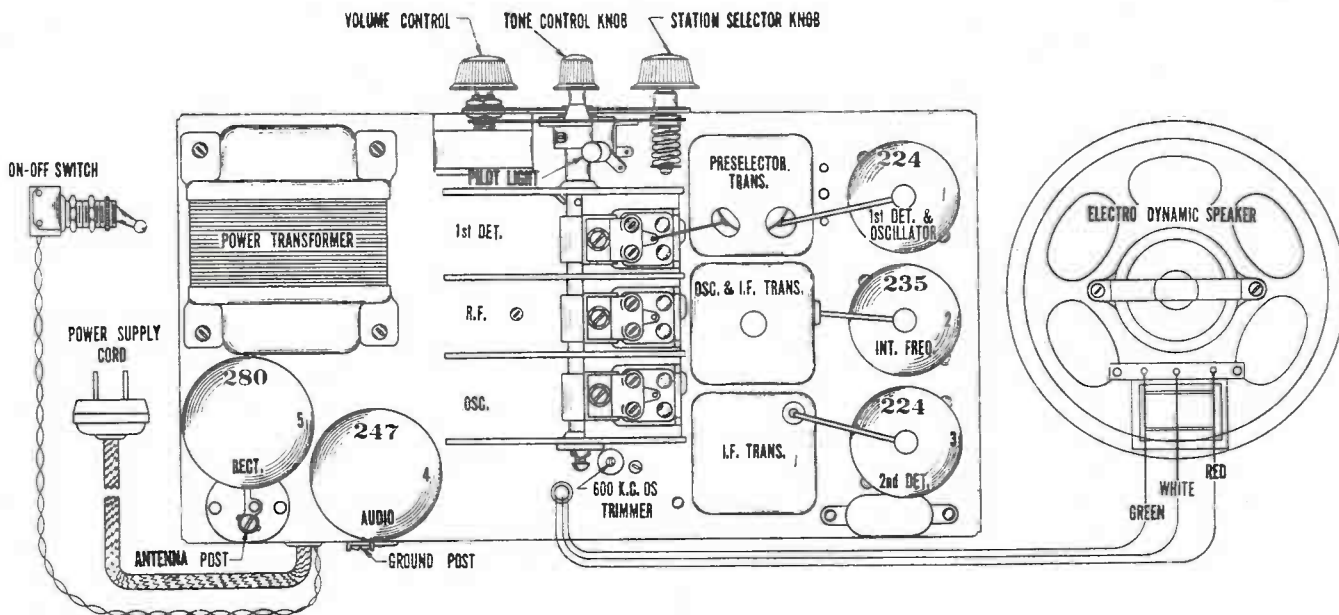


Figure 2—Top View of Chassis

## Voltage Chart for Nos. 16, 18, 13 and 15 Chassis—Voltages at Sockets

LINE VOLTAGE 115—VOLUME CONTROL AT MAXIMUM

Type of Tube	Position of Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
224	1	1st Det. & Osc.	2.25	165	4.5—5.25 <sup>(1)</sup>	65	.4	4.5—5.25 <sup>(1)</sup>	1.3	2.0
235	2	I. F.	2.25	165	2.5	65	1.5	2.5	6.4	7.4
224	3	2nd Det.	2.25	128	6.5	60 <sup>(2)</sup>	.05	6.5	.22	.23
247	4	Audio	2.25	205	16. <sup>(3)</sup>	225	8.0		29.	33.
280	5	Rect.	4.9						27.	
									Per Plate	

(1) Varies with frequency setting of dial approximately as shown.  
 (2) Voltage as measured with 600,000 ohm meter.  
 (3) Measured across 300 ohm section of voltage divider resistor.

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## Important Notice

Two entirely different chassis were supplied to the Retail Stores under the name "Grenadier." Each chassis, however, has a different Catalogue number and should be distinguished from this number. The Grenadier No. 62-12 uses the U. S. Radio 8 tube chassis and is exactly the same as our Nos. 1238 and 1838. Therefore, when servicing or ordering repair parts for the Grenadier No. 62-12, use the No. 1238 and 1838 service manual. Grenadier No. 62-14 (Catalogue No. 62-11) is the Wells-Gardner 8 tube chassis which will be described in this service manual.

## General Description

The tubes used are as follows: R. F. 1st detector, and intermediate stages, '35 vari-mu; oscillator '27; 2nd detector and automatic volume control tube, '24 screen grid; audio, '47 pentode power supply rectifier, '80.

The chassis has one stage of radio frequency amplification, a first detector (mixer), an oscillator, one stage of intermediate frequency amplification, a second detector, one stage of audio frequency amplification, an automatic volume control system, and a power supply. The intermediate stage operates at a frequency of 175 kilocycles. All stages are transformer coupled with the exception of the audio stage which is resistance coupled to the second detector.

The antenna (R. F.), 1st detector and oscillator stages are tuned simultaneously by a three gang condenser operated by a knob on the receiver panel. Trimmer condensers are provided so that the gang may be accurately and permanently aligned.

The primary and secondary of both intermediate transformers are tuned with adjustable condensers which remain fixed after the transformers have been tuned to exactly 175 kilocycles.

## Power Supply

The 25 and 60 cycle power transformers have been designed to supply the tube voltages necessary for operation on any 95 volt to 130 volt A. C. supply, without adjustment or overloading.

The R. F., 1st detector, oscillator and 1st I. F. tubes have one side of their heater circuit grounded.

## Dynamic Speaker

The dynamic speaker is especially designed for use with these chassis. The speaker field is used as a choke in the power supply and the voice coil is designed to permit faithful reproduction of all audio frequencies. The voice coil and speaker frame are grounded to prevent any "feedback" of a 175 K. C. frequency which might enter the speaker.

## Condensers and Resistors

The blue lead on the filter block is common for condensers C4, C5, and C16, and the black lead is common for condensers C3, C15, C16, and C17. The second detector plate filter choke is also contained in the block and is connected by two yellow leads C8 (White-red leads) and C10 (red leads) are connected as shown in Fig. 1, Schematic Wiring Diagram.

## Testing

(Tube and Voltage Tests)

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing

The oscillator has an adjustable tracking condenser which is adjusted at 600 kilocycles and remains fixed thereafter.

## Automatic Volume Control (A. V. C.)

The action of the A. V. C. tube controls the grid bias on the R. F., 1st detector, and 1st I. F. tubes and consequently the amplification of those tubes.

A signal of sufficient strength reaching the second detector, applies a voltage on the grid of the A. V. C. tube and the voltage thus applied depends upon the signal strength.

The plate of the A. V. C. tube will draw current when the grid voltage of the tube rises in potential and the drop in plate voltage is applied to the grids of the R. F. tubes, through their grid returns to the plate of the A. V. C. tube. This results in a control of the amplification of those tubes and a practically constant receiver output.

The manual volume control (R18, Fig. 1), sets the A. V. C. grid voltage at a point where only a signal of sufficient strength will cause an increase in grid potential.

## Resonance Meter

This meter is a small milliammeter in the plate return of the R. F. tube. When the receiver is turned on, and no signal is tuned in, the meter will indicate the total plate current drawn by the R. F. tube. When a signal is tuned in, the meter will indicate less current, and when tuned to resonance, the greatest swing (or least deflection), of the meter hand will be obtained.

The deflection of the meter hand will vary according to the setting of the manual volume control on this chassis

the receiver in any other manner. Weak or defective tubes should be replaced.

## Method of Aligning

These chassis will only lose their alignment when they have been subject to extremely rough handling or have been used under abnormal conditions, as for instance, a very hot or very humid location. Under any one of these conditions, the alignment may shift slightly and the chassis should be realigned according to the following procedure.

Tune in a local station of approximately 1400 Kilocycles, being very careful to tune this station in at the exact resonance point. This may be easily done by carefully adjusting for maximum deflection of the tuning meter. Then reduce the volume to the desired level. Turn to Figure 2 and note the position of the first radio frequency trimmer adjustment. Slowly turn the trimmer to the right or left until the signal is at maximum intensity. Proceed to adjust the detector trimmer in the same manner. In most instances these two adjustments will align the chassis perfectly. If the receiver still lacks sensitivity after the first RF and detector trimmers have been adjusted, then the oscillator trimmer may be checked by turning the adjusting screw not more than a quarter of a turn to the right or left of its present adjustment. When aligning any of these receivers be sure that the condenser shield is firmly in place and that you are using good tubes in the chassis. This is particularly true in case of the oscillator and automatic volume control tube.

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## Oscillator

Let us again call your attention to the importance of the oscillator tube. A 227 tube used in this socket that does not oscillate will completely stop any signals from reaching the intermediate frequency amplifier and the chassis will not operate. There is also a slight variation in the characteristics of tubes, and for this reason it is advisable to try a number of tubes in the oscillator position and to use the one which gives the most satisfactory performance.

## Automatic Volume Control Tube

The automatic volume control tube is equally as important as the oscillator tube. In this chassis a 224 is used. If the A.V.C. tube's characteristics are not exact, it will cause the chassis to lack sensitivity or spoil the tone quality. The tuning meter will not function properly with a poor A.V.C. tube. If the grid circuit of this tube is open the chassis will lose its sensitivity and in some cases will not pass signals. In each installation, therefore, it is advisable to try a number of 224's in the automatic volume control position and use the tube which gives the most satisfactory performance as to control of volume, operation of tuning meter, and tone quality.

## Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating

conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

## 25 Cycle Chassis No. 62-14X

The 25 cycle receivers use power transformer No. P50540 instead of P50539. Two 8.0 mfd. electrolytic condensers No. P80880 are used instead of No. P80873 and No. P80874. The .25 mfd choke condenser C10 is not used in the 25 cycle chassis.

## Voltage Readings

The voltage readings on this chassis cannot be taken in the conventional way, namely between the tube elements and ground. You will note from diagram Figure No. 1, that the ground connection is taken off the shunt resistor near to the positive end, and the chassis is therefore, approximately 150 Volts positive, with respect to the tube elements. The correct voltage readings may be obtained by taking readings to the cathode of the heater type tubes, and filament of the 247.

REMEMBER:—Voltage measurements will vary slightly with the different sets of tubes, and also with different chassis. Unless the voltages are radically different from normal, they may be considered satisfactory.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

TUBE	CIRCUIT	LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
R.F. '35	Screen grid	70	78	85	92	100
	Plate	143	159	175	191	207
1st Det. '35	Screen grid	70	78	85	92	100
	Plate	143	159	175	191	207
I. F. '35	Screen grid	70	78	85	92	100
	Plate	143	149	175	191	207
Oscillator '27	Plate	70	78	85	92	100
2nd Det. '24	Screen grid	66	73	80	87	94
	Plate	127	134	141	148	155
A. V. C. '24	—Grid grid	14	15.5	17	18.5	20
	Screen	24	26	28	30	32
Audio '47	Accel. Grid	199	221	244	267	289
	Plate	171	190	210	230	250
Rectifier '80	Current (both plates)	67 MA	75 MA	82 MA	89 MA	96 MA
	Plate to Plate Voltage	512	569	625	682	739

The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

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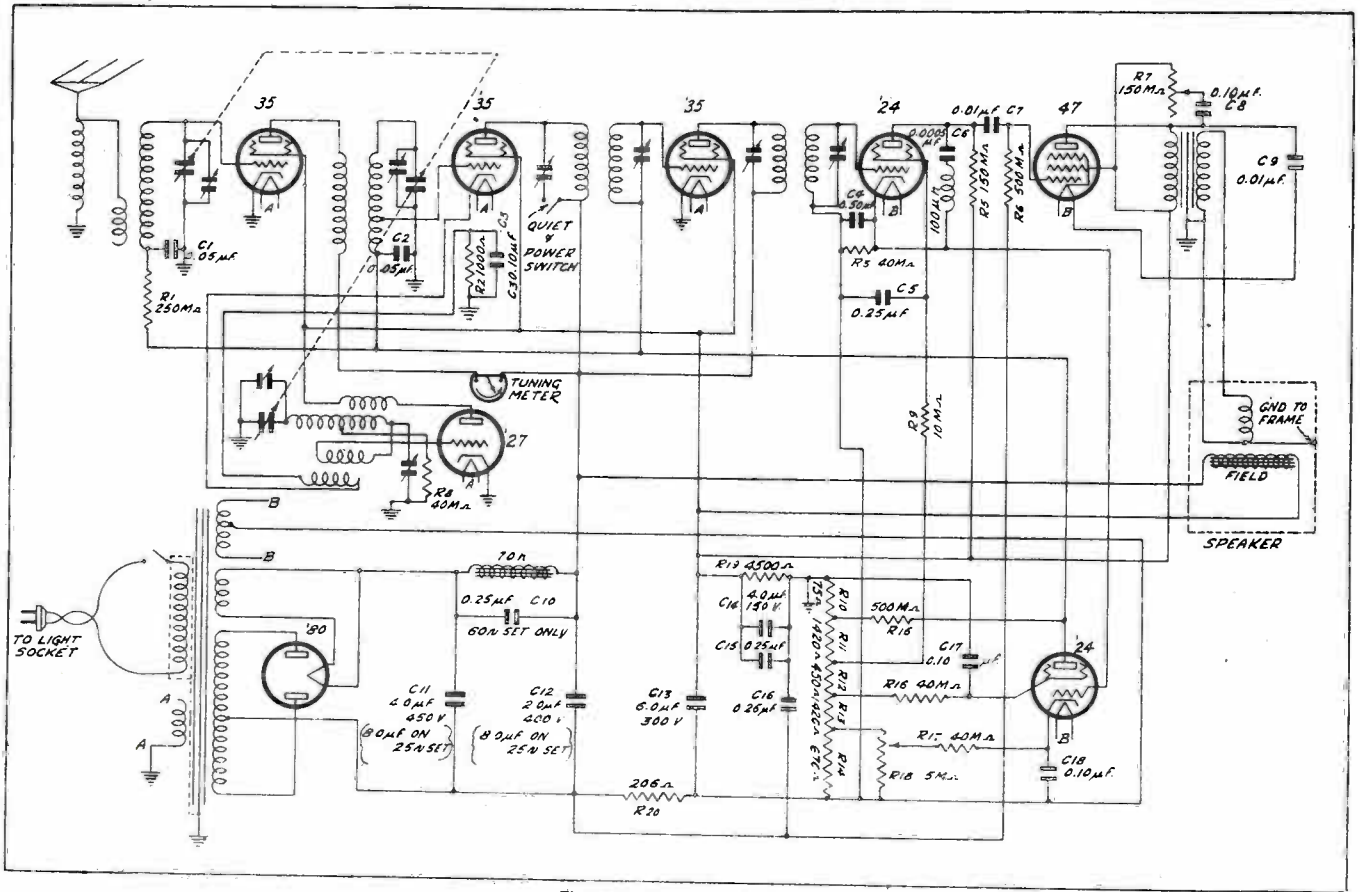


Figure 1—Schematic Diagram

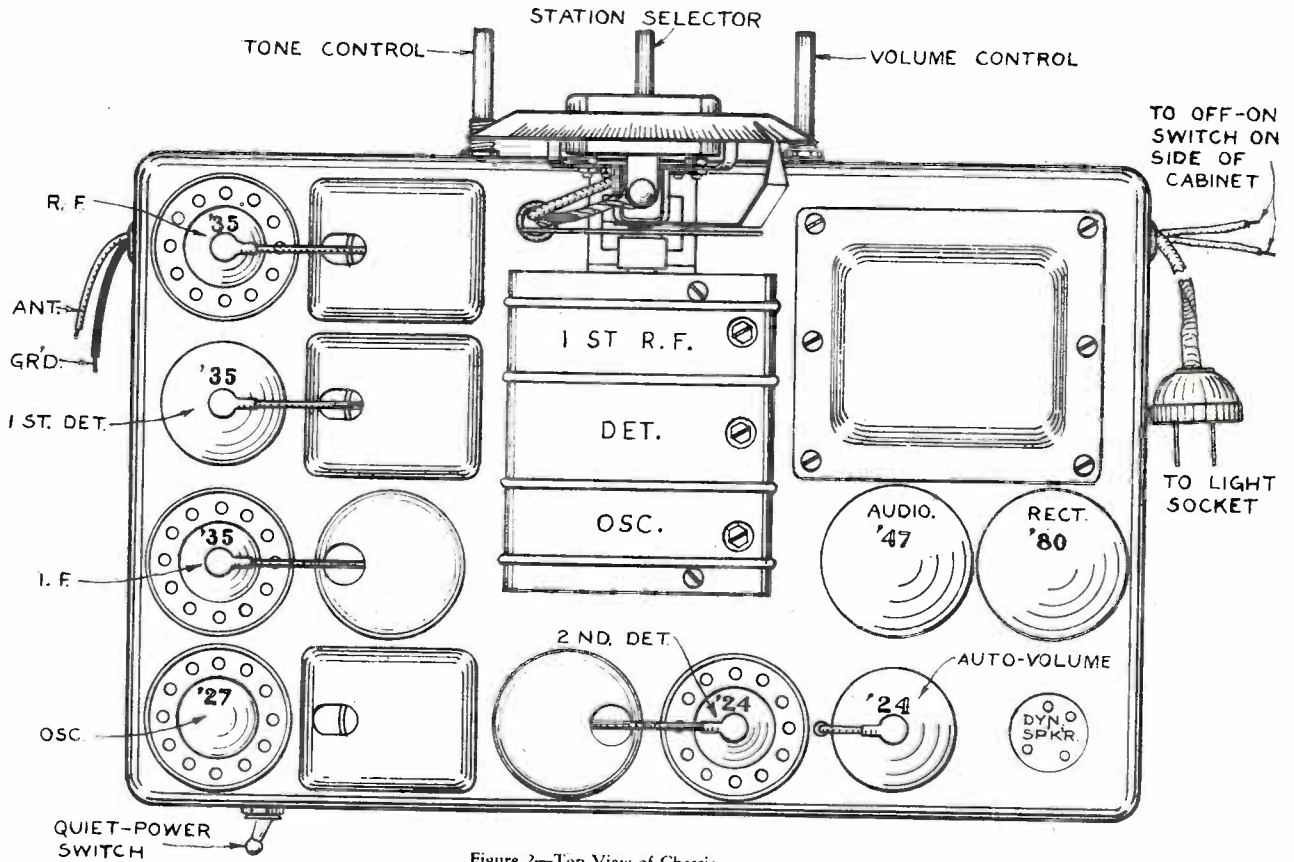


Figure 2—Top View of Chassis

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## Service Manual Supplement Showing Automatic Volume Control Change in Airline 8 Tube Screen-Grid Superheterodyne

"Grenadier" No. 62-14

(Catalogue No. 62-11, 62-27, 62-19)

The automatic volume control system in this chassis has been changed and therefore some of the parts are not as listed and described in the service manual. The parts which differ are listed below and the revised automatic volume control circuit is shown in the schematic wiring diagram on the opposite side of this sheet. No other changes in the circuit or in the mechanical arrangement of the chassis have been made.

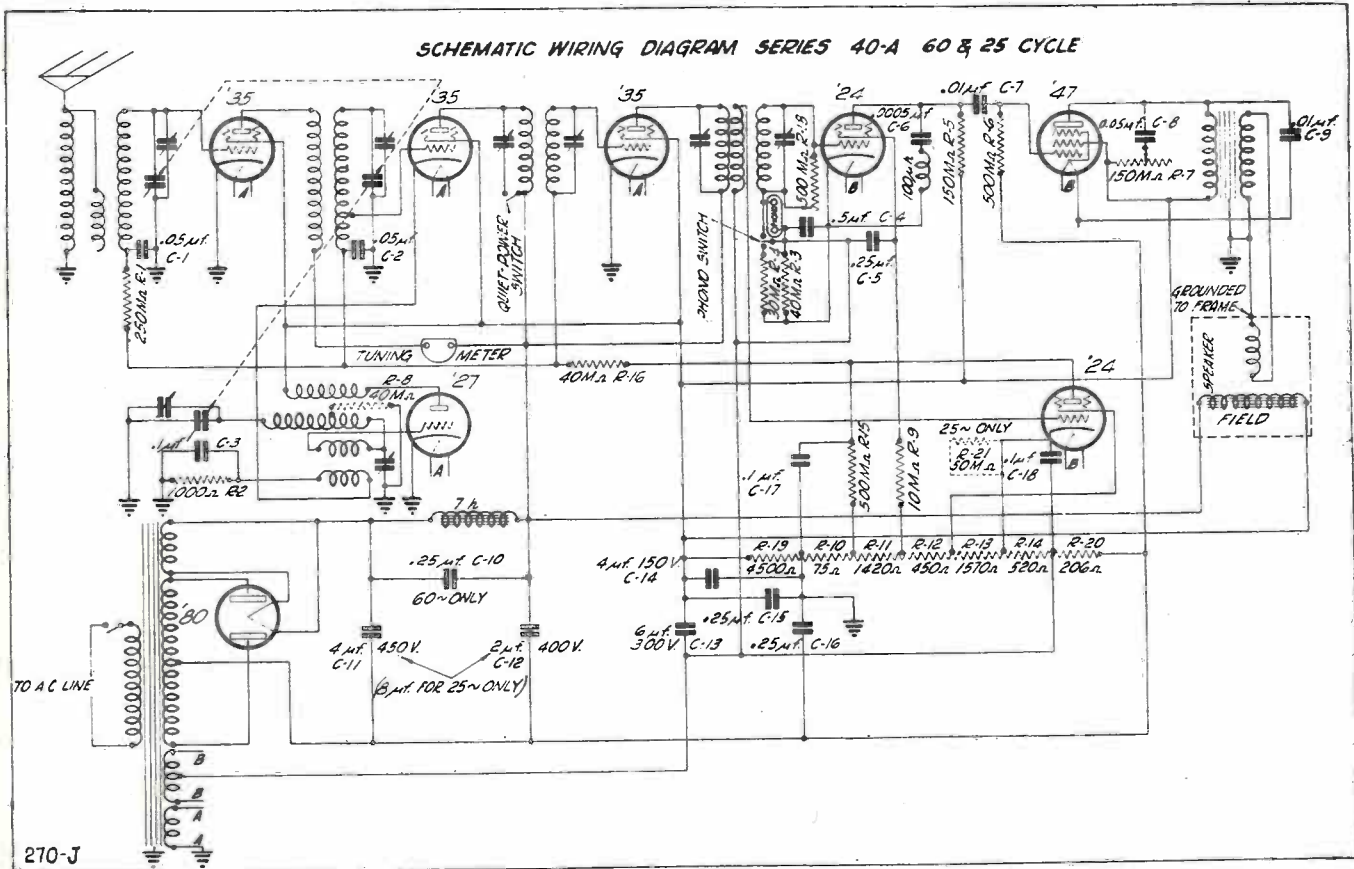
A chassis in which the automatic volume control system has been changed may be identified by a green paint mark on the left rear corner of the chassis near the speaker socket, or by two grid leaks brought out of the top of the 2nd I.F. transformer assembly. This chassis formerly had but one lead brought out of the top of the 2nd I.F. transformer assembly. The resonance meter furnishes a further means of identification as the deflection of the meter hand will not vary when the setting of the manual volume control is changed. This is due to the manual volume control having no effect on the action of the automatic volume control tube. The manual volume control is connected in parallel in the grid circuit of the 2nd detector tube and is used to vary the resistance in that circuit and, in so doing, control the input to that tube.

The following parts are for use only in a chassis having the revised automatic volume control system and are not interchangeable with those listed in the service manual repair parts list.

When ordering parts for replacement, be sure the correct part number is given.

Part No.	Name	Cost Price	Selling Price
P-90988-A	Candohm Resistor	\$0.38	\$0.95
P-90988	500,000-ohm Volume Control	.30	.75
P-1446	2nd I.F. Transformer Assembly	.70	1.75
P-70719	Shielded Volume Control Wire Assembly	.06	.15
P-1445	R.F. Interstage Coil Assembly	.37	.93

(The 40,000-ohm Resistor, R16, is a part of this assembly. The 500,000-ohm Resistor, R15, is a part of the R.F. Interstage Coil Assembly (Part No. 1397) listed in the service manual.)



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## Seven Tube Screen-Grid Super-Heterodyne Receiver

60 Cycle Chassis, No. 62-22, No. 62-30 (Catalogue No. 62-21)

25 Cycle Chassis, No. 62-22X, No. 62-30X

### General Description

The complete circuit consists of an oscillator first detector unit in which the local signal is generated and combined with the R. F. signal to form the intermediate or beat frequency; the I. F. amplifier, the second detector or demodulator, the A. V. C. and localizer, the A. F. amplifier and the power system.

### Tubes

A 235 tube is used in the first R. F. stage; a 224 as first detector and oscillator; a 235 in the I. F. stage; a 227 as second detector; 247 audio; 224 A. V. C.; and a 280 rectifier.

### RF Amplifier

The R. F. amplifier consists of a R. F. or antenna input transformer with tuned secondary feeding into a 235 R. F. amplifier tube. This is followed by another R. F. transformer with tuned secondary feeding into the first detector. The .5 Mfd. condenser in the grid circuit of the 235 R. F. tube tends to prevent an over-all motor boating action. The 3000 Ohm resistor and a .1 Mfd. bypass condenser in this grid circuit prevents any tendency toward R. F. oscillation. In chassis with serial numbers above 1,070,000, the 3000 Ohm resistor is replaced by a 5 M. H. choke.

### A.V.C. and Localizer

Briefly stated, the A. V. C. reduces the signal strength by increasing the bias voltage on the R. F. and I. F. 235 tube when a signal of given intensity or greater is applied to the grid circuit of the second detector. The localizer regulates the initial A. V. C. bias voltage so that plate current does not start to flow in this tube until a signal of given intensity or greater is applied to the second detector grid circuit. A 224 tube is used as the A. V. C. The importance of the localizer is that it controls the point at which the automatic volume control action commences. Since the second detector plate current will vary with tubes, it is obvious that with a fixed resistor in the cathode circuit, the drop across this resistance will vary, thus changing the A. V. C. grid voltage with resulting change in operating point. The purpose of the localizer is to compensate for different 227 tubes used in the second detector stage so that the A. V. C. will operate at maximum efficiency. To properly adjust the localizer—

1. Turn the knob to the extreme counter-clockwise position. Then turn this knob about a quarter turn in a clockwise direction. Next tune in a fairly strong station and reduce the volume by means of the volume control knob on the front panel to ordinary room volume.
2. Turn localizer knob to extreme clockwise position. In most cases the signal will be cut off entirely.
3. Turn localizer knob in counter-clockwise direction slowly, until the signal is again received with satisfactory volume.
4. The above adjustment is correct and should not be changed. If the localizer knob is adjusted too far in a clockwise direction, the A. V. C. starts to work too soon and cuts down the signal before maximum output is reached. If the localizer is adjusted too far in a counter-clockwise direction,

### First Detector Oscillator

The first 224 tube functions both as an oscillator and first detector. Bias voltage for this tube is established by the plate current returning to the cathode through the 3200 Ohm resistor. This resistor is bypassed with a .01 Mfd. condenser. The bias voltage is influenced to some extent by the oscillatory current and will vary within a small range, depending upon the frequency setting of the receiver.

### IF Amplifier

The I. F. amplifier is tuned to a frequency of 262 Kilocycles. A 235 tube is used. Bias voltage for this tube is varied by the action of the automatic volume control.

### Second Detector

A 227 detector tube is used and is of the bias type. Bias voltage is obtained by a drop established across the 120,000 Ohm cathode resistor and the portion of the 200,000 Ohm localizer resistance being used. The grid of the second detector is connected to the high potential end of the speaker field and the bias voltage is determined by the difference in potential between the grid and cathode of this tube.

the A. V. C. does not start to work soon enough, and a very strong signal is then necessary in the second detector to cause the A. V. C. to operate.

### Servicing

In every instance check the line voltage before installation, and in any cases where the line voltage is found to be over 115 Volts, use one of our line voltage regulators. In servicing, always check the tubes first. In this receiver, the 224 used in the A. V. C. and the 224 used as the detector and oscillator are the most critical. A poor 224 A. V. C. will cause lack of volume, distorted tone and in many cases no control of volume. Always bear in mind that in any superheterodyne that is inoperative, check the oscillator tube first. No signals of any kind will be received if this tube is not oscillating properly.

Poor tone quality is usually due to a defective A. V. C., second detector or audio tube. If changing these tubes does not remedy the condition, check the voice coil of the speaker for proper clearance and alignment.

Hum is usually caused by a defective filter condenser, open .1 Mfd. choke tuning condenser, improperly grounded chassis or shields, mechanical hum due to the vibrating of the core of the power transformer or filter choke, external pickup from the antenna, or an open grid circuit.

Noisy operation is due to noisy tubes, loose connections, leaky filter or bypass condensers, poor aerial and ground connection, aerial grounded on eaves, trees, etc., speaker voice coil off center, broken or cracked resistors, dirt in the variable condenser, or partial short of the trimming condenser.

Oscillation is caused by open bypass condenser, poorly grounded shield or chassis, dirt on the spring contacts connecting to the rotor shaft of the gang condenser, tubes of high mutual conductance, high line voltage or improperly placed grid cap leads.

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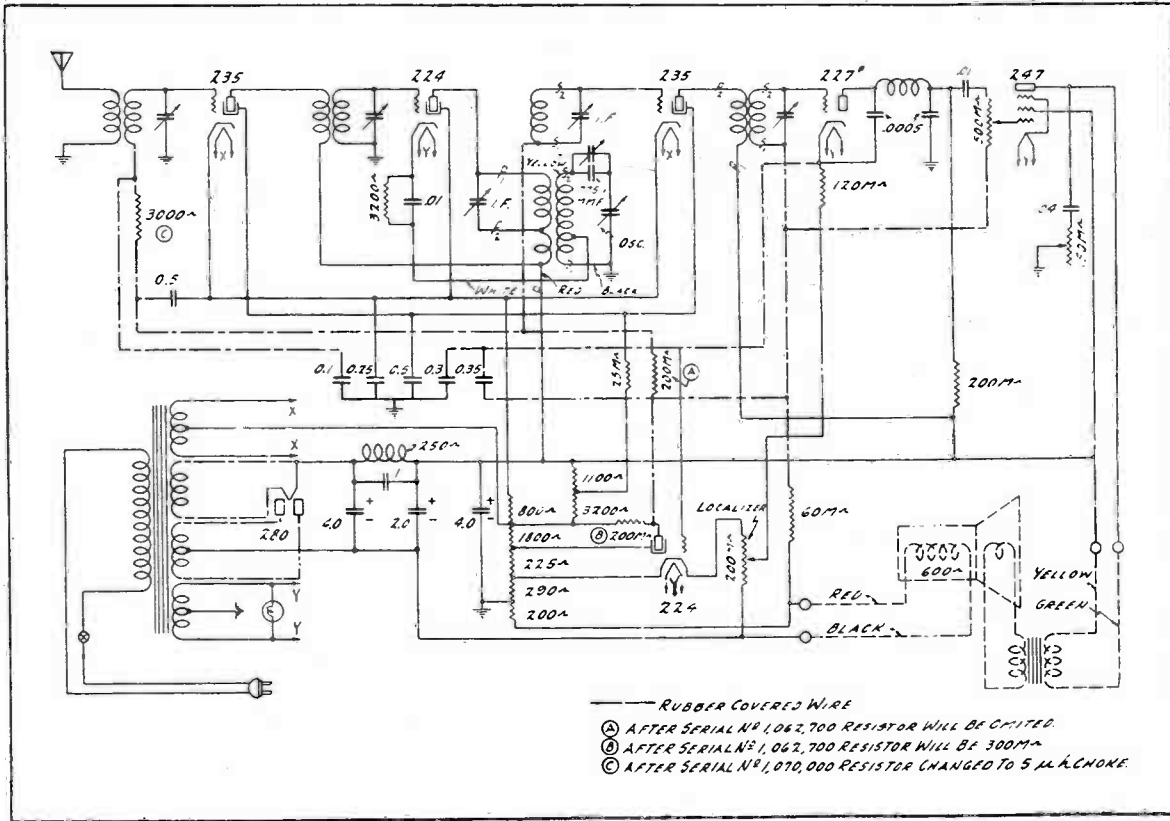


Figure 1

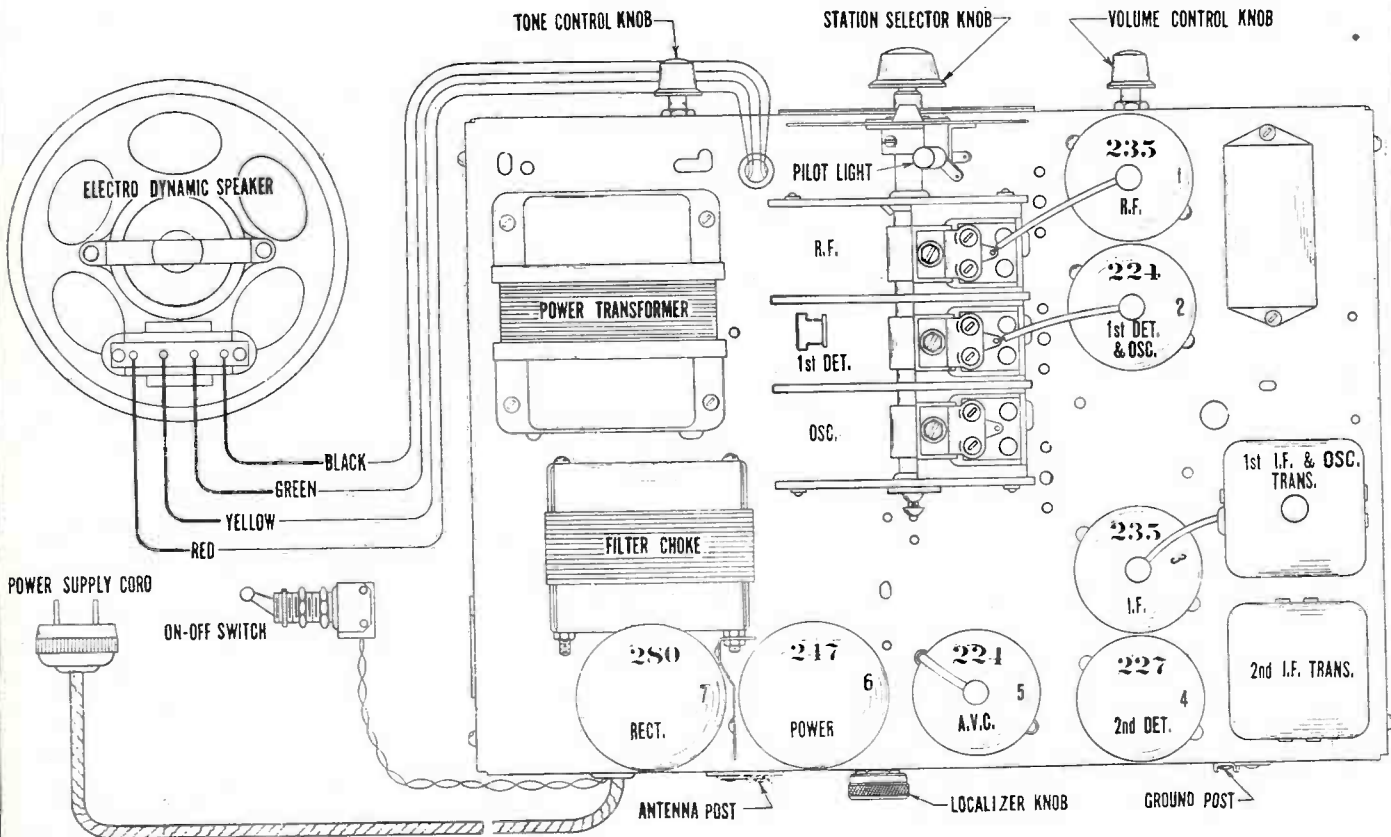


Figure 2—Top View



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No. 62-22, 62-30, 62-21 CHASSIS—VOLTAGES AT SOCKETS  
—LINE VOLTAGE 115 VOLUME CONTROL AT  
MAXIMUM — LOCALIZER AT NORMAL  
SETTING

Type of Tube	Position of Tube	Function	Across Filament or Heater	Plate to Cathode	Grid to Cathode	Screen to Cathode	Screen MA	Cathode Heater	Plate MA	Grid Test MA
235	1	R. F.	2.35	150	4.5 <sup>(1)</sup>	70 <sup>(2)</sup>	9	4.5	2.7	4.2
224	2	1st Det. & Osc.	2.35	245	6.4	93	3	6.4	1.8	2.6
235	3	I. F.	2.35	150	4.5 <sup>(1)</sup>	70 <sup>(2)</sup>	9	4.5	2.7	4.2
227	4	2nd Det.	2.35	150	12—24 <sup>(3)</sup>	0—10 <sup>(3)</sup>	0	12	2—5 <sup>(3)</sup>	21—51 <sup>(3)</sup>
224	5	A.V.C.	2.35	60	0—15 <sup>(3)</sup>	9	0 <sup>(4)</sup>	0	0 <sup>(4)</sup>	0 <sup>(4)</sup>
247	6	Power	2.35	220	10 <sup>(5)</sup>	240	6.4		34	40
280	7	Rect.	4.9						39	
										Per Plate

(1) This voltage read across 800 ohm resistor.  
 (2) Voltage as read with 500,000 ohm meter.  
 (3) Varies with setting of localizer. Voltages read with high resistance meter.  
 (4) Current zero with no signal and localizer at normal position.  
 (5) The voltage read across 200 ohm section of voltage divider.

## Aligning

The method of aligning this receiver is fully explained Page 5 of the Grenadier No. 62-14 service manual.

## Voltages

To properly read the voltages disconnect the antenna and ground and be sure the tube shield is in place. When reading the voltages of tubes under the shield, the shield should be substantially on to prevent oscillation. The cable to the plug can be brought up under the shield. Care should be taken that the grid connection on the plug is not shorted to the tube shield. All voltages in the chart are taken with a line voltage of 115 Volts. Variations in readings will be introduced by variations in line voltage. All of the readings are taken with the localizer knob in its normal position. Its position will vary somewhat however, and will determine the voltage of the A.V.C. grid and second detector cathode. All voltages associated with these points therefore, will vary and are shown that way in the voltage chart, with the exception of the second detector plate voltage. The 235 and 247 grid voltages cannot satisfactorily be read at the sockets and are therefore taken across the resistors at which they are developed.

## 25 Cycle Chassis

The 25 cycle chassis uses a 25 cycle power transformer, a 4 Mfd. filter condenser in place of the 2 Mfd. and a .35 Mfd. choke tuning condenser in place of the .1 Mfd. choke condenser used in the 60 cycle chassis. All other parts remain the same.

# MONTGOMERY WARD & CO.

## General Description

### Circuit

This chassis has one stage of radio frequency amplification, a combined detector and oscillator, one stage of intermediate frequency amplification, a second detector, and one stage of audio frequency amplification. The intermediate stage operates at a frequency of 175 K.C. All stages are transformer coupled with the exception of the audio stage which is coupled to the detector by a choke, condenser and resistor network.

The plate choke in the oscillator circuit has been substituted for the 15,000 ohm resistor to allow wider limits on the tube used in this circuit.

The complete chassis is mounted on rubber to prevent any vibration being transmitted to the tubes.

### Tubes

Type '32 tubes are used in the R.F., 1st detector, intermediate, and second detector stages. The audio output tube is a type '33 pentode.

### Controls

The right hand knob on the panel adjusts the volume control, the center knob controls the tuning and the left hand knob the filament switch.

### Output System

The .006 mfd. condenser connected from the plate of the pentode tube to ground is there for two reasons,—one, to prevent any I.F. or harmonic of the intermediate frequency from getting into the speaker and possibly coupling back into the antenna to cause a squeal; two, to put the proper amount of capacity across the speaker winding to produce a pleasing tone quality. This condenser may be varied to any value from .002 mfd. to .006 mfd. without losing its effectiveness in preventing the I.F. from getting into the speaker.

Poor sensitivity and selectivity are indicative of misalignment, but no attempt should be made to re-align the receiver until you are sure these things are not caused by other defects, such as poor tubes, incorrect voltages or an inefficient aerial and ground system; then if you are thoroughly convinced that the set is out of alignment, proceed as follows:

Very carefully tune in a local broadcasting station at approximately 1400 K.C. and reduce the volume to a point where the signal is just audible. With a small screw driver, adjust the antenna trimming condenser for maximum volume (this may be reached through the hole in the top of the

adjusting the trimming condensers for maximum volume. Or better still, if an output meter is available, connect the output meter across the speaker and in each case adjust the trimming condensers for greatest deflection on the output meter. If the receiver has been badly damaged, or the intermediate frequency adjustments have been tampered with, it will be necessary to re-align the intermediate stages at 175 K.C. To do this, adjust the oscillator to 175 K.C. and connect the output to the grid of the first detector tube, without removing the clip on the tip of the tube. A condenser of .006 mfd. or larger should be inserted in series with this oscillator lead.

### The Filament Rheostat

The filament rheostat is mounted on the back of the chassis and is provided with graduations marked in the chassis around the knob. The red spot at about the half way point on the graduations designates the position of the rheostat for a filament voltage of 2 volts when the "A" battery is fresh. As the "A" battery voltage drops, the rheostat should be advanced in a clockwise direction just enough to bring the voltage up to 2 volts on the filaments. The set should operate very well until the voltage drops below 1.7. No harm will be done if the filament voltage reaches 2.2 volts, but this is absolutely the upper limit. If a 2 volt storage cell is substituted for the dry cell "A" battery the rheostat should be turned to the extreme right so that the full voltage of the battery is impressed on the filaments of the tubes.

### Oscillator and First Detector

The oscillator first detector tube is important. If this tube fails to oscillate properly no signals will be received. There are four type '32 tubes included in the tube kit with each receiver. Pick out a '32 tube for this socket that will oscillate on any part of the dial.

gang shield and is the first trimmer nearest the front of the chassis). Adjust the R.F. trimmer condenser in the same manner. The oscillator trimmer may next be checked by turning the adjustment screw not more than a quarter of a turn in either direction from its present setting.

In the majority of cases these adjustments will be all that is necessary, but in the event the receiver is still insensitive and lacks proper selectivity, the intermediate frequency transformers should be aligned. They are adjusted by inserting a screw driver through the holes in the chassis base, directly below the I.F. transformers. Adjust each of the trimmers in consecutive order for maximum volume. After these adjustments have been made, re-check the oscillator and R. F. trimming condensers. Now tune in a station at 600 K.C. and rotate the adjusting screw on the oscillator 600 K.C. tracking condenser (located on top of the chassis, near the oscillator assembly). at the same time tuning the gang condenser back and forth across the signal. Do this until maximum volume is obtained.

This method is essentially the same as explained for aligning with a broadcast signal, with the exception that the output of the oscillator is connected to the antenna post of the receiver. The chassis may then be aligned as explained above, by tuning the oscillator to 1400 K.C. and

Adjust the four I.F. adjustment screws for maximum volume on the output meter. The oscillator section of the tuning condenser should then be adjusted by means of its compensator for maximum response in the output meter. A very high signal level from the generator may be necessary to locate the signal if the set is badly out of resonance. Reduce immediately when the signal is located. Bring the antenna and first R.F. compensators to resonance next. Remove the output meter and adjust the 600 K.C. tracking condenser on a 600 K.C. signal from the oscillator, in the same manner as explained for adjusting the 600 K.C. tracking condenser on a broadcast signal.

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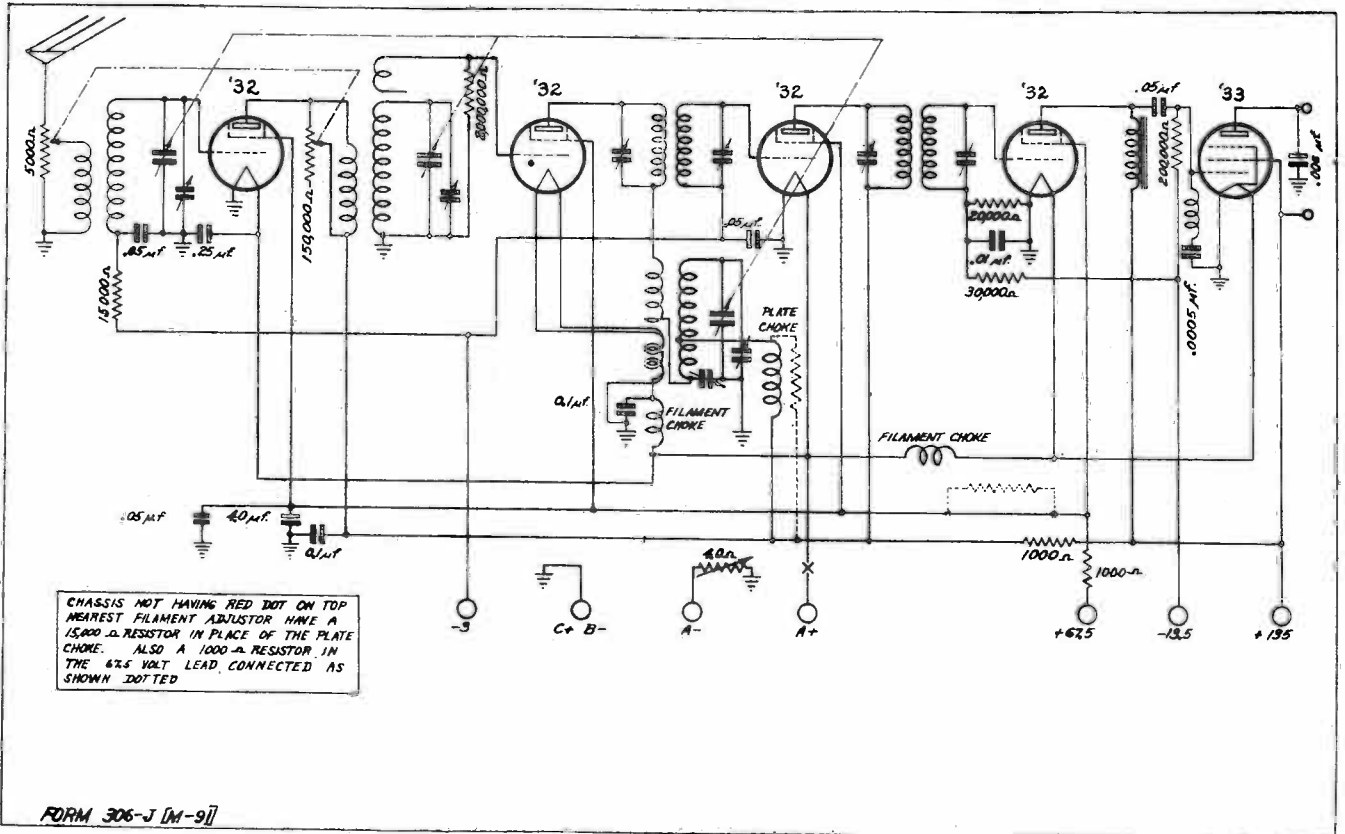


Figure 1. Schematic Diagram

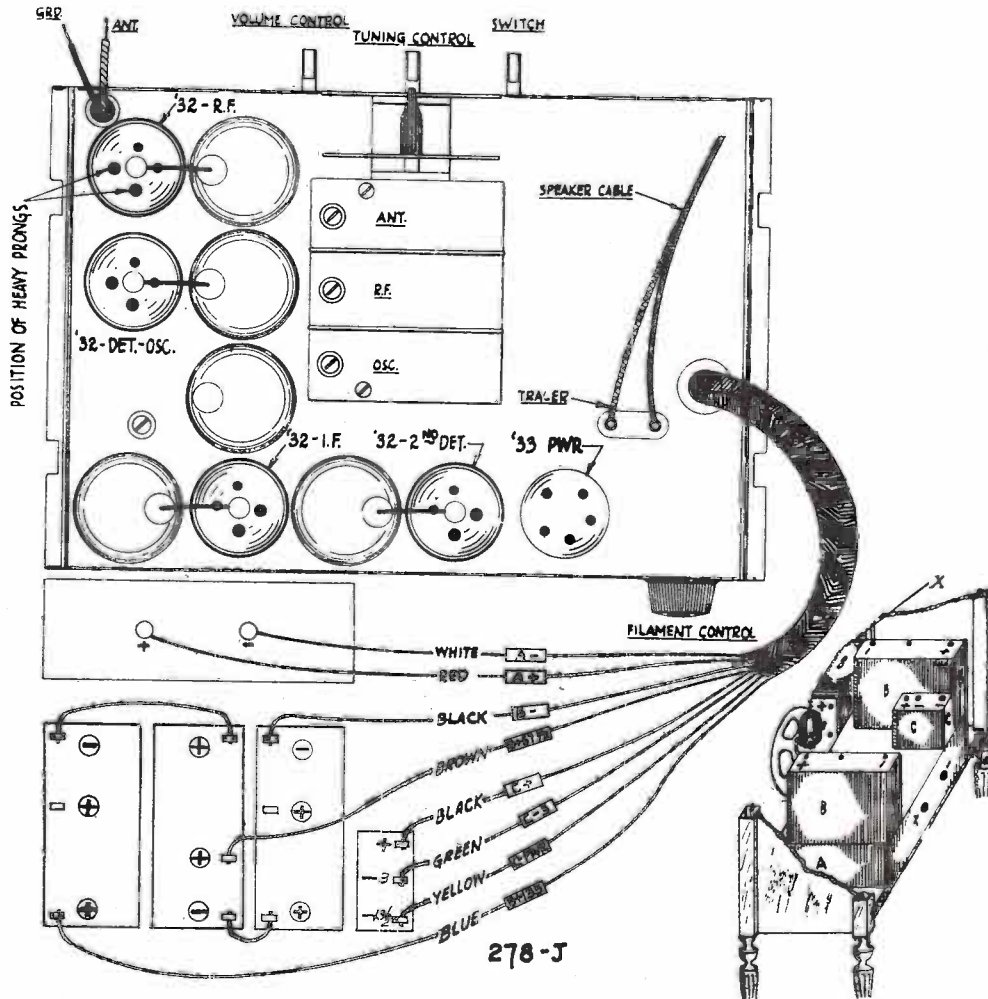


Figure 2. Top View of Chassis.

**MONTGOMERY WARD & CO.****Airline**  
REG. U.S. PAT. OFF.**7 Tube Screen-Grid Super-Heterodyne**No. 62-20 60 cycle  
No. 62-20X 25 cycle

(Catalogue No. 62-25)

**General Description****Circuit**

One stage of radio frequency amplification, a first detector-modulator, one stage of intermediate frequency amplification, a second detector, one stage of audio frequency amplification, an automatic volume control system, and a power supply.

The intermediate stage operates on a frequency of 175 kilocycles.

All stages are transformer coupled with the exception of the audio stage which is resistance coupled to the first detector.

The 25 cycle chassis is described under "POWER SUPPLY."

**Tubes**

R.F., '35; 1st detector-modulator, '24; I.F., '35; 2nd detector, '24; audio, '47; automatic volume control, '24; rectifier, '80.

**Tuning**

The R.F. and 1st detector stages and the secondary of the oscillator coil are tuned simultaneously by a three gang condenser. The gang is accurately aligned with trimmer condensers in parallel with the main tuning condensers.

The primary and secondary of both intermediate transformers are tuned with adjustable condensers which remain fixed after the transformers have been tuned to exactly 175 kilocycles.

The oscillator has an adjustable tracking condenser which is adjusted at 600 K.C. and remains fixed thereafter.

**Controls**

The left hand knob on the panel adjusts the manual

volume control, the center knob controls the tuning, and the right hand knob is the tone control. The "ON-OFF" switch is mounted on the side of the cabinet.

The action of the manual volume control is explained below under "Automatic Volume Control."

The tone control consists of a 150,000 ohm variable resistor and a fixed .1 mfd. condenser connected in series and shunted across the primary of the speaker coupling transformer.

The tuning control has a rubber drive, which, through friction on a metal disc mounted on the gang condenser shaft, operates the dial indicator.

**I. F. and Oscillator Units**

The oscillator 600 K.C. tracking condenser is mounted directly in front of the oscillator coil shield on the right rear corner of the chassis base.

Holes in the chassis base allow the tuning condensers for the intermediate transformers to be adjusted with a screw-driver from the under side of the chassis.

**Automatic Volume Control  
(A.V.C.)**

The action of the automatic volume control tube controls the grid bias on the R.F. and I.F. tubes and consequently the amplification of those tubes. The primary of the 2nd I.F. transformer has a tertiary winding which is connected in series in the A.V.C. tube grid circuit.

A signal of sufficient strength reaching the second detector, applies a voltage on the grid of the A.V.C. tube and the voltage thus applied depends upon the signal strength.

The plate of the A.V.C. tube will draw current when the grid voltage of the tube rises in potential and the drop

# MONTGOMERY WARD & CO.

in plate current is applied to the grids of the R.F. and I.F. tubes through their grid returns to the A.V.C. tube plate. This results in a control of the amplification of these tubes and a practically constant receiver output.

The manual volume control adjusts the negative biasing on the control grid of the A.V.C. tube, regulating in this manner the level of the input to the second detector at which the A.V.C. action commences. Thus the manual volume control behaves virtually as an output level control.

If the A.V.C. tube is defective or removed from its socket, there will be no control of the volume. Similarly, if the A.V.C. tube grid circuit is open, the plate of the tube applies a high grid bias on the R.F. and I.F. tube grids and practically no amplification is obtained from these tubes and consequently no receiver output.

A signal which is too weak to affect the A.V.C. tube grid voltage will not, of course, produce any change in plate current and the maximum amplification of the R.F. and I.F. tubes will be obtained, depending upon their grid bias as set by the A.V.C. tube plate.

## Power-Supply, Condensers and Resistors

The 25 and 60 cycle power transformers are designed for operation on any 95 to 130 volt A.C. supply without adjustment and without overloading.

The 25 cycle chassis has a special power transformer and has two 8 mfd. 450 volt dry electrolytic condensers, in parallel, instead of the one condenser, C14, shown in the schematic diagram. An 8 mfd. 450 volt wet electrolytic condenser is mounted on top of the chassis base and this condenser replaces the condenser, C17, shown in the diagram. The 25 cycle chassis differs in no other way from the 60 cycle chassis.

Tables will be found in the "REPAIR PARTS" section which will identify the condensers and resistors when consulting diagrams or test data.

## Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

## Tube and Voltage Tests

The tubes should be tested in a set analyzer and the voltage measurements taken on each tube before servicing the receiver in any other manner. Weak or defective tubes should be replaced.

The measurement of grid bias voltages is not recommended, as this causes an abnormal rise in plate current which is injurious to the tube. When the receiver does not function properly, and the trouble is apparently due to incorrect grid bias on any tube or tubes, the cause of the incorrect bias may be determined by applying the proper continuity test.

Comparison of the voltage measurements taken and those shown in the chart below will show any irregularities. The cause of any variation may be determined by applying the proper continuity test. **REMEMBER:** Voltage measurements will vary slightly with different sets of tubes, and also with different chassis. Unless the voltages are radically different than normal, they may be considered satisfactory.

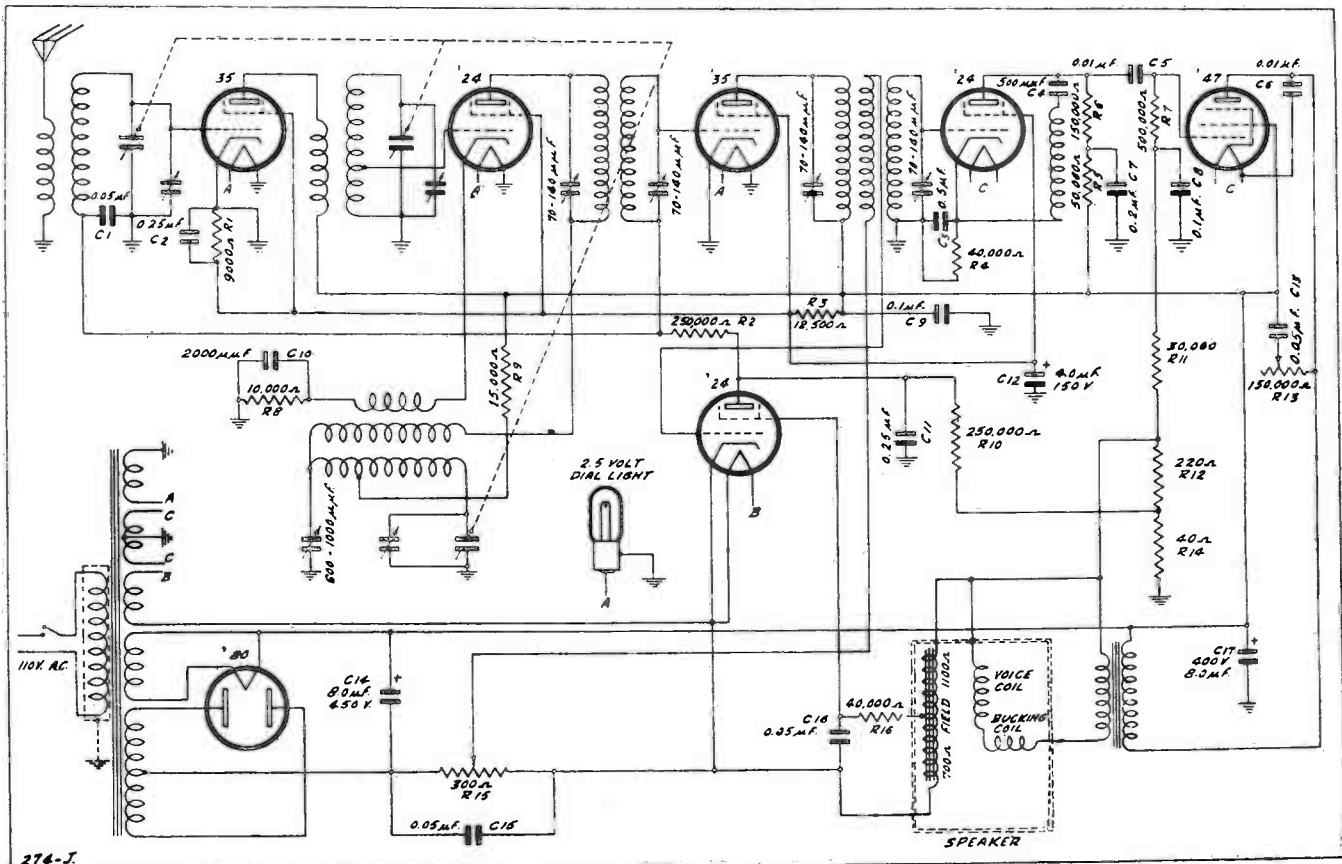
The voltages shown in the chart were taken with a 1000 ohm per volt voltmeter; voltage measurements taken with a voltmeter having a different resistance will, of course, differ from those shown.

TURN THE VOLUME CONTROL ALL THE WAY ON, CONNECT THE ANTENNA AND GROUND LEADS TOGETHER AND TURN THE GANG CONDENSER PLATES ALL THE WAY OUT. CHECK THE LINE VOLTAGE.

TUBE	CIRCUIT	LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
R. F. '35	Screen-Grid	70	78	85	92	100
	Plate	192	213	234	256	277
Det.-Modulator '24	Screen-Grid	70	78	85	92	100
	Plate	192	213	234	256	277
I. F. '35	Screen-Grid	70	78	85	92	100
	Plate	192	213	234	256	277
2nd Detector '24	Screen-Grid	70	78	85	92	100
	Plate	154	171	187	204	221
Audio '47	Accelerating Grid	199	221	244	267	289
	Plate	181	200	220	240	260
A. V. C. '24	Grid	12.3	13.7	15.1	16.5	17.8
	Screen-Grid	34.5	38.5	42	46	50
Rectifier '80	Plate to Plate	308	342	376	410	445
	Current (both plates)	52.3 MA	58.1 MA	64 MA	69.7 MA	75.5 MA

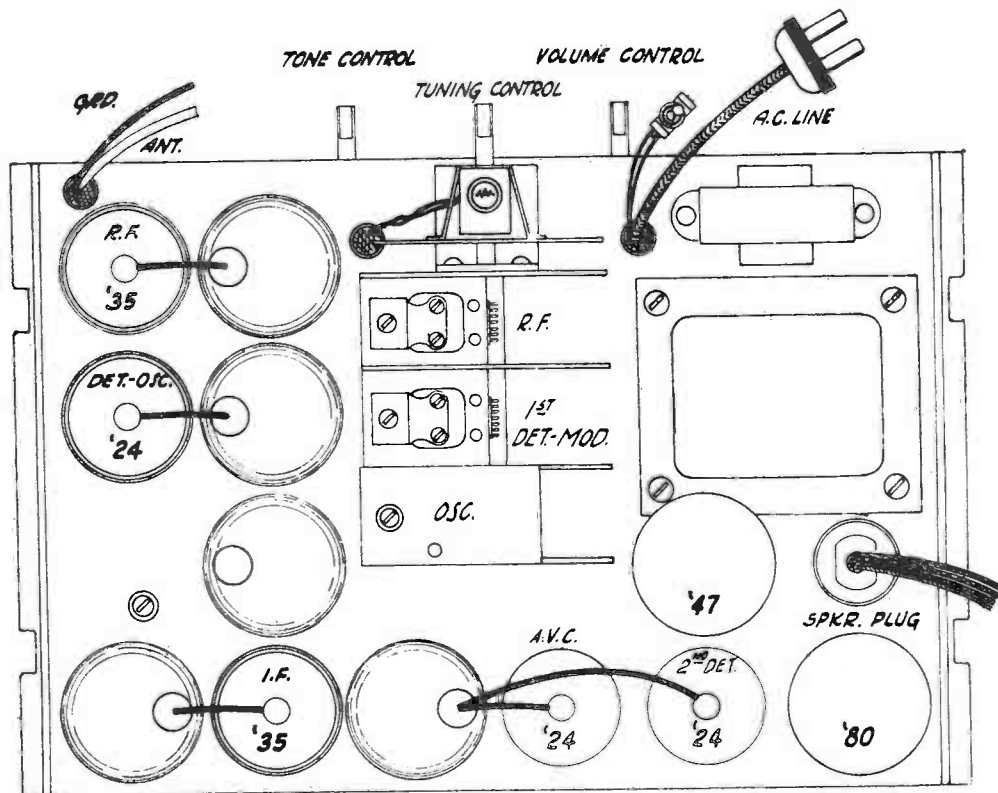
The voltages shown are measured to the cathode of the heater type tubes and to filament of the '47 Pentode.

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274-J

Figure 1. Schematic Diagram



273-J

Figure 2. Top View of Chassis.

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SERVICE MANUAL

For 10 Tube Dual Speaker Super-Heterodyne Receiver No. 62-52

MONTGOMERY WARD & CO.

CHICAGO, U. S. A.

Circuit

The R.F. amplifier consists of an R.F. transformer with tuned secondary feeding into a 235 amplifier tube followed by another R.F. transformer. This tube and the first I.F. tube are self-biased by means of a 260 ohm resistor connected between cathodes and ground. The automatic volume control, which further affects the bias voltage is discussed later.

A 227 tube functions as the oscillator or local R.F. generator. The oscillating circuit is always resonant at a frequency of 175 kilocycles above the frequency to which the R.F. amplifier is tuned. In order to provide satisfactory tracking with the R.F. and first detector tuned circuits, the oscillator is provided with 600 K.C. and a 1400 K.C. trimmer condensers.

A 224 tube is used as the first detector or mixer. The bias voltage for this tube is obtained by connecting the

cathode circuit through a 5,000 ohm resistor to ground.

Two stages of I.F. amplification using 235 tubes are employed. The intermediate or beat frequency is 175 K.C. Bias voltage for the first 235 I.F. tube is the same as the bias voltage as described for the R.F. 235 tube. Bias voltage for the second I.F. 235 tube is obtained by connecting the cathode to the voltage divider resistor as shown in the schematic diagram. The primary and secondary of the first and third I.F. transformers are tuned by small adjustable condensers located in the I.F. assembly cans. The second I.F. transformer is provided with an extra primary winding of low inductance connected to one side of the "Quiet-Power" switch. The purpose of this is to reduce the gain in this stage if desired.

**Second Detector and A.V.C.** A 227 tube is used as the second detector or demodulator. This tube also functions as the automatic volume control tube. The plate and grid are connected together externally so that it operates as a

two-element tube or Diode. During the positive portion of the cycle, current flows in this tube. The voltage drop established by this current flowing through a resistor is applied through isolating resistors to the grid circuits of the R.F. and 1st I.F. tubes, increasing the bias voltage on these tubes and thus reducing the amplification. As the signal voltage increases, the control voltage applied to these tubes increases, resulting in practically uniform output as set by the manual volume control. The audio component is applied through a coupling resistor and condenser to the grid circuit of the first audio tube. A 500,000 ohm grid leak resistor is used. This resistor also serves as the manual volume control. It is connected as a potentiometer, one end going to the coupling condenser and the other end to ground. The movable arm is connected to the control grid of the first A.F. tube, thus varying the audio voltage applied to the A.F. amplifier.

The audio amplifier has two stages. The first stage uses a 224 tube and is coupled to the second detector as explained above. The bias voltage for this tube is obtained by connecting the cathode to the voltage divider resistor at the point shown on the schematic diagram. The second stage is resistance coupled and uses two '47 pentode tubes in parallel. The tone control circuit consists of a .01 mfd. condenser and 0-1 megohm variable resistor connected in series across the input circuit of the second audio stage. Bias voltage for the pentode tubes is obtained by connecting the control grids through a 250,000 ohm resistor to the low potential end of the voltage divider.

The power unit consists of the conventional power transformer, full wave rectifier, filter choke, filter condensers and voltage divider resistor. The field of the speaker serves as an additional filter choke.

Voltages at Sockets

LINE VOLTAGE 115—VOLUME CONTROL AT MAXIMUM—SECOND DETECTOR TUBE REMOVED FROM SOCKET

Type of Tube	Function	Across Filament or Heater	Plate to Cathode	Screen to Cathode	Grid to Cathode	Normal Plate MA
'35	R.F.	2.2	260	103	3.8 <sup>(1)</sup>	6.5
'24	1st. Det.	2.2	252	98	9.	2.2
'27	Osc.	2.2	100		8. <sup>(2)</sup>	7. <sup>(2)</sup>
'35	1st. I.F.	2.2	260	103	3.8 <sup>(1)</sup>	6.5
'35	2nd. I.F.	2.2	257	100	4.5	4.7
'24	1st. Audio	2.2	200	97	7. <sup>(3)</sup>	1.
'47	2nd. Audio	2.2	240	260	18. <sup>(4)</sup>	31.
'80	Rect.	4.8	725 volts plate to plate			65 per plate

(1) Read from cathode to ground.  
 (2) Subject to variation with dial setting.  
 (3) Read across 230 and 185 ohm sections of voltage divider.  
 (4) Read across 140 ohm section of voltage divider resistor.  
 NOTE:—All readings, except heater, for second detector tube are zero.

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## Voltages

Check the voltages at the sockets to see if the power unit is delivering the correct voltages. The antenna and ground should be disconnected and the second detector tube removed from its socket. The reason for removing this tube is that it may affect other normal voltage readings.

All of the D.C. voltage readings as shown on the chart are read with a 1000 ohm per volt meter. As high a range as possible should be used. In general, the higher the resistance of the meter, the more accurate the reading will be. Several of the bias voltages, as indicated in the chart, cannot be read at the socket because of the high resistance in the circuit. The points at which the readings can be made are indicated in the references.

The voltage chart gives the voltages with all tubes in, the speaker connected and the set in operating condition. These voltages are typical of the sets but will vary slightly with variations in individual receivers and variations in tube characteristics. All voltages in the chart are taken with a line voltage of 115. Differences in line voltage as well as differences in test equipment used will introduce other variations in the voltage readings.

## Condenser Alignment

Misalignment or mistracking of condensers generally manifests itself in broad tuning and lack of volume at portions or all of the broadcast band. The receivers are all properly aligned at the factory with precision instruments and realignment should not be attempted unless all other possible causes of the faulty operation have first been investigated and unless the service technician has the proper equipment. A signal generator that will provide an accurately calibrated signal of 175 K.C. and accurately calibrated

signals over the broadcast band, and an output indicating meter are desirable. The procedure is as follows:

Set the signal generator for 175 K.C. Disconnect the grid cap from the first detector tube. Connect the antenna lead from the signal generator to the grid terminal of this tube. The ground lead goes to the ground connection. Then adjust the four intermediate frequency condensers for maximum output. The adjusting screws for these condensers are reached from the bottom of the chassis.

Next, set the signal generator for a signal of 1400 K.C. The input in this instance is made to the antenna lead of the receiver. Replace the grid cap on the first detector tube. Set the dial pointer on the 1400 K.C. mark on the dial scale and adjust the three trimmer condensers on the gang tuning condenser for maximum output, adjusting the oscillator trimmer first.

Then, set the signal generator for a signal of 600 K.C. The oscillator 600 K. C. trimmer condenser is underneath the chassis but the adjusting screw is reached from the top of the chassis and is adjacent to the oscillator coil can. Adjust this oscillator 600 K.C. trimmer condenser for maximum output, turning the rotor slowly back and forth over the 600 K.C. setting until highest output is obtained. A recheck may then be made of the alignment at 1400 K.C.

## Replacing Rubber Drive

You will note that the Vernier tuning drive on this chassis uses a rubber pinion. Under normal operating conditions this rubber will last for a number of years. Should it become worn it can be readily replaced by loosening the set screw of the brass bushing located next to the rubber pinion and pulling out the station selector shaft. Place a new bushing in position, slip the station selector shaft in place and tighten the set screw.

## Replacing R. F. Transformers and Oscillator Unit

The first and second R.F. transformers and oscillator assembly are matched. If one of these units is replaced, it is essential that the new one be of the correct value. At the bottom of the unit assembly a spot of paint will be seen. Be sure when ordering one of these assemblies to indicate in your order the color of the spot of paint.

## Dual Speaker Connections

Two speakers are used in this model, one designed to give best response on the higher audio frequencies and the other designed to give best response on the lower frequencies. The fields of the two speakers are connected in series, and the voice coils in parallel. The resistance of the two fields in series is 450 ohms.

## Low Volume

If the volume is below normal there are a number of possible causes in the chassis and accessories as follows:

Probably the most common cause of low volume is defective tubes. In any case of low volume, therefore, procure a new set of tubes that have been tested or have been operating satisfactorily in another receiver. Insert these in the chassis one at a time and note any difference in performance.

Another very common cause of low volume is weak pick-up due to a faulty antenna or the antenna being in a shielded location. The antenna and lead-in system should be inspected for poor connections and grounds. If the antenna is in or near a steel building the pick-up will be weak because of the shielding effect of the steel.

Misalignment or mistracking of variable tuning condensers is another possible cause of low volume. Instructions for realigning are contained in this manual. Do not, however, attempt realignment unless other causes of low volume have first been investigated.

Other causes of low volume are; defective speaker, defective power unit causing low voltages to be supplied, excessively low line voltage, and various opens, grounds and shorts in the receiver assembly.

## Excessive Hum

The design of the power unit and arrangement of the filters in this chassis are such that the A.C. hum is scarcely audible. If the hum is excessive there are a number of possible causes.

Defective tubes are very often the cause of excessive hum. Try out a new set of tubes and note any difference. The hum may be due to external pick-up. Disconnect the antenna and ground and see if the hum disappears.

A shorted filter choke or open filter condensers can cause excessive hum. Inspect these items for the defects named. Other causes of hum are; shorted choke tuning condenser, unequal rectifier plate currents, defective hum filter resistors and condensers; defects in grid circuits; and defective power transformers.

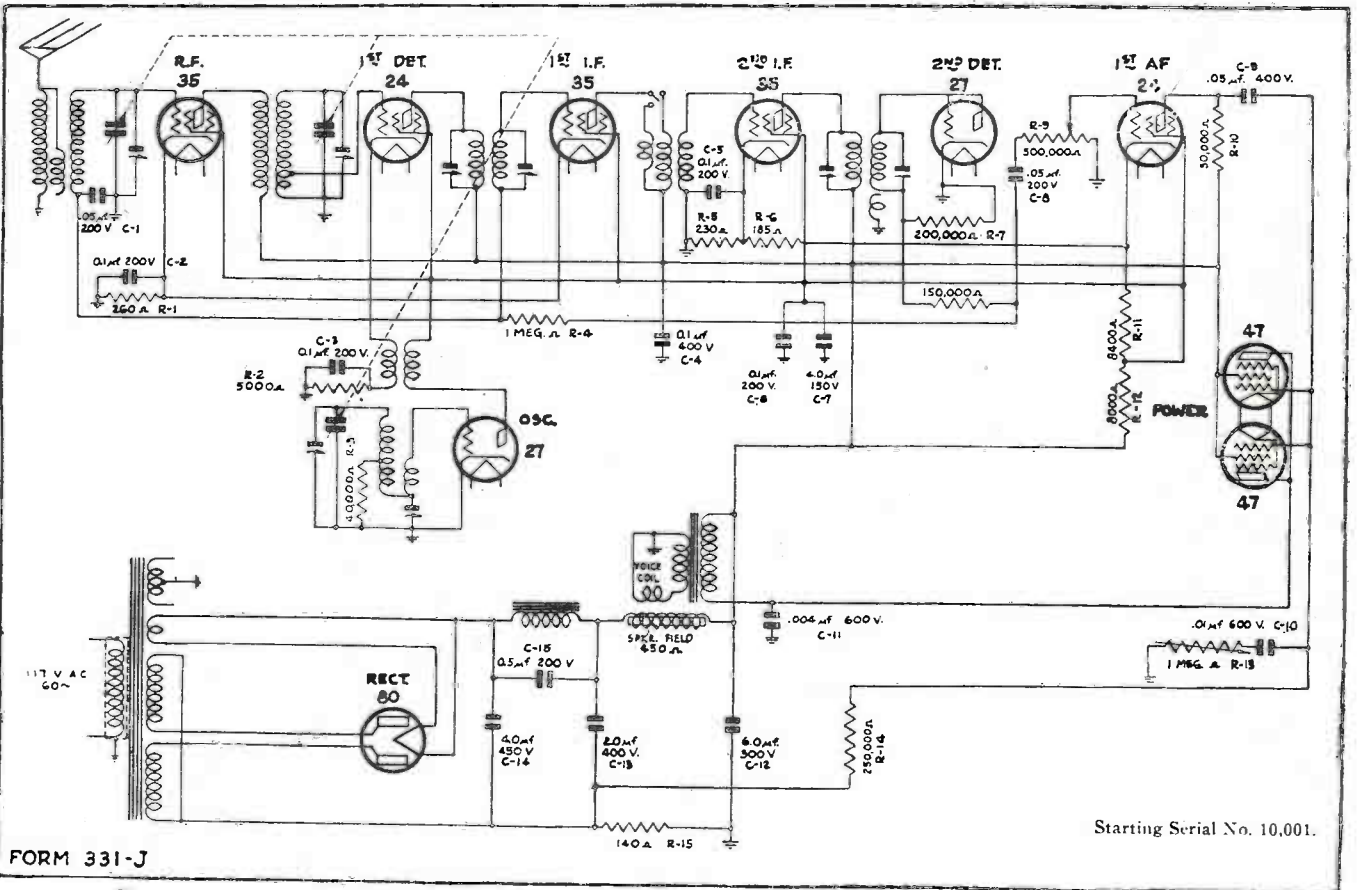
## Oscillation

There is very little possibility of oscillation on this receiver, as the circuit is exceptionally stable.

Should the set oscillate in being connected it may be due to tubes whose characteristics are very far off from standard. Change the tubes around and try out a new set. See if all the tube shields are on. Check the bypass condensers and leads to them for opens. See if the receiver is properly grounded and if it is, try out a different ground.



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FORM 331-J

Starting Serial No. 10,001.

E

Figure 1. Schematic Circuit Diagram

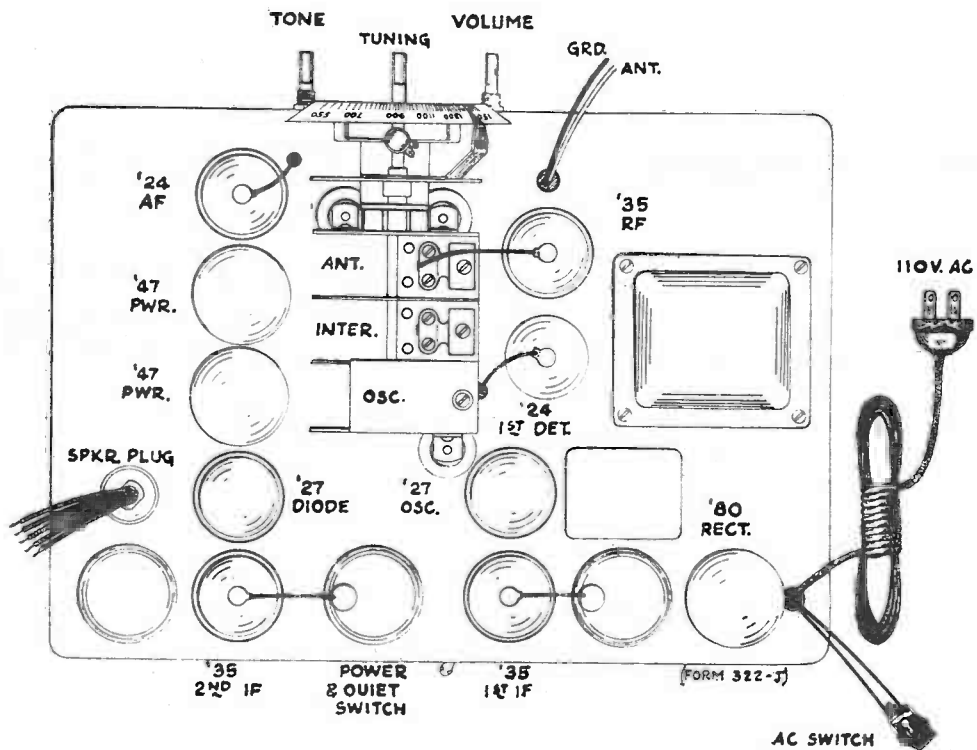
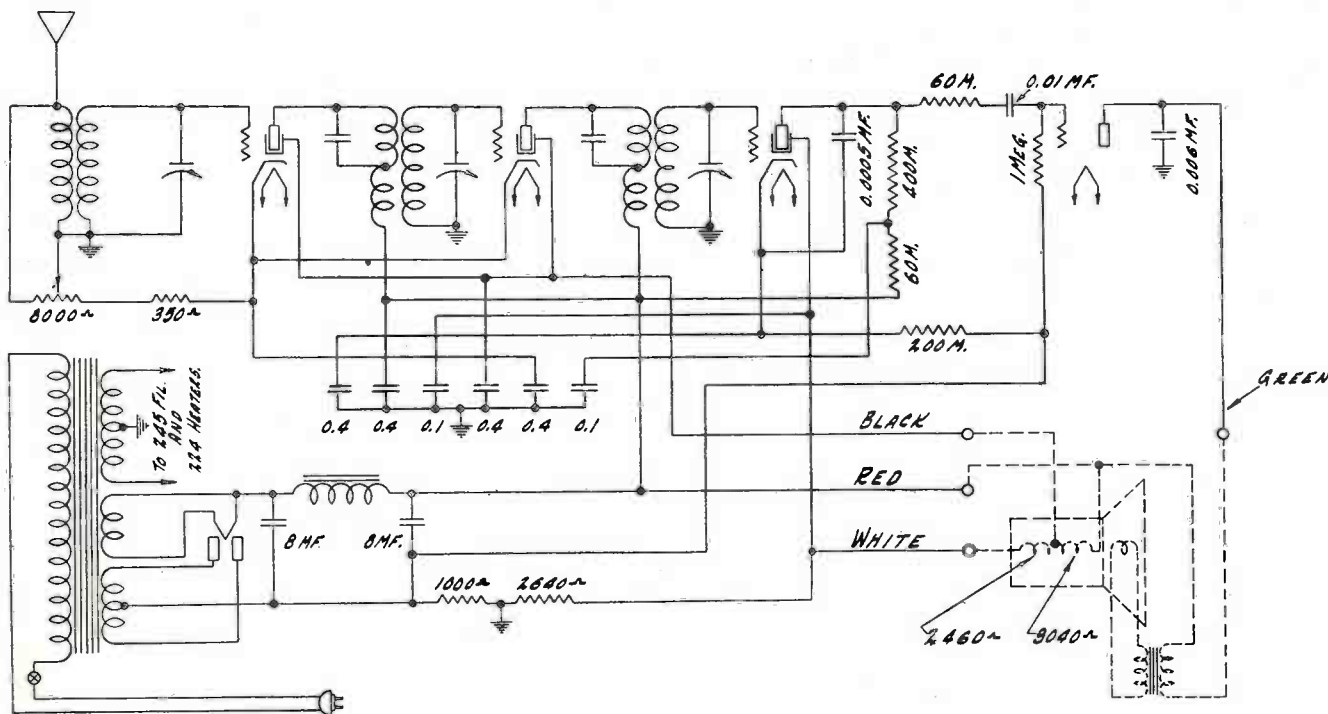


Figure 2. Top View of Chassis

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DOTTED LINES SHOWN ARE IN SPEAKER.

Figure 1

## General Description

The Model 26W chassis used in both the Princess and Challenger, Jr. is similar in many respects to the 32W chassis used in the Troubadour. The operating voltages, however, will be found to be different, and also this chassis does not use the band pass filter input circuit, as used in the 32W. Only one 245 tube is used in this chassis, and only one stage of resistance coupled audio.

The speaker is of a new type using a center tap field. The entire field winding being used as a shunt resistor. The center tap supplies the screen grid voltage to the radio frequency tubes. Only two electrolytic filter condensers are used, and a number of the small bypass condensers are eliminated, as shown in the schematic diagram, Figure I.

The general service procedure as described for the Model 32 W chassis can be used in servicing the 26W chassis.

**NO. 26 W CHASSIS—VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM—LINE VOLTAGE. 115—PLUG IN SOCKET OF RECEIVER—TUBE IN TEST SET**

Type of Tube	Position Tube	Function	"A" Volts	"B" Volts	Control Grid "C" Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
224	1	1st Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	2	2nd Radio	2.2	245	2.5	80	.6	2.5	2.9	5.1
224	3	Detector	2.2	130	3.	40	.1	3.	.25	.4
245	4	Audio	2.35	245	50.			28.		31.
280	5	Rectifier	4.6					25.		
									Per Plate	

# MONTGOMERY WARD & CO.

## Seven Tube Screen Grid Receiver, Nos. 62-030 and 62-232

### General Description

The 32W is a seven tube screen grid receiver using the following tubes.

- 2—224 Tubes as R. F. Amplifiers.
- 1—224 Tube as Detector.
- 1—227 Tube as First Audio.
- 2—245 Tube as Second Audio.
- 1—280 Tube as Rectifier.

The model 32W chassis used in the Troubadour and Lafayette is similar in many respects to the Commander, Cavalier, Coronado and Cortez. The special differential features of this chassis are the band pass filter and the radio frequency transformers.

A band pass filter is used in the antenna input stage, and consists of two separate tuned circuits which are inductively coupled. The advantages of this filter are an increase in selectivity; elimination of cross talk and improved tone. Incorporated in the filter is a special coil and condenser, which is inductively coupled to the grid coil of the first tube, tending to give this stage a constant gain over the entire frequency band.

Another feature of this set is the tuned radio frequency coils which have two separate primary windings, so connected as to give equal gain throughout the broadcast band. A screen grid power detector is used, giving the advantages of sensitivity with very good overload characteristics. The over-all fidelity response characteristics are especially good, due to the resistance coupling used in the first stage of audio, and the 245 tubes in push pull in the last stage. Sensitivity in this chassis averages 4 Microvolts per meter.

### R.F. Coils

The antenna input transformer is of the high impedance type, and is both inductively and capacitively coupled. The

As the volume control is also connected between the aerial and ground, it is necessary that a good ground be used with this chassis to effectively control the volume in all cases.

The plate voltage for the 224's is obtained from the positive side of the power unit. Screen grid voltage for the 224's is obtained from the 8 M tap of the shunt resistor.

### Detector

The detector circuit is a power detector using a 224 screen grid tube. The necessary grid bias for this tube is obtained by the voltage drop across the 25 M cathode resistor. Plate voltage for the detector is obtained by the voltage drop across the 25 M resistor connected in the plate circuit, while the screen grid voltage is obtained through the 500 M resistor, connected in the screen grid circuit. The screen voltage cannot be properly measured with your Weston set checker, but it is of a calculated value of forty volts.

### Audio System

The detector is coupled to the first audio stage through a .01 M.F. fixed condenser. A 60 thousand Ohm resistor is connected to one side of this condenser and acts as a R.F. choke. The 100 M.M.F. condenser connected between the grid of the first audio tube and ground is used to bypass any radio frequency. A short in this condenser will short circuit any signals up to this point. A 1 Megohm resistor is connected between the grid and ground of the first audio tube to give the grid the proper bias. The bias is obtained by the voltage drop through the 2500 Ohm cathode resistor, this resistor being bypassed to ground through a 1 M.F. condenser. A short in this condenser will be indicated when there is no voltage drop across the 2500 Ohm resistor. The last stage of audio and tone control are used in the same manner as described for previous chassis, with the exception that the grid bias for these power tubes is obtained by connecting the center tap of the secondary push pull winding to the negative side of the filter

primary winding is on a small bobbin inside the coil form, wound concentric with the secondary, allowing inductive coupling. The capacity coupling is obtained by an extra turn of wire connected to the primary and wound on the coil alongside one end of the secondary winding. This antenna coil is coupled to the grid coil of the first tube through three turns of wire wound on the low potential end of the grid coil. Inside of the grid coil is a small bobbin coil shunted by a 100 mmfd. condenser, and being in inductive relation to the grid coil. This small coil with condenser in shunt is tuned to the lower frequency. The 100 mmfd. condenser is a small condenser without any color marking to distinguish it from the 50 M.M.F. condensers with the yellow dot which are used in the other stages of the radio frequency. The primaries of the radio frequency coils proper, are made up of two parts; the inside primary is wound on a bobbin which is inside the coil form, and is shunted with a 50 M.M.F. condenser. The outside primary is wound on the coil form over the secondary winding and is separated by an insulated strip, the two primaries being connected in series. The energy transfer of the inside tuned primary decreases with increase in frequency—the energy transfer of the outside primary increases with increase in frequency; resulting in a net gain that is practically uniform over the broadcast band. Any trouble in the R.F. coils of this receiver will be noted by the lack of sensitivity at either the high or low wave part of the dial.

### R.F. Amplifier and Volume Control

Bias for the screen grid tubes is variable and depends on the setting of the volume control arm. As indicated in Figure 1, the volume control will vary the resistance between 350 Ohms and 8350 Ohms, depending on the setting of the arm. The voltage drop of the plate current flowing through this resistance provides the necessary bias voltage.

system, making this connection more negative than the filaments, due to the voltage drop through the 700 Ohm field resistance.

### Electrolytic Filter Condensers

Electrolytic filter condensers have a capacity of 8 M.F. each. They should always be kept in an upright condition, with the rubber vent at the top, otherwise there may be a leakage of electrolyte from some of the units. The electrolytic condenser has the advantages that when an excessive voltage breaks down the dielectric, the condenser action ceases—however, no damage has been done, and upon standing for a few minutes, the condenser will build up a new film of dielectric, and the unit will function as before. The electrolytic condensers will freeze at 18°F. A frozen condenser is not operative, but will become operative at ordinary room temperature in fifteen minutes without damage in any way to the condenser.

The electrolytic condenser can be tested by applying a direct current voltage of 200 to 350 volts to the terminals, the center pole or anode being made positive. After the condensers have been on for five minutes, connect the milliammeter of your Weston set checker in series with the condenser and read the leakage current; up to 5 milliamperes per 8 M.F.D. section is normal. On some occasions it may be found that the electrolyte has crystallized around the vent, indicating a slight amount of leakage. This does not indicate that the condenser has been damaged, and it is only necessary to wipe the electrolyte away, and the unit will function normally, provided a large amount of electrolyte has not escaped, in which case the capacity of the condenser will be low. Electrolytic condensers cannot be tested by the ordinary method of using A.C. Another method of testing is to replace a doubtful condenser with a new one, checking them by means of comparison.

### Loud Speaker

The loud speaker is of the dynamic type using a 700 Ohm field winding. As the loud speaker is really part of the power pack, no other speaker should be used in this chassis.

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## Weak Signals

The most prominent cause of weak signals is defective tubes. Check these by using a new set of tubes that have been tested, or a set of tubes which have been operating satisfactorily in another receiver. Insert these in the chassis, one at a time and note any difference in performance. The antenna may be shielded if the antenna is in or near a steel building, the pick-up will be weak, because of the shielding effect of the steel. In a case of this kind, try out a new antenna in a different location. Check the line voltage. On rare occasions low volume is due to the condensers being out of line. In this case align the condensers as explained in previous service manuals.

## Excessive Hum

The most probable cause for excessive A.C. hum is defective tubes. In each case, therefore, try out a new set of tubes and note any difference in performance. The hum may be due to outside pick-up. Disconnect the antenna and ground from the set and see if the hum disappears. Other causes of hum are shorted filter choke, open filter condenser or a filter condenser with a large amount of electrolyte leakage. If the field plate of the power transformer between the primary and secondary winding is not properly grounded, excessive hum will result. A defective 280 tube is another frequent cause of hum. A heater to cathode short on one side of the heater or filament being grounded will cause hum. A grounded speaker cable, open grid circuit or open .4 M.F.D. plate condenser will also cause hum. *It is always essential to have a good 224 in the detector socket—try a number of different tubes in this socket.*

## Servicing

Unless you know definitely the exact trouble, proceed in an orderly manner, first testing the tubes, the aerial, ground, etc., as given under servicing in the other parts of the manual.

## Oscillation

This set is exceptionally well shielded and few troubles from oscillation should be experienced. Most frequent causes for oscillation are dirty connections to the rotor shaft of the variable condenser, high mutual conductance tubes or high line voltage—the remedies are obvious.

## Howling

*Howling is invariably caused by a poor detector or first audio tube. Try a number of different tubes in these sockets.*

## Noisy Speaker

A rattling or blasting noise in the speaker may be due to dirt or iron filings in the gap between the voice coil and the pole base of the magnet, or to the voice coil being out of line and scraping on the pole base. Move the cone backwards and forwards with the fingers and note if it appears to rub. To center the voice coil, loosen the adjusting screw at the center of the spider. Next, loosen the two screws securing the strip to the head. Get three spacers made of paper or metal, three eighths of an inch wide, three inches long and .006 of an inch thick. Put the spacers through the oval holes in the spider and between the voice coil and inner pole base. Then tighten the screws and remove spacers. If the noise is caused by particles in the gap, loosen the adjusting screw at the center of the spider and get the fingers in back of the cone, near the apex. Pull outward on the cone and blow into the gap.

## Twenty-Five Cycle Chassis

A twenty-five cycle power transformer and an additional .45 M.F.D. condenser are used in this chassis. In converting a sixty cycle chassis to twenty-five cycle, first remove the .1 M.F.D. condenser across the filter choke and connect it across the .1 M.F.D. screen condenser. This provides additional filtering. Connect the .45 M.F.D. condenser across the filter choke.

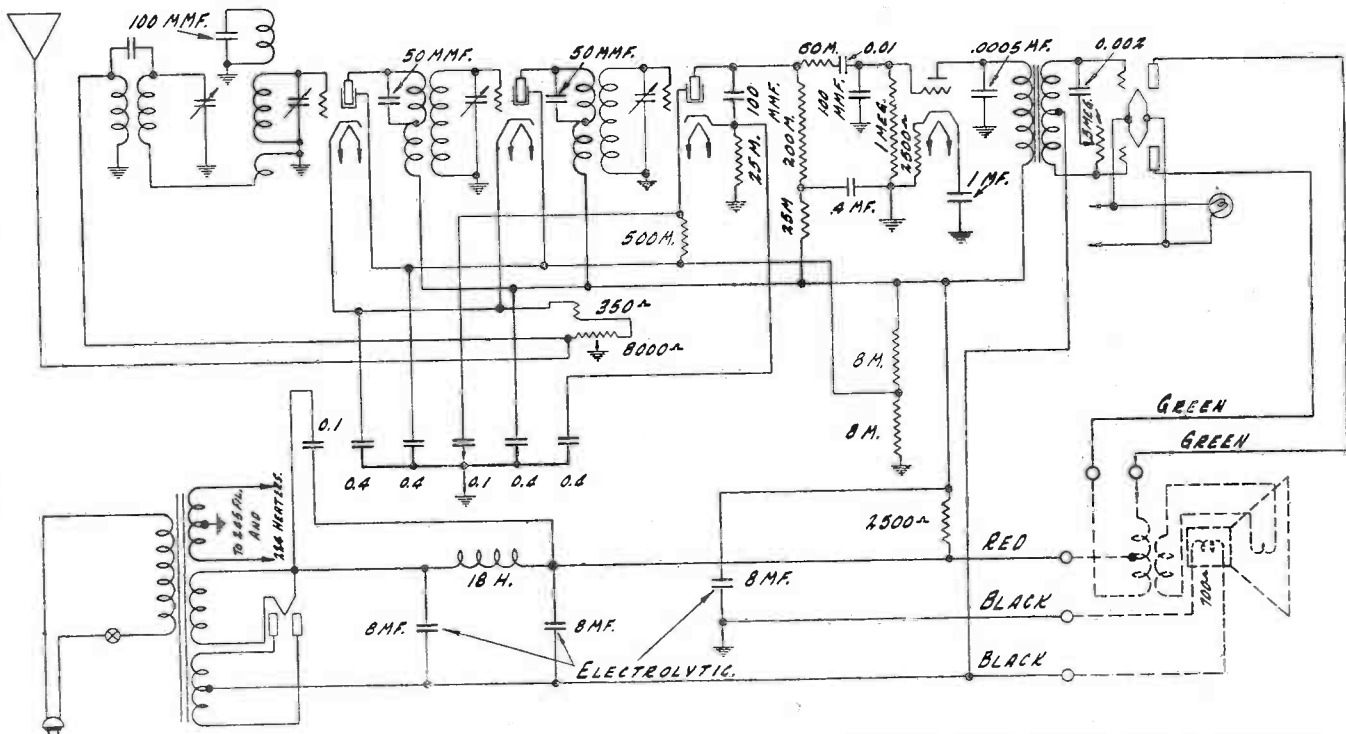


Figure 1

## MONTGOMERY WARD & CO.

# Recital Eight Tube Super-Heterodyne Receiver, No. 1238

(Catalogue No. 62-1838)

### General Description

The complete circuit consists of an R. F. amplifier, the oscillator or local signal generator, the 1st detector or mixer which combines the signals of the R. F. amplifier and the oscillator to form the intermediate frequency, the I. F. amplifier, the 2nd detector or demodulator, the A. F. amplifier, the automatic volume control and the power system from which the required voltages are obtained. Each of these will be discussed.

### R. F. Amplifier

The R. F. amplifier consists of a tuned input followed by an additional tuned stage. A 235 tube is used as an R. F. amplifier. The first or antenna input transformer is inductively coupled. It has a high impedance primary resonant to a frequency below the broadcast band, permitting the use of varying antenna lengths. The 2nd R. F. transformer couples the plate circuit of the R. F. 235 tube to the grid circuit of the 235 1st detector and is also inductively coupled. The drop in signal strength at the lower frequencies is compensated for by increased oscillator signal voltage at these frequencies. Sections one and two of the three-gang condenser are used to tune the two tuned circuits in the R. F. amplifier and 1st detector.

The value of the grid bias voltage of the 235 R. F. amplifier is subject to some variable factors including the position of the power level switch and the operation of the automatic volume control. With the power level switch on the "H" power position and with no plate current flowing in the automatic volume control, the bias voltage consists of the drop across the 250 ohm series resistor in the cathode circuit. The action of the A. V. C. and power level switch will be discussed in the paragraphs on these items.

### Intermediate Frequency Amplifier

In the I. F. amplifier is obtained the high degree of selectivity and sensitivity of the Super-heterodyne. Four tuned circuits are used as the grid and plate circuits of both I. F. transformers are tuned. This affords a high degree of selectivity as well as high amplification. A 235 tube is used as an I. F. amplifier.

Bias voltage for the 235 I. F. amplifier is the same as the bias voltage described for the 235 R. F. tube.

The I. F. transformers are small universal wound coils mounted on a piece of tubing. The I. F. tuning condensers are small mica condensers. The coil tubing standards and condensers are mounted on porcelain bases and are enclosed in metal cans located on top of the chassis. The adjusting screws of the four I. F. tuning condensers are reached from the bottom of the chassis.

### 2nd Detector

A 227 tube is used as the 2nd detector or demodulator tube. This detector is also of the bias type. The tube is self-biased, the voltage being obtained by the drop established by the plate current returning to the cathode through the 100,000 ohm resistor. As the grid is above ground potential the bias voltage is determined by the difference above ground between grid and cathode. The R. F. choke in the plate circuit is mounted in a metal can and located directly under the plate terminal of the 2nd detector socket. The reason for shielding this circuit is that certain harmonics of the intermediate frequency fall within the broadcast band and if fed into the R. F. stages would cause audible beats.

### Oscillator

The oscillator is of the tuned grid type. This circuit is tuned by the third section of the three-gang tuning condenser. Energy is fed from the plate circuit of the oscillator tube to the grid circuit through a .01 Mfd. condenser. The oscillator signal is 262 K. C. above the R. F. signal in frequency at any setting of the tuning condenser. The oscillator coil is coupled inductively to the cathode of the 1st detector thus introducing the oscillator signal to the grid circuit of this tube.

The drop across the 50,000 ohm resistor brought about by the D. C. component of the grid current establishes the bias voltage. As the signal is greater at the lower frequencies the drop across this resistor is correspondingly greater.

In order to provide satisfactory tracking with the R. F. and 1st detector tuned circuits the oscillator is provided with a 600 K. C. and a 1400 K. C. trimmer condenser. The 1400 K. C. trimmer condenser is located on top of the tuning condenser and is connected across the tuning condenser. The 600 K. C. trimmer condenser is across the 550 Mmf. fixed condenser and the adjusting screw is in front of the first I. F. can on top of the chassis.

### 1st Detector or Mixer

The 1st detector or mixer is of the bias type. A 235 tube is used. In the grid circuit of this tube are the R. F. signal and the oscillator signal which combine to form the beat or intermediate frequency. The tube is self-biased by means of a 3000 ohm resistor connected in series in the cathode circuit to the ground.

In addition to the intermediate frequency there is also present in the plate circuit of the 1st detector the R. F. signal, the oscillator signal, and the sum frequency signal of the two beating signals. All these frequencies except the intermediate frequency are filtered out in the I. F. amplifier.

### Audio System

The audio stage is resistance coupled. A 100,000 ohm resistor in the grid circuit of the 2nd detector provides the necessary impedance so that the A. C. voltage is developed across it and impressed through the .04 Mfd. coupling condenser on the control grid of the 247 Pentode output tube. A zero to 1 Megohm variable grid leak resistor is used which serves as the volume control. It is connected at a potentiometer. One end is connected to the .04 Mfd. coupling condenser and the other end is connected to ground. The control grid of the 247 output tube is connected to the movable arm. As the position of the movable arm is changed the voltage impressed on the 247 grid circuit is varied, thus changing the volume.

Bias voltage for the 247 Pentode tube is provided by the drop established by the plate current returning to the cathode or filament through the 550 ohm series resistor which is connected between the center tap of the filament winding and the ground. This 550 ohm resistor is by-passed by an 8 Mfd. condenser which completes the audio circuit to the filament, thus avoiding the degenerating effect brought about by the plate current flowing through this resistor.

Incorporated in the plate circuit of the 247 tube is a variable impedance, called the tone blender which controls the degree of reproduction of the higher audio frequency notes. This optional limitation in the reproduction of the higher audio frequency is accomplished with a .04 Mfd. condenser and zero to 150,000 ohm variable resistor connected across the primary of the output transformer. With the 150,000 ohms all in series no audio frequencies pass through the filter. With no resistance in the circuit only the .04 condenser is across the primary and the higher audio frequency finding a low impedance path pass through this condenser. By varying the resistance between the two extremes the impedance is varied and the degree to which the high notes are reproduced is accordingly varied.

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## Power Supply

The power system consists of the conventional power transformer, filter choke, filter condensers, and voltage divider resistor. The field of the speaker is in series with the voltage divider resistor and is tapped to supply screen voltage for the R. F. and I. F. tubes. The filter choke is tuned with a .06 condenser to offer maximum opposition to the 120 cycle ripple voltage.

## Automatic Volume Control

The automatic volume control as used in this receiver varies the signal strength by changing the bias voltage of the R. F. and I. F. 235 tubes. A 227 tube is used as the A. V. C. tube. Plate cathode and grid circuits of this tube are connected to the voltage divider resistor as shown in Fig. 1 to secure the required plate and grid voltage. In the plate circuit of this tube is a 200,000 ohm resistor. The grid circuits of the R. F. and I. F. tubes are connected to the plate of the A. V. C. tube. The cathodes of these two tubes are connected through the 250 ohm biasing resistor to the other end of this 200,000 ohm resistor in the plate circuit (power level switch on "H" power). The grid of the A. V. C. tube is connected to the plate of the I. F. 235 tube through a .0005 condenser. The A. V. C. tube has an initial bias of 40 volts and under conditions of no signal, no plate current flows in this tube. However, when an A. C. voltage of 35 or greater is applied to the grid circuit of the A. V. C. through the .0005 coupling condenser, plate current flows and a drop is established across the 200,000 ohm resistor. This lowers the voltage of the I. F. and R. F. grids, increasing the bias and decreasing the signal strength. The higher the A. C. voltage applied to the A. V. C. grid the greater the drop across the 200,000 ohm resistor and the bias voltage correspondingly increases. For weak signals, therefore, the A. V. C. does not

affect the bias and maximum sensitivity is obtained, while for strong signals the bias is increased and a corresponding reduction in volume effected.

## Tuning Meter

The visual tuning meter in this receiver is a milliammeter connected in series between the positive B and the plate circuits of the R. F. and I. F. 235 tubes. When the On-Off switch of the receiver is turned on, plate current flows in these two tubes and the pointer of the meter swings over. If a signal voltage is applied to the A. V. C. tube of sufficient strength to cause plate current to flow in this tube, the bias voltage of the R. F. and I. F. tubes is increased as explained above. This reduces the plate current of the R. F. and I. F. tubes and causes the pointer of the meter to swing back. At resonance the bias voltage is the greatest and the swing of the pointer will be correspondingly greatest. The action of the visual tuning meter is most satisfactory with the power level switch in the "H" power position. With the switch in this position, the R. F. and I. F. bias voltage is the least and the pointer of the meter swings over the greatest amount. With the power level switch in the "L" power position the pointer of the meter swings back due to the increased bias voltage resulting in lessened plate current.

## Power Switch

The power level switch likewise changes the volume by changing the bias voltage of the R. F. and I. F. tubes. With the switch set on the "H" power position the bias voltage consists of the drop across the 250 ohm series resistor (no drop in A. V. C. plate circuit). With the switch set on the "L" power position the bias voltage consists of the drop across the 500 ohm section of the voltage divider resistor in addition to the drop across the 250 ohm resistor.

## Voltages

Check the voltages at the sockets to see if the power system is delivering the correct voltages. The antenna and ground should be disconnected. The shield should be on. The tester plug can be inserted in the sockets and the shield placed over it. When the plug is inserted in the oscillator socket the cable must be doubled back over it in order to get the shield back on. When reading the voltages of the 1st detector bring the grid cap and wire through the trimmer condenser hole in the shield. The voltage chart shows the voltages and currents with all tubes in, speaker connected and set in operating condition. The voltages will vary with individual receivers and with variations in tubes. The voltages as shown are with a line voltage of 115.

Several of the voltages as indicated in the chart cannot be satisfactorily read at the socket but should be read across the resistors at which they are developed.

## 25 Cycle Chassis No. 1238X

For 25 cycle sets remove the .06 Mfd. condenser across the filter choke and use No. U-3084 power transformer instead of U-2783.

8 TUBE CHASSIS—VOLTAGES AT SOCKETS—  
VOLUME CONTROL AT MAXIMUM LINE  
VOLTAGE 115—POWER LEVEL  
SWITCH HIGH POWER

Type of Tube	Function	"A" Volts	"B" Volts	Control Grid Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate MA	Grid Test MA
235	R.F.	2.3	190	2.3 <sup>(1)</sup>	68	1.0	0	3.8	6.5
235	1st Det.	2.3	190	6.5	70	.35	14.	2.0	4.9
227	Osc.	2.3	80	15—50 <sup>(2)</sup>			20.	4.7	4.8
235	I.F.	2.3	190	2.3 <sup>(1)</sup>	68	.6	0	3.6	6.0
227	2nd Det.	2.3	150	20.			20.	.4	.4
227	A.V.C.	2.3	65 <sup>(3)</sup>	40. <sup>(4)</sup>			20.	0.	0.
247	Power	2.35	260	20. <sup>(5)</sup>	280	7.		32.	36.
280	Rectifier	5.						41. Per plate	

(1) Measured across 250 ohm series resistor.

(2) Bias voltage varies from 15 to 50 between 1500 and 550 K.C. settings of tuning condenser.

(3) Measured across 1000 and 1200 ohm sections of shunt resistor.

(4) Measured across two 660 ohm sections of shunt resistor.

(5) Measured across 550 ohm series resistor.

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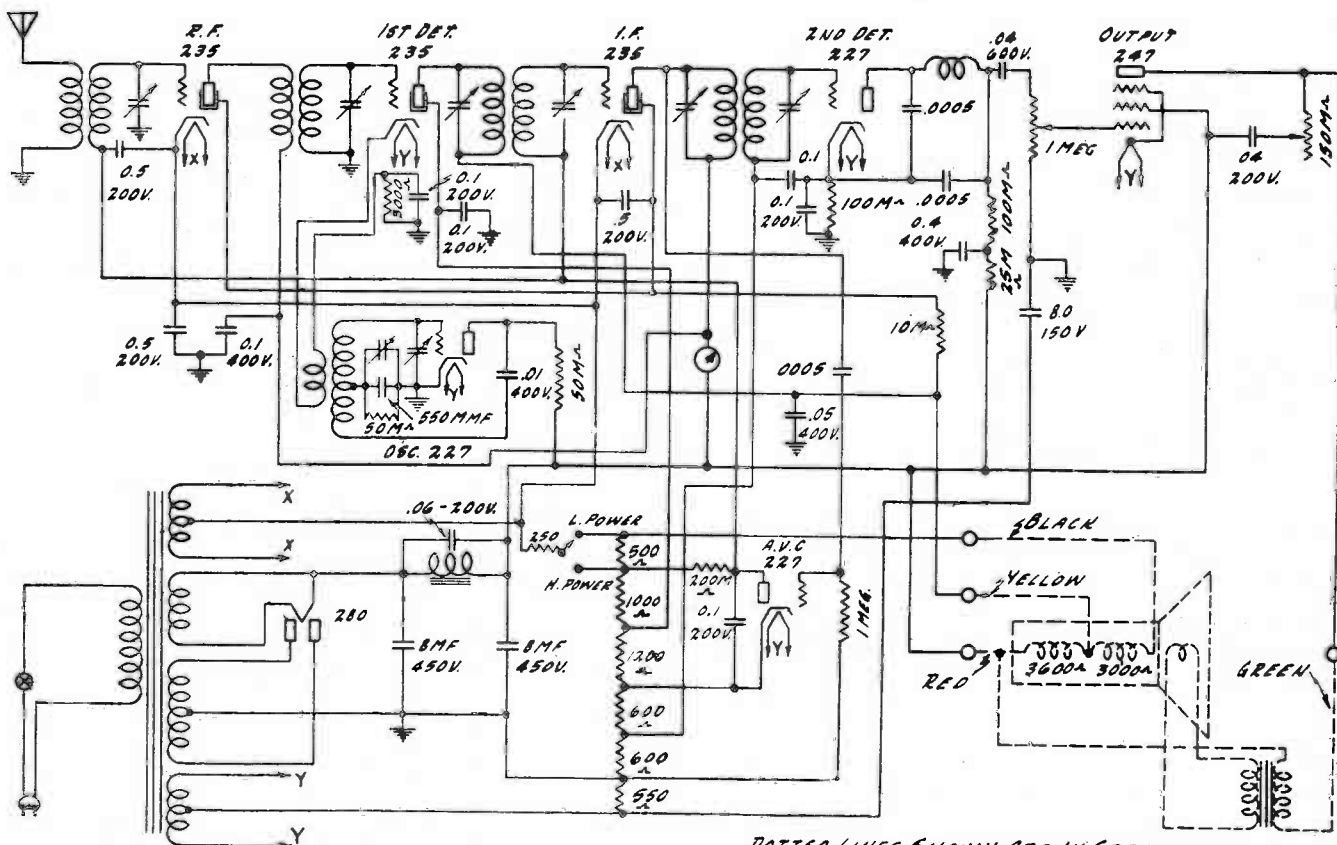


Figure 1

DOTTED LINES SHOWN ARE IN SPEAKER

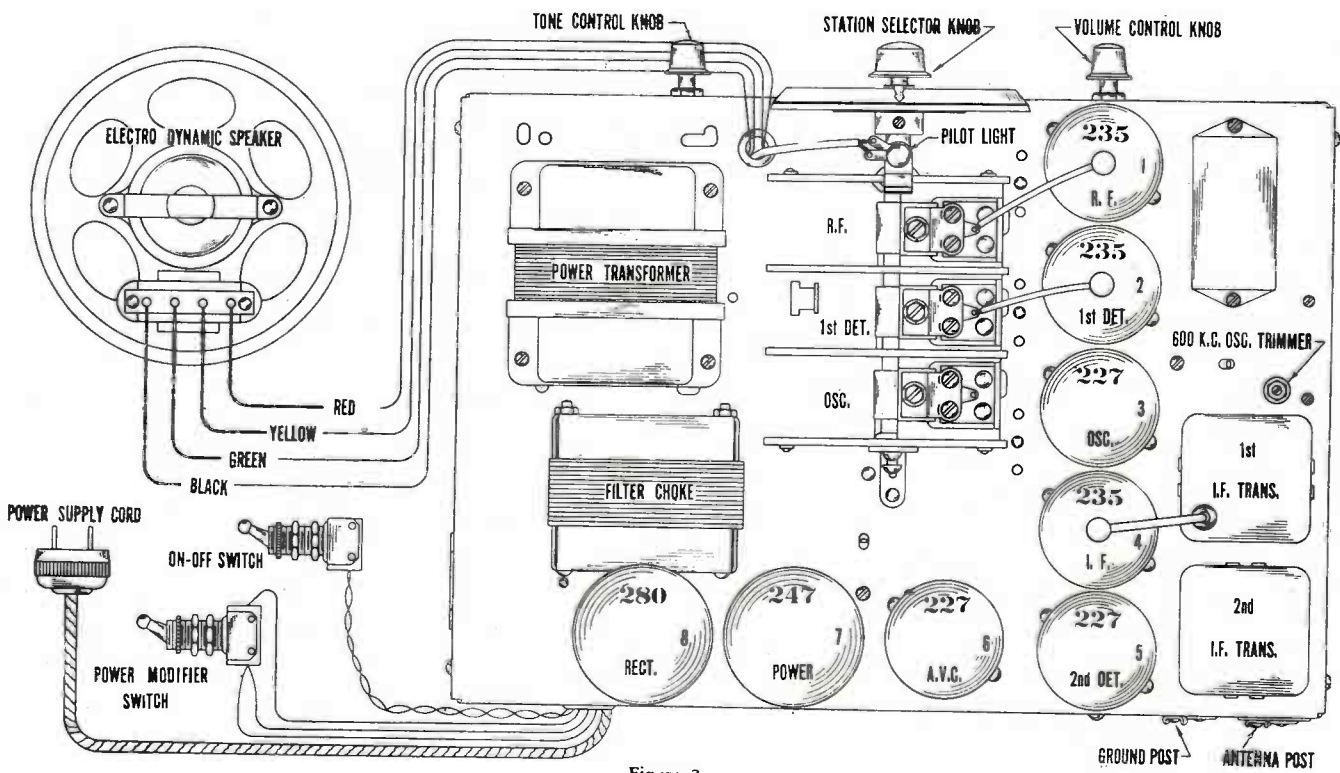


Figure 2

GROUND POST ANTENNA POST

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## Challenger Five Tube Mantel Receiver No. 15000 Chassis

(Catalogue No. 1500)

(60-Cycle—27W)

The 27W Chassis uses the following tubes:

- 2—224's as R.F. Amplifiers,
- 1—227 as Detector,
- 1—245 as Audio Amplifier,
- 1—280 as Rectifier.

The two stages of screen grid R.F. amplification in conjunction with the tuned antenna stage of this chassis give a sensitivity averaging 10 Microvolts per meter while the 227 power detector used with the single stage high gain audio provides good power output, with excellent tone quality.

## Volume Control

The 8000 ohm volume control is connected across the antenna and ground of the input stage. The movable arm of the volume control is connected to ground in series with the cathodes of the two 224 R.F. tubes. This method of connection gives us a dual volume control action, which varies the signal input to the antenna stage as well as the grid bias on the first two R.F. tubes. The volume control may be easily tested by taking the voltage readings from the cathode of the 224's to the ground connection and at the same time, varying the volume control. This will give an indication if the volume control is controlling the grid bias properly.

The R.F. transformers in the R.F. stages are the same as those used in the 32W and 26W chassis. The cathode, screen grid, and plates of the R.F. tubes are bypassed by the 964A bypass condenser.

## The Power Detector

The power detector receives its grid bias from the voltage drop across the 50M cathode resistor (Part No. 1892). The

(25-Cycle—27WX)

plate of the detector is bypassed to ground through the .001 M.F. R.F. plate bypass condenser.

The audio stage consists of a high ratio audio transformer of special design. The secondary of this transformer connects directly to the 245 power tube. The audio transformer may be tested with the continuity meter of your set checker. Disconnect the primary and secondary leads from the chassis before taking continuity measurements. Test the primary and secondary for opens or shorts, and also take continuity readings between the primary and secondary terminals, and ground. There should be no readings between these terminals and the core of the transformer or chassis ground.

The tone control is connected across the primary of the output push pull transformer, and consists of 50M variable resistance in series with a .2 M.F. fixed condenser. A short in this condenser will short circuit the primary of the speaker transformer and no signals will reach the loud speaker.

The power supply of the 27W chassis is similar to that used in some of our other chassis previously described.

Two electrolytic condensers are used in the filter circuit and care must be taken that these chassis are always kept in an upright position to prevent any small amount of electrolytic leakage in the filter condensers. It is a good idea to inspect the electrolytic condensers, upon delivery of any sets, and to wipe the top perfectly dry.

## 25 Cycle Chassis No. 27WX

This chassis uses a 25 cycle power transformer. Otherwise the constants of the circuit are the same.

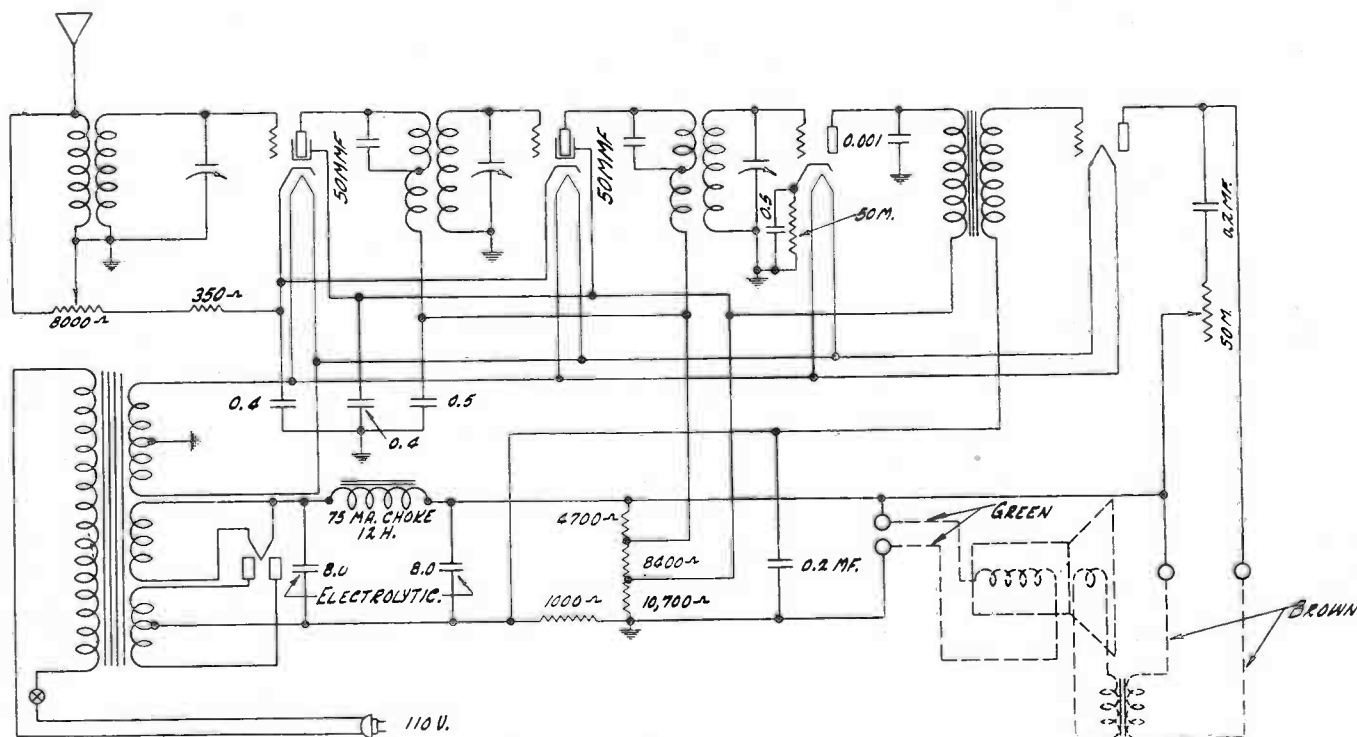


Figure 1

DOTTED LINES SHOWN ARE IN SPEAKER





## MONTGOMERY WARD &amp; CO.

# Airline

REG. U.S. PAT. OFF.

## "Challenger" 7 Tube Screen-Grid No. 11,000

Some minor changes were made in the detector circuit of the Challenger set after production was started. Picture 1 shows the original circuit, and Picture 2 shows the changes. The serial numbers of sets are shown beneath each diagram.

### The Challenger Seven Tube Screen-Grid Receiver

#### General Description

The Challenger set is a seven-tube screen grid receiver incorporating the following tubes:

3—224's, 2—245's,  
1—227, 1—280.

One of the screen grid 224 tubes is used as the detector. The other two are the radio frequency amplifiers.

#### R.F. Coils

The antenna coil in particular is a departure from the usual performance of antenna stages in other receivers. With the usual commercial type of antenna circuit, a short antenna will detune the antenna stage and reduce the sensitivity of the set accordingly. The antenna stage in this set is so constructed that it will not be affected by short or long antennas to any appreciable extent. The R.F. coils in each stage are marked with a color, according to the group in which they fall, and three coils of the same color are placed in the chassis. This color marking is a streak of paint inside the secondary coil inside the lugs. In ordering coils for replacement, be sure to mention the color of the paint on the coil so that the replacements will be of the same characteristics. If in doubt, return the coils.

#### Gang Condensers

The usual method of aligning the condenser by means of a small trimmer on the top of each individual unit is used. Trimmer condensers may be adjusted by inserting a screw driver through the hole in the condenser shield, and adjusting the screws controlling the trimmer plate. The shield should not be removed during the aligning process. At times it may be necessary to oil the drive shaft on the drum dial assembly. To do this, remove the tuning knob from the shaft and insert the

tip of the oil can. Use only enough oil to lubricate, otherwise the oil will work into the contacts of the condenser.

#### Volume Control

The volume control system in this receiver consists of a variable resistor (R1) of 11,500 ohms resistance, connected so that it varies both the radio frequency input to the receiver (by shorting the antenna and ground) and also the grid bias on the R.F. amplifier tubes. This system controls the volume very effectively. If the volume control does not reduce the volume promptly on a strong local signal, be sure the receiver is grounded properly.

#### Tone Control

The tone control consists of a high variable resistor and a condenser connected across two grids of the push-pull 245 tubes. If the condenser becomes shorted, adjusting the tone control, will not affect the tone, but will act as a volume control, and in such instances, the condenser should be replaced. The variable resistor does not carry any current and therefore should seldom give trouble. If, however, it does become defective, either by a short or by opening up, no control will be obtained over the tone.

#### Detector Circuit

Probably the most critical portion of the set is the screen grid detector circuit, and it is essential that a good tube be used in this position. The detector circuit is a screen grid power detector. This arrangement is such that considerable sensitivity is obtained and at the same time the overload factor is somewhat higher than the usual 227 tube in other circuits. If a poor tube is used in this socket, the hum from the speaker will immediately become evident. The set will also tend to

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## General Troubles

bubble on strong signals. Sometimes a tube which will do this in a set appears perfectly O. K. in the tube checker. Whenever either of these difficulties develop in the set, that is to say, hum or distortion on loud signals, try several detector tubes until the trouble is eliminated.

### No Tubes Light

(1) See if radio "on-off" switch is defective, or if power transformer primary is open. (2) Examine attachment cord and plug to see if connections are tight. (3) Make sure that the convenience outlet socket connections are correct, and that there is current at the socket. This test can be made with an A. C. voltmeter. (4) The tubes may all be defective.

### One or More Tubes Do Not Light

(1) Examine these tubes and see if they are defective. (2) Check the filament winding on the transformer. Note: If these tests show that the filament terminals on one of the sockets are open, examine the wiring at that socket.

### No Reproduction

*(Tubes Lighted; Normal Hum in Speaker)*

(1) One or more of the tubes may be defective; test the tubes. (2) The antenna circuit may be open. (3) The tuning condenser may be shorted, or the R.F. control grid circuits open.

### No Reproduction

*(Tubes Lighted; No Hum in the Speaker)*

(1) One or more of the tubes may be defective. Test the tubes, especially the 280 tube. (2) The high voltage secondary

### Excessive Hum

(1) Excessive hum is most usually caused by a defective tube in the detector or first audio socket. (2) In certain unusual cases, hum may be caused by a defective center tapped resistor across the 224 and 227 filament winding. (3) Excessive hum may also be caused by a shorted or open filter or by-pass condenser; however, this is an extremely rare occurrence due to the high margin of safety in the voltage ratings on our condensers. (4) Hum may also be caused by an open grid circuit in the 1st A.F. This is extremely rare. (5) Try other 224 tubes in the detector socket: Note: In some cases hum may be of a mechanical nature. If the filter choke hums, examine the cardboard wedge between the side of the chassis and the choke coil. If this wedge is loose, the choke may vibrate and cause mechanical hum.

### Sputtering or Motor Boating

(1) This may be caused by a defective 245 tube. (2) Sputtering or motor boating may also be caused by one of the 245 tubes not being lighted. (3) Check for an open 245 grid circuit or a defective push-pull input transformer.

### Howling

(1) The most usual cause of howling is a defective or microphonic detector tube. Try other 224 tubes in the detector socket. If the 224 is microphonic and yet cannot be replaced, slip a piece of rubber hose (a Ford lower radiator hose is just the right size) down, over the tube. (2) Howling is also caused by excess lengths of the antenna and ground wire inside the cabinet. The antenna and ground wires should run straight out from the cabinet, and should not run over or alongside of the chassis. (3) In extremely rare cases, a microphonic 227 tube in the first audio may cause howling.

on the power transformer may be defective. (3) The plate circuit in one of the audio amplifier tubes may be open. (4) The dynamic speaker coils may be open. (5) Filter condenser shorted.

### Weak Signals

(1) Some of the tubes may be weak or defective; test the tubes. (2) The power supply may not be of the proper rating, or the line voltage may be low; test the line voltage with a voltmeter, and determine the frequency of the power supply by calling the local power company. (3) The antenna or ground connection may be defective, or the antenna may have been erected in a shielded location. (4) The gang condenser may not be lined up properly. This may readily occur in a set that has been in use over one year, due to normal wear. It would also be well to slightly tighten the end thrust screw on the condenser after one year's use.

If the gang condenser is out of line, that is, if one or two of the single condensers in the gang are not balanced up with the others, it will be necessary to realign the gang. The most efficient method of doing this is to use a modulated oscillator.

If the service man does not possess an oscillator he can line the condensers up by ear. Tune in some weak station around 10 or 15 on the dial (the volume control being turned full on). If no such weak station is available, a strong station may be tuned in and the volume decreased by use of the volume control until the reproduction is inaudible over three feet from the speaker.

Now adjust each individual trimmer condenser until maximum volume on that station is secured. The trimmers may be adjusted by inserting the shank of a screwdriver through the holes in the condenser shield.

### Distortion

(1) Distortion may be caused by defective tubes; test the tubes. (2) If the grid bias on the tubes is very much higher or lower than normal, distortion may result. Check the voltages with an analyzer. (3) Distortion may also be caused by a defective audio transformer. (4) In very rare cases, distortion may be caused by C12 being open.

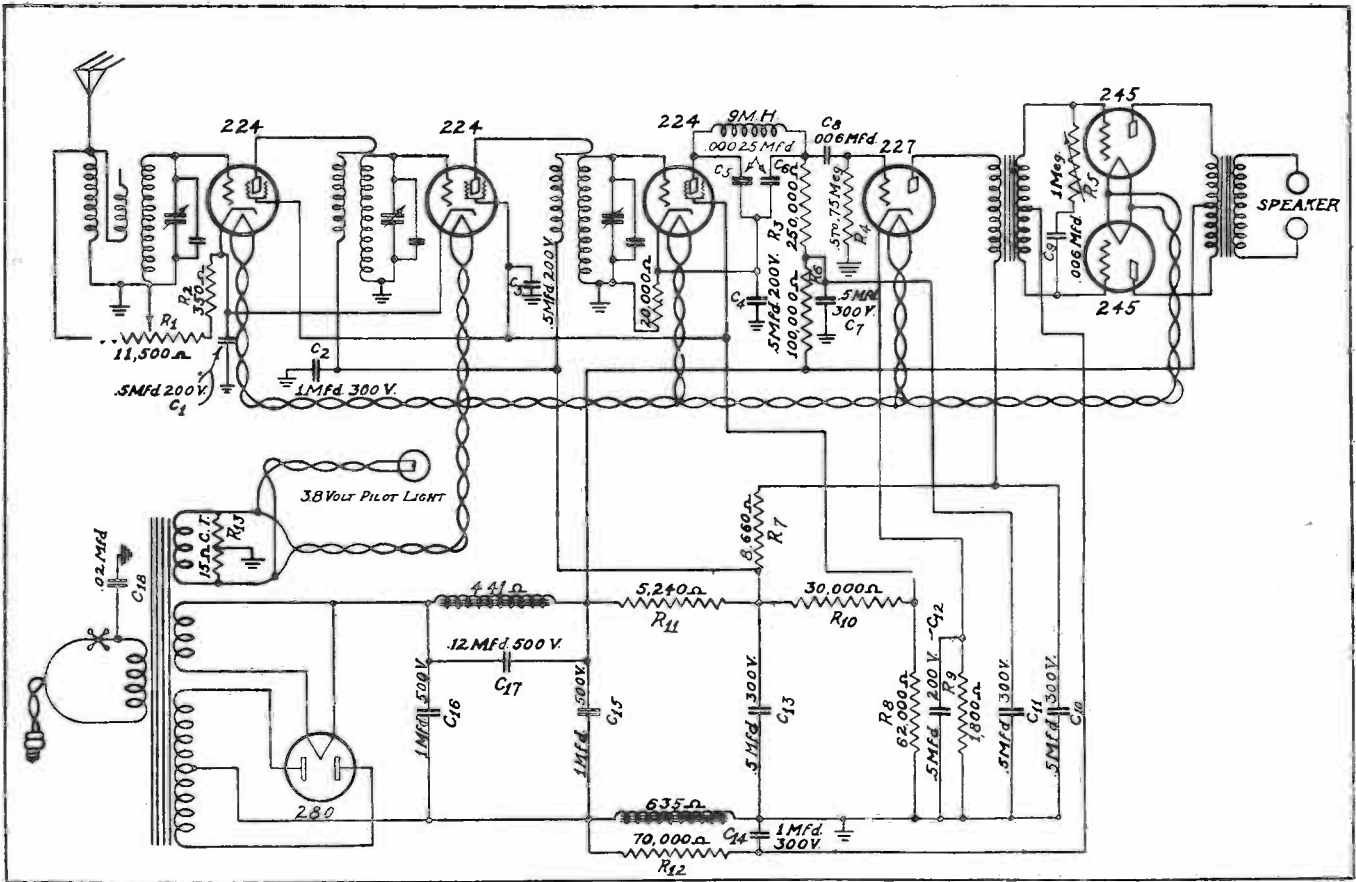
### Voltage Characteristics

All D. C. voltages taken with a 1,000 ohm per volt voltmeter. Check your line voltage before taking readings. Volume control full on.

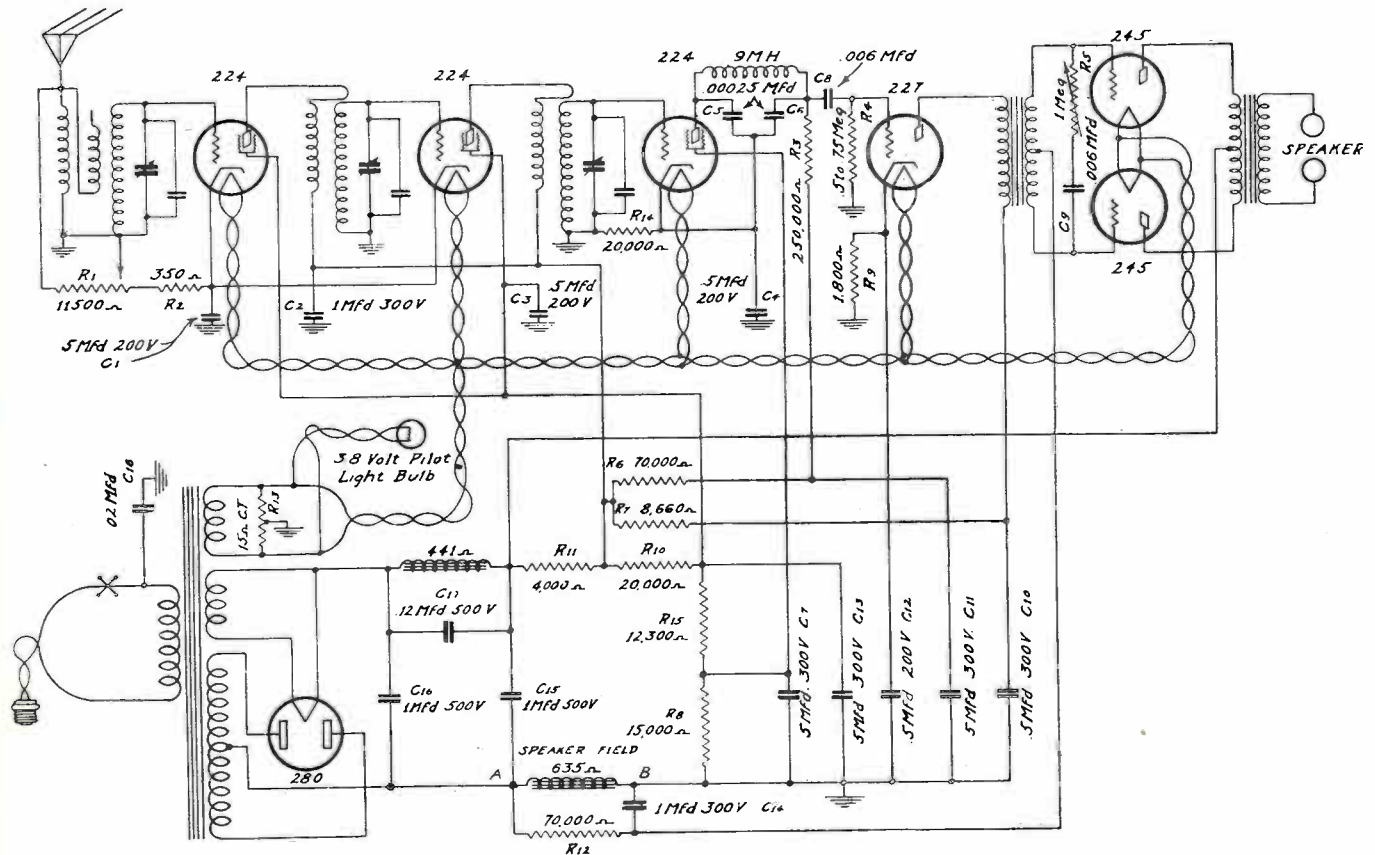
TUBE CIRCUIT UNDER TEST		LINE VOLTAGE				
		90 V.	100 V.	110 V.	120 V.	130 V.
224 R. F.	Fil.	1.75	1.95	2.17	2.3	2.57
	Plate	130	150	169	183	193
	Screen	68	78	86	94	100
	Cathode*	2.0	2.43	2.83	3.2	3.6
224 Detector	Fil.	1.77	1.97	2.19	2.33	2.6
	Plate	35	40.8	45.5	50.5	55
	Screen	37.5	43	48	52	56.8
	Cathode*	2.55	3.1	3.65	4.2	4.8
227 1st A. F.	Fil.	1.79	1.99	2.22	2.34	2.62
	Plate	95	108	118	122	138
	Cathode	5.7	6.7	7.5	8.4	9.3
245 2nd A. F.	Fil.	1.8	2.0	2.23	2.35	2.62
	Plate	180	210	233	255	280
	Grid	-35	-42.3	-49	-55	-62
280 Rect.	Fil.	3.66	4.1	4.55	4.8	5.35
	Plate Current	54 ma	64 ma	73 ma	82 ma	90 ma

\* Control grid voltages on the 224 tubes are measured from cathode to ground.

MONTGOMERY WARD & CO.



Picture 1. Schematic Diagram of Challengers with Serial Number Below A94313.



Picture 2. Schematic Diagram of Challengers with Serial Number Above A94313.

MONTGOMERY WARD & CO.



Commander and Cavalier 8 Tube  
 (No. 14,000) (No. 62,000)  
 Screen-Grid Receivers

Model 29 W chassis used in both the Commander and Cavalier sets is similar in all essential respects to the Airline Cortez and Coronado.

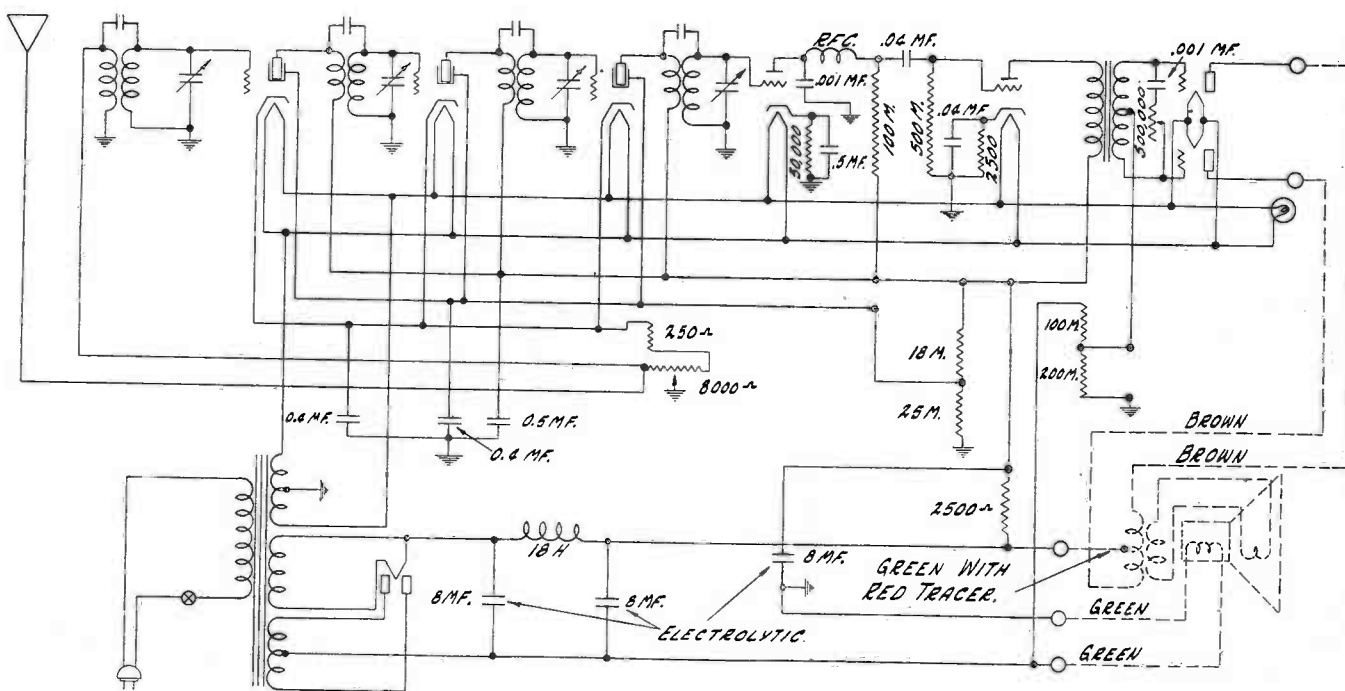
Certain changes have been made, however, which have to do chiefly with the operating voltages. The schematic diagram as compared with the diagram of the Cortez will show clearly where these changes have been made, and the operating voltages chart will show the effect that the changes have had in the voltages at the various tube sockets. In performance this chassis is quite similar to the Cortez, with the exception of slightly less power out-put when operated with the volume control full on.

Servicing instructions which apply to the Cortez also apply in the 29 W chassis. Do not forget, however, that in making any measurements with the set analyzer on the 29 W chassis, that the voltages are widely different from those used in the Cortez.

Operating Voltages

VOLTAGES AT SOCKETS—VOLUME CONTROL AT MAXIMUM—LINE VOLTAGE, 115 PLUG IN SOCKET OF RECEIVER—TUBE IN TEST SET

Type of Tube	Position of Tube	Function	A Volts	B Volts	Control Grid Volts	Screen Volts	Screen Current MA	Cathode Volts	Plate M.A.	Grid Test M.A.
224	1	1st Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
224	2	2nd Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
224	3	3rd Radio	2.3	247	4.0	103	.75	4.0	4.6	9.3
227	4	Detector	2.3	160	17	.....	.....	17	.35	.4
227	5	1st Audio	2.3	223	15	.....	.....	15	5.9	6.9
245	6	2nd Audio	2.25	243	29.2	.....	.....	.....	27.5	32
245	7	2nd Audio	2.25	243	29.2	.....	.....	.....	27.5	32
280	8	Rectifier	4.9	.....	.....	.....	.....	.....	.....	42.5



DOTTED LINES SHOWN ARE IN SPEAKER.

Picture 1. Schematic Diagram of Commander and Cavalier Sets

# RCA-VICTOR, INC.

## RCA-VICTOR RADIOLA MODEL M-30 AUTOMOTIVE RADIO SET

(Automatic Volume-Control—Push-Push Power Amplification—9 Tubes)

Automotive radio receivers have been undergoing a change, with the primary objective of obtaining in automobiles comparatively the same over-all efficiency which exists in the less mobile "home" installation. A close approach to this degree of perfection is obtained from the Radiola Model M-30 receiver, manufactured by RCA-Victor Co., Camden, N. J.

The values of the components of this receiver model are as follows:

Condensers C1, C2, C3, tuning condensers, 18-325 mmf.; C1A, C2A, C3A, trimmers, 4-50 mmf.; C4, padding condenser, 720 mmf.; C4A, padding trimmer, 10-75 mmf.; C5, trimmers, 15-75 mmf.; C6, trimmers, 140-220 mmf.; C7, 745 mmf.; C8, C10, 0.25-mf.; C9, C11, C12, 0.1-mf.; C13, C14, .0024-mf.; C15, C16, 0.5-mf.; C17, 4 mf.; C18, C19, .018-mf.

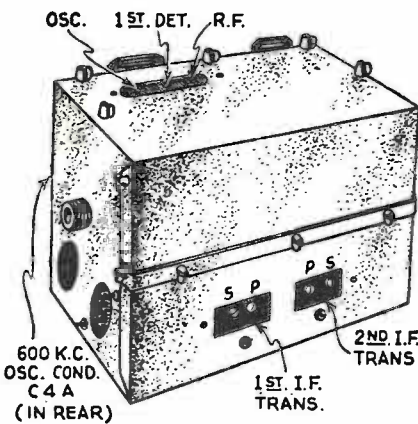
interference should be experienced with the receiver operating at full sensitivity. Approximate operating voltage and current values (obtained on a Weston Model 547 test set), taken with the volume control set at the "minimum" and "maximum" (maximum values shown in parentheses) positions are as follows:

Filament potential, V1 to V6, V9, 6 volts; V7, V8, 4.5 volts. Cathode-to-heater potential, V1, V4, 18 volts; V2, 1 volt; V3, 6 volts; V5, 12 volts; V6, 15 volts; V9, 10 (5) volts. Control-grid-to-cathode (or filament) potential, V1, 0.5-volt; V2, 3 volts; V3, zero; V4, 1. (0.5) volt; V5, 10 volts; V6, 2 volts; V7, V8, 20 volts; V9, 1. (9) volts. Screen-grid-to-cathode potential, V1, V4, 100 (70) volts; V2, 42 volts. Plate-to-cathode (or filament) potential, V1, V4, 136 (135) volts; V2, 150 volts; V3, 45 volts; V5, 110 volts; V6, 165 volts; V7, V8, 155 volts; V9, 15 volts. Plate current, V1, V4, zero (4 ma.); V2, 0.25-ma.; V3, V6, 3.5 ma.; V5, 0.5-ma.; V7, V8, 1.5 ma.; V9, zero. Screen-grid current, V1, V4, zero (1. ma.); V2, 0.1-ma.

Automatic volume-control tube V9 is connected to the cathode circuit of second-detector V5. The change in the bias voltage of V5, due to fluctuation of the signal, is applied to the control-grid of V9, resulting in a drop across plate resistor R7 which constitutes the control-grid bias for the R.F. and I.F. tubes. As the value of the plate current in a tube is a direct result of the voltage applied to the grid, a greater plate current in V9 gives a greater voltage drop across the resistor in its plate circuit and therefore a higher bias on the I.F. and R.F. stages, resulting in less sensitivity, and vice versa; previous A.V.C. systems have operated on different principles. Manual volume-control resistor R17 varies the bias on the control-grid of V9.

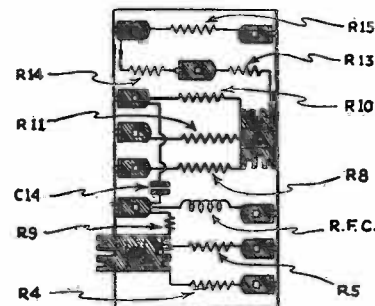
The total "A" current is 2.85 amps.; "B," 12 ma. min. and 25 average max. The power output rating of this receiver is 2 watts. This high rating is a result of "push-push" (or "class B") power output, which has been described in detail in past issues of RADIO-CRAFT; notably, the January and February, 1932 issues.

To adjust these circuits, dismantle the chassis but do not remove its connections or the flexible cable. Balance the R.F. circuits at 1400 and

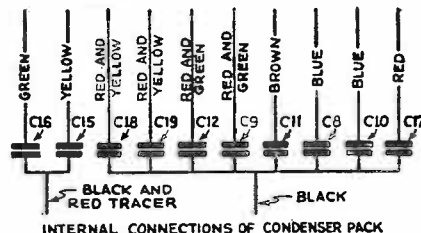


Resistor R1, 10,000 ohms; R2, 6,000 ohms; R3, 40,000 ohms; R4, R5, 30,000 ohms; R6, 170 ohms; R7, 0.5-meg.; R8, 28,000 ohms; R9, 0.1-meg.; R10, 1. meg.; R11, 3,500 ohms; R12, 4 ohms; R13, R14, 270 ohms; R15, 1,200 ohms; R16, 70,000 ohms; R17, 50,000 ohms.

The Model M-30 receiver has been designed with particular regard to ease of installation and service. Properly installed, freedom from



RESISTOR BOARD CONNECTIONS



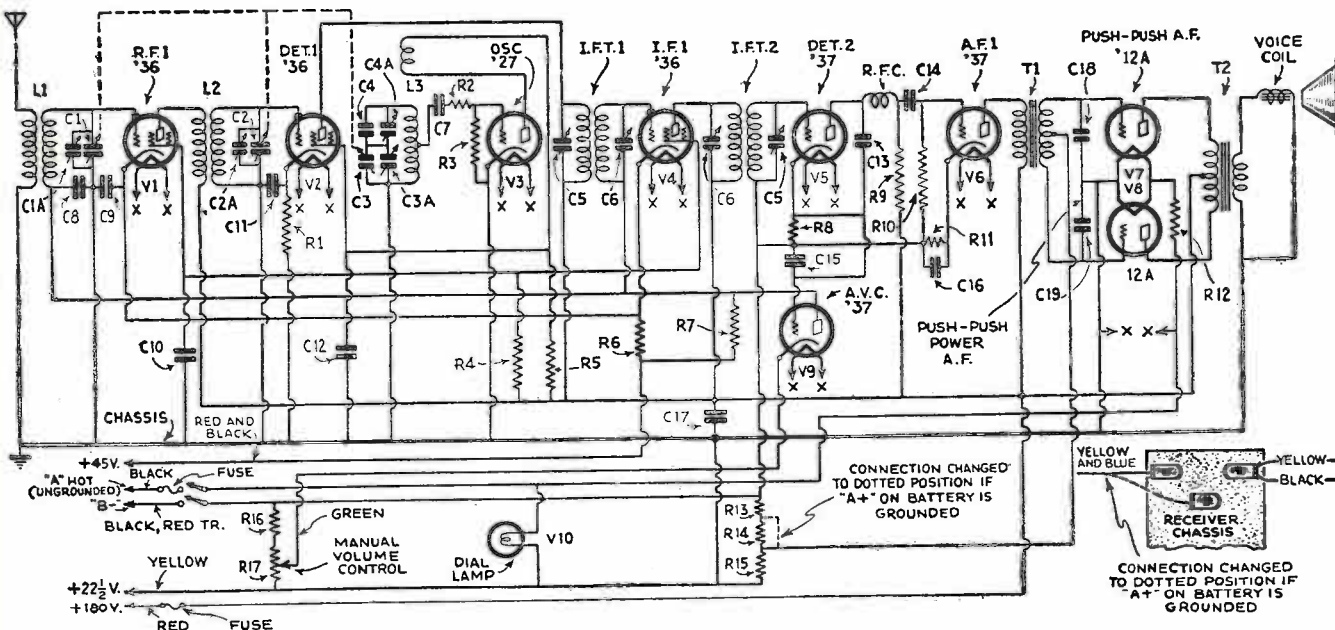
INTERNAL CONNECTIONS OF CONDENSER PACK

600 kc., using a No. 5 Spintite, and an insulated screw driver. When the dial indicates 150, the tuning condensers should be fully meshed. Padding condenser C4 comes into consideration when the 600-kc. adjustments are being made; its trimmer C4A is then adjusted, while the main condenser gang is rocked back and forth for maximum deflection on the output test meter. During these adjustments, V9 must be removed from its socket.

For the I.F. adjustments, at 175 kc., it is also necessary to remove the chassis from its mounting brackets.

Insufficient volume-control by means of R17 may be due to the use of a tube of wrong constants for V9.

In the receiver, the tubes are arranged in two rows. In one (left to right) they are: V3, V2, V1, V4, V5, V8; in the other: V9, V6, V7.



# PHILADELPHIA STORAGE BATTERY CO.

## Service Bulletin — No. 130

### Model 15 Series

The Philco Radio of the 15 series is an eleven-tube superheterodyne, employing the high efficiency 6.3-volt filament tubes, automatic volume control, superpower push-pull pentode output, and twin, electro-dynamic speakers. Philco shadow tuning and the combination distance switch and power switch on the control panel are additional features. The intermediate frequency used in adjusting the superheterodyne circuit of the 15 series is 175 kilocycles. The total power consumption is approximately 115 watts.

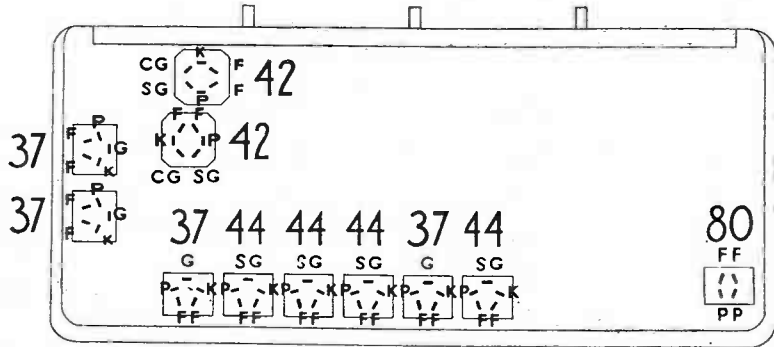


Fig. 1—Tube Sockets

F Filament  
P Plate  
SG Screen Grid  
CG Control Grid  
K Cathode

Caution: Never connect the chassis to the power supply unless the speakers are connected and all tubes are in place.

Table 1—Tube Socket Data\*—A. C. Line Voltage 115 Volts

Type	Tube Circuit	Filament Volts F to F	Plate Volts P to K	Screen Grid Volts SG to K	Control Grid Volts CG to K	Cathode Volts K to F
44	R. F.	6.3	165	55	15	30
44	1st Det.	6.3	250	90	15	10
37	Osc.	6.3	60	...	85	10
44	1st I. F.	6.3	250	90	85	10
44	2nd I. F.	6.3	275	90	3	10
37	Det.-Rect.	6.3	0	...	2	10
37	1st Audio	6.3	75	...	4	10
37	2nd Audio	6.3	100	...	2	10
42	P. P. Output	6.3	255	270	15	15
42	P. P. Output	6.3	255	270	15	15
80	Rectifier	5.0	320/Plate	...	...	...

\*All of the above readings were taken from the under side of the chassis using test prods and leads with a suitable A. C. volt meter for filament voltages and a high resistance multi-range D. C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end. Power switch in middle position.

Table 2—Power Transformer Data

Terminals on Figs. 3 and 4	A. C. Volts	Circuit
1-2	105 to 125	Primary
3-5	6.3	Filament
6-7	5.0	Filament of 80
8-10	720	Plates of 80
4	...	Center Tap of 3-5
9	...	Center Tap of 8-10

Table 3—Resistor Data

No. on Figs. 3 & 4	Power (Watts)	Resistance (ohms)	Terminals	COLOR		
				Body	Tip	Dot
66	...	50	1-2	Long	Tubular	
		50	2-3			
		205	3-4			
36	.5	1000	...	Brown	Black	Red
		5000	...			
45	.5	10,000	...	Green	Black	Red
		5000	...			
1	.5	13,000	...	Green	Black	Orange
		25,000	...			
32	1	51,000	...	Brown	Orange	Orange
		99,000	...			
50	.5	160,000	...	Red	Blue	Yellow
		240,000	...			
21	.5	490,000	...	White	White	Yellow
		1,000,000	...			
40	.5	...	...	Yellow	White	Yellow
		...	...			
10	.5	...	...	Red	Black	Green
		...	...			

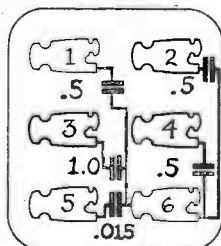


Fig. 2—Internal Connections Filter Condenser

# PHILADELPHIA STORAGE BATTERY CO.

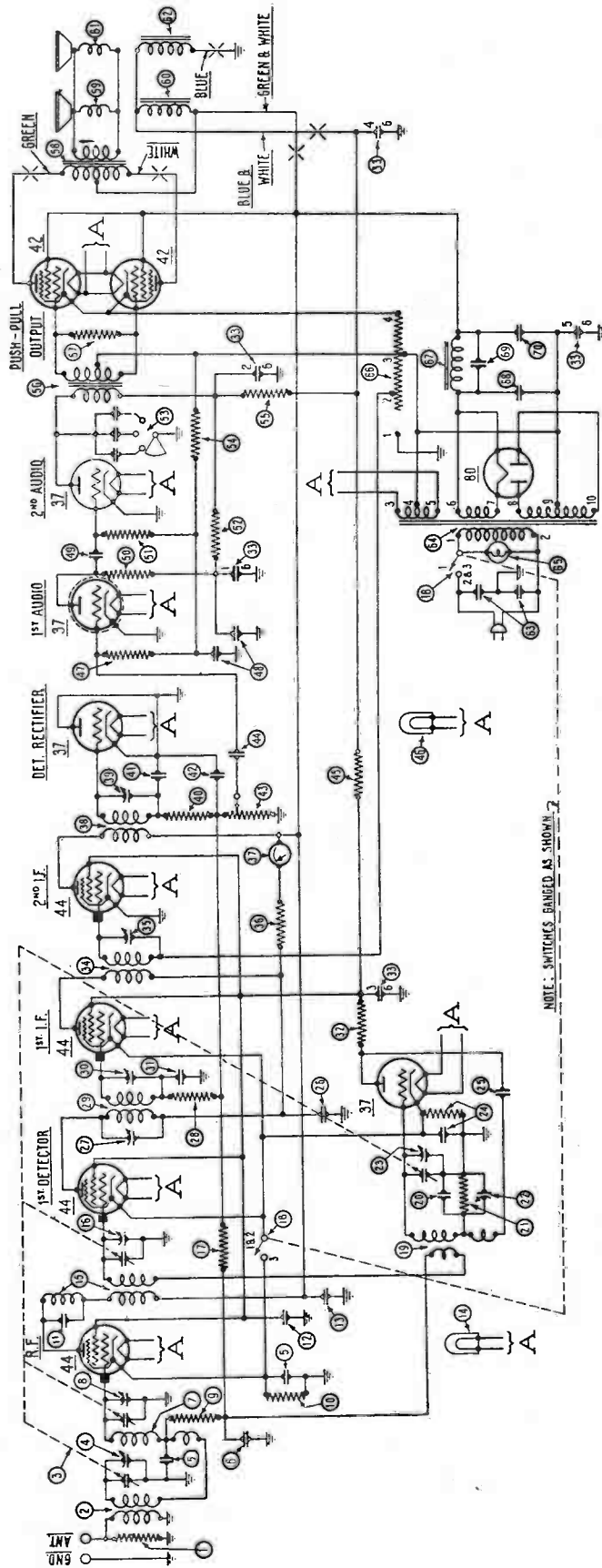


Fig. 3—Schematic Wiring Diagram



# PHILADELPHIA STORAGE BATTERY CO.

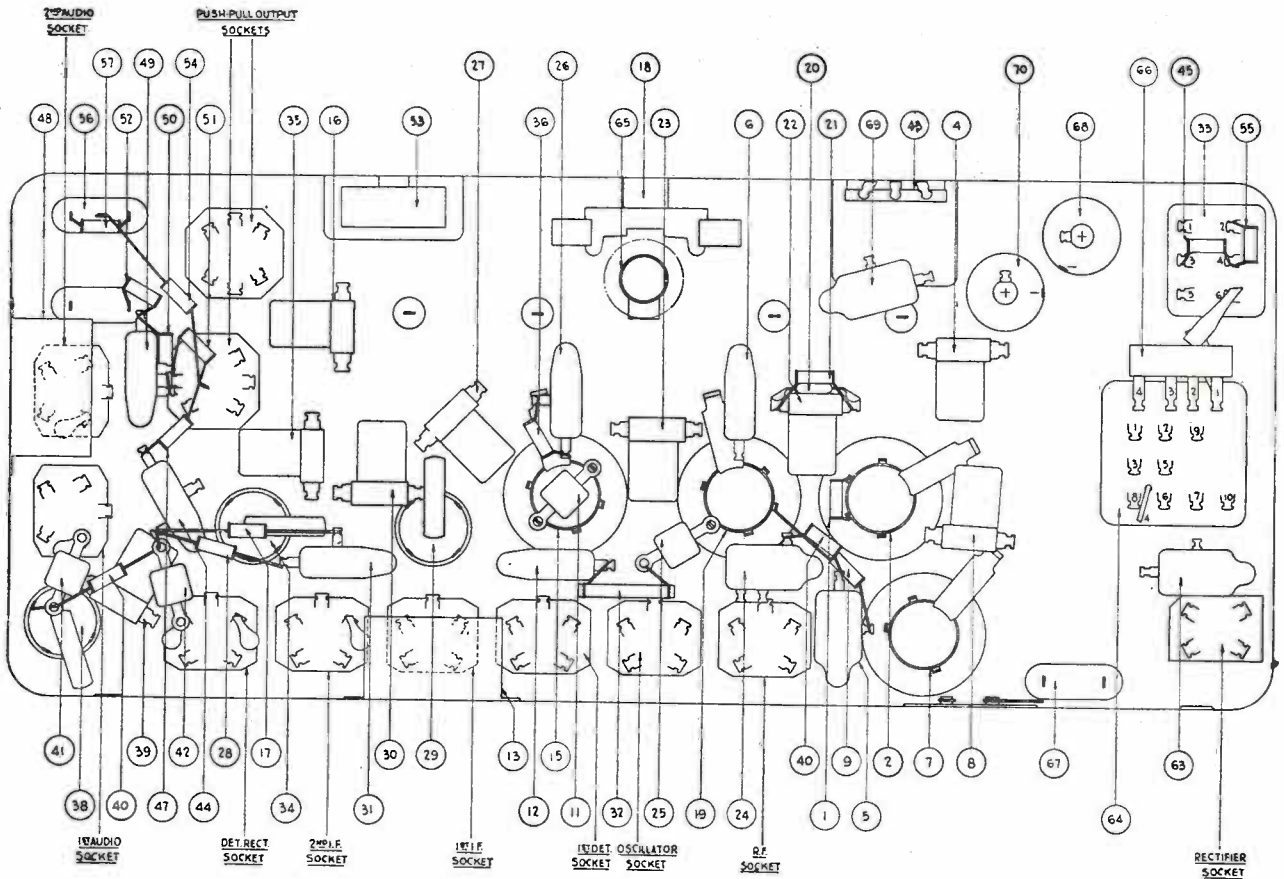


Fig. 4—Parts Diagram

## Adjustment of Model 15 Series

These receivers are accurately adjusted at the factory prior to shipment. Under normal conditions it will never be necessary to re-adjust the compensating condensers. If for any reason such adjustment should be required, it should not be attempted without first receiving the proper instruction and equipment from your distributor. The Philco Model 095 Oscillator has been especially designed for use in this work and will be found the most in expensive and most reliable for the purpose.

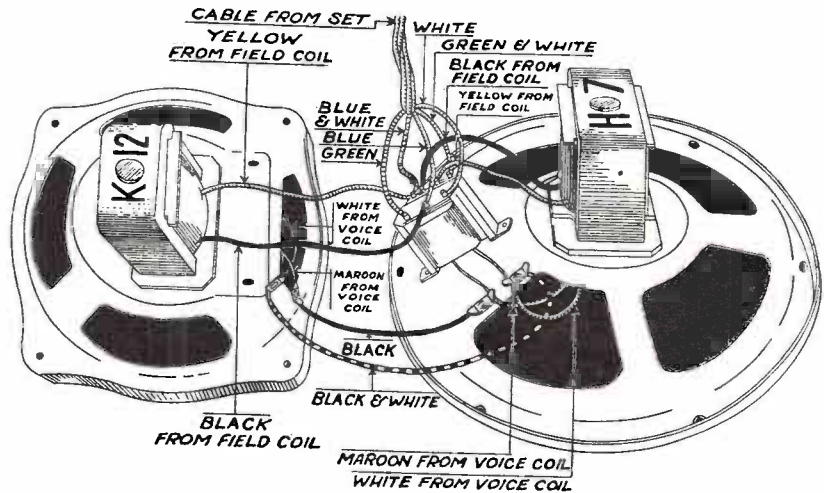


Fig. 5—Speaker Connections

# PHILADELPHIA STORAGE BATTERY CO.

# PHILCO

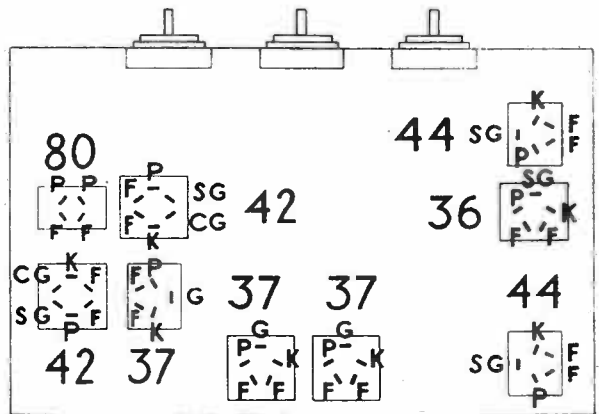
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## Service Bulletin—No. 129

### Model 91 Series

The Philco Radio of the 91 series is a nine tube super-heterodyne, employing the high efficiency 6.3 volt filament tubes, automatic volume control, shadow tuning, and push-pull pentode output. The chassis is made in two different types, one known as the 121 type, employing a single dynamic speaker and the other known as the 221 type, employing twin dynamic speakers. These type numbers appear on the radio chassis as a part of the model number. Chassis of one type are not interchangeable with those of another. The intermediate frequency used in adjusting the superheterodyne circuit of the 91 series is 260 kilocycles. The power consumption of the various models is as follows:

Model	Volts	Cycles	Watts
91-121	115	50-60	90
91-221	115	50-60	95
91A-121	115	25-40	92
91A-221	115	25-40	97
91E-121	230	50-60	90
91E-221	230	50-60	95



F = Filament      SG = Screen Grid      K = Cathode  
P = Plate          CG = Control Grid

Fig. 1—Tube Sockets

Table 1—Tube Socket Data\*—A.C. Line Voltage 115 Volts

Type	Tube Circuit	Filament Volts	Plate Volts	Screen Grid Volts	Control Grid Volts	Cathode Volts
44	R.F.	6.3	200	50	.6	25
36	Det.—Osc.	6.3	250	80	10	10
44	I.F.	6.3	250	85	.2	5
37	Det.—Rect.	6.3	0	...	.2	2
37	Det.—Ampl.	6.3	60	...	.2	2
37	Audio	6.3	100	...	0	2
42	Output	6.3	240	250	15	15
42	Output	6.3	240	250	15	15
80	Rectifier	5.0	310/Plate	...	...	...

\*All of the above readings were taken from the under side of the chassis, using test prods and leads with a suitable A.C. voltmeter for filament voltages and a multi-range D.C. voltmeter for all other readings. Volume control at maximum and station selector turned to low frequency end.

Table 2—Power Transformer Data

Terminals	A.C. Volts	Circuit	Color
1-2	105 to 125	Primary	White
3-5	6.3	Filament	Black
6-7	5.0	Filament 80	Blue
8-10	670	Plates of 80	Yellow
4	...	Center Tap of 3-5	Black Yellow Tracer
9	...	Center Tap of 8-10	Yellow Green Tracer

Table 3—Resistor Data

Nos. on Figs. 4 & 5	Resistance (ohms)	Power (Watts)	Terminals	Color					
				Body	Tip	Dot			
Ⓞ Single Speaker	900	...	1-2	LONG	TUB	ULAR			
	2700	...	2-3						
	95	...	3-4						
	205	...	4-5						
	136	...	1-2						
Ⓞa Twin Speaker	Blank	...	2-3	LONG	TUB	ULAR			
	85	...	3-4						
	205	...	4-5						
	1,000	.5	...				Brown	Black	Red
	10,000	.5	...				Brown	Black	Orange
Ⓞ1	15,000	.5	...	Brown	Green	Orange			
	25,000	.5	...	Red	Green	Orange			
Ⓞ1a	13,000	1.	...	Brown	Orange	Orange			
	99,000	.5	...	White	White	Orange			
Ⓞ2	490,000	.5	...	Yellow	White	Yellow			
	1,000,000	.5	...	Brown	Black	Green			
Ⓞ3	1,000,000	1.	...	Brown	Black	Green			
	1,000,000	1.	...	Brown	Black	Green			

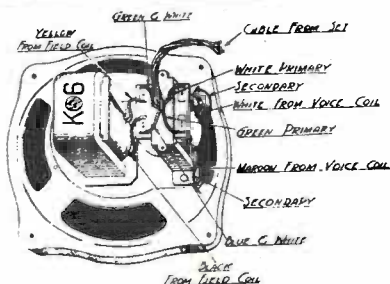


Fig. 2—Speaker Connections—121 Code

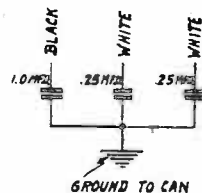


Fig. 3—Internal Connections Filter Condenser

# PHILADELPHIA STORAGE BATTERY CO

## PHILCO MODEL 91 SERIES

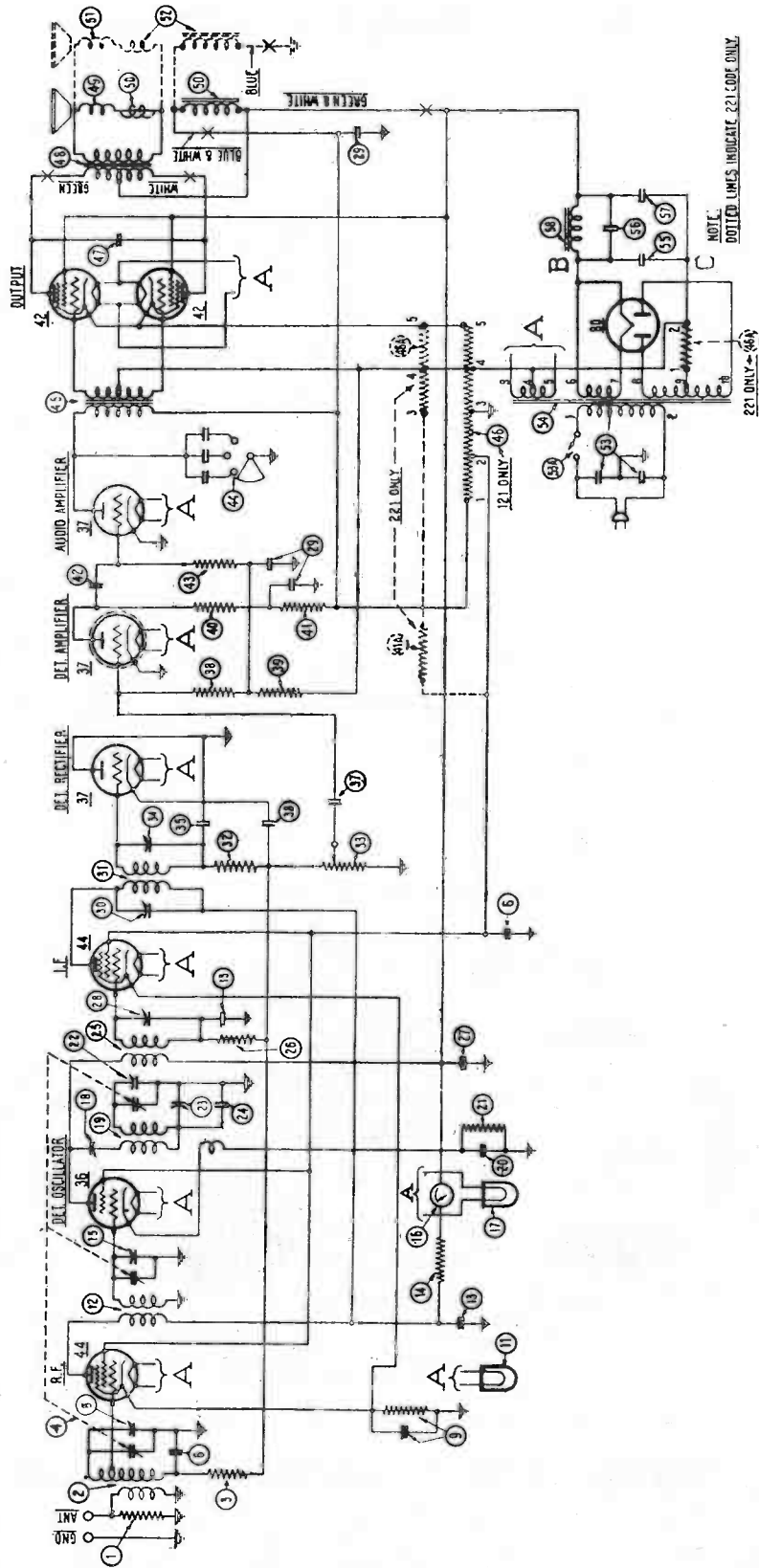


Fig. 4—Schematic Wiring Diagram

# PHILADELPHIA STORAGE BATTERY CO.

## PHILCO MODEL 91 SERIES

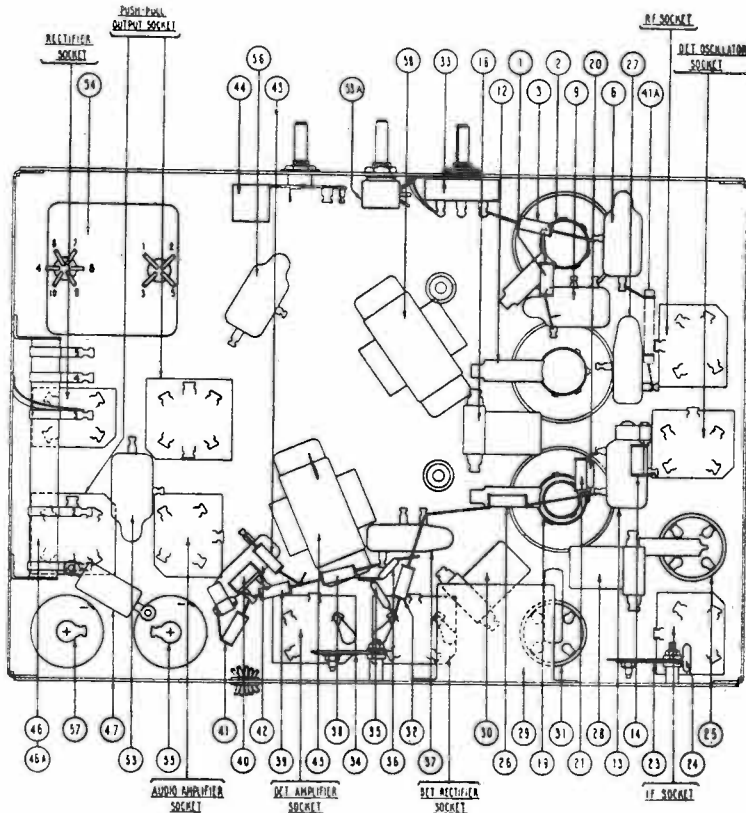


Fig. 5—Parts Diagram

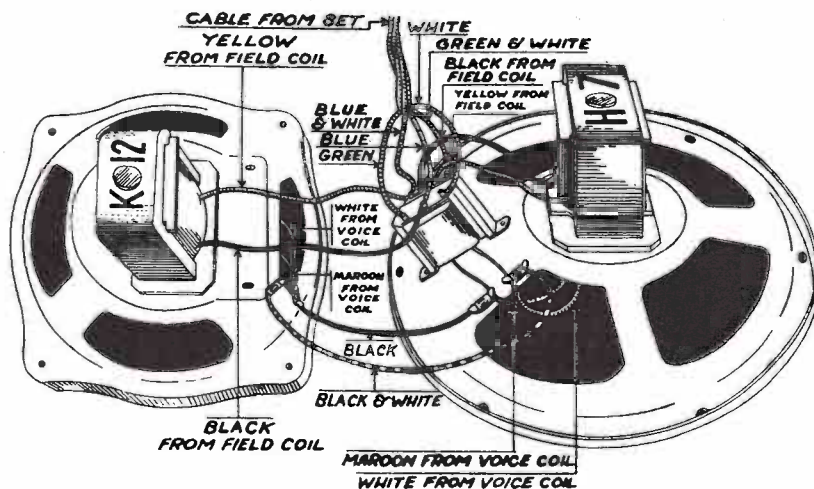


Fig. 6—Speaker Connections—221 Code

### ADJUSTMENT OF MODEL 91 SERIES

These receivers are accurately adjusted at the factory prior to shipment. Under normal conditions it will never be necessary to re-adjust the compensating condensers. If for any reason such adjustment should be required, it should not be attempted without first receiving the proper instruction and equipment from your distributor. The Philco Model 095 Oscillator has been especially designed for this work, and will be found the most inexpensive and most reliable for the purpose.

# STROMBERG-CARLSON TELEPHONE MFG. CO.

## STROMBERG-CARLSON No. 29, 9-TUBE SUPERHETERODYNE RECEIVER

What is probably the first receiver to derive its designation from the number of its design features is the "29" receiver of Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y. These features, as furnished by the factory, are listed below (where their position in the circuit is not evident from the wording, a more detailed description of the nomenclature is given):

1. Optosynchronous (Visual) Tuning, with sensitive meter for accurate setting of the station-selector dial;
2. Mono-Vision Dial and Tuning Meter, for quick, accurate tuning;
3. Large Baffle Area Cabinet, for full, smooth range of musical and voice tones;
4. Manual Volume-Control, for pre-setting to desired audio volume and for increasing sensitivity on extreme distance;
5. Level-Action Automatic Volume-Control, to maintain the predetermined volume over an extremely wide range of signal strength;
6. Detectomatic (Duo-Diode) Detector, for most efficient demodulation action;
7. Adjustable Automatic Clarifier, to allow hand adjustment of high-frequency reproduction to meet receiving conditions; (R15-C27);
8. Antenna Aligner, for obtaining maximum results with any particular size of antenna;
9. Image Suppressor, for giving a very high discrimination (over 100,000 to 1) against "cross-talk"; C1-C2-C3, L1-L2-L3;
10. Isolated Oscillator Tube and Circuit, for correct control of sensitivity;
11. Bi-Resonator Radio-Frequency Tuning System, for better selectivity; C1-C2, L1-L2, C;
12. Tri-Resonator Intermediate Amplifier, providing high selectivity;
13. Triplex Audio System, employing screen-grid first audio, and push-pull output;
14. Variable-Mu (Super-Control) Screen-Grid Tubes, for long range of action;
15. Triode Push-Pull Output, for best audio quality;
16. Four-Gang Tuning Condensers, for super-selectivity;
17. Non-Glare Dial, with wide-spaced markings for easy and accurate tuning;

18. Phonograph Key, for switching from radio to records;
19. Telephone Cabling, grouping of wires in neat, insulated cables for quiet operation;
20. Full-Size Chassis, avoids crowding units and provides accessibility for servicing;
21. Highly Efficient, Large Size Electro-Dynamic Speaker, to give ample undistorted sound output;
22. Karvart Panel of Airplane Fuselage Construction, giving ornamental carved design of real wood;
23. Precision-Selected Tubes, sealed in sockets, the style of tubes used having been picked for best over-all results;
24. Non-Radiating, avoids disturbing, with heterodyne squeals, neighboring radio receivers;
25. Super-Sensitivity, the highest compatible with clarity of reception;
26. Flexibility of Volume, from a whisper to auditorium volume;
27. Oscillograph Aligned, Tested and Sealed, to assure laboratory performance in every set;
28. Telephone-Built, by a manufacturer with more than 37 years experience;
29. Heavy Genuine Walnut Veneer Cabinet, for beauty and permanence.

Taking these points in their numerical order, the following comments are made in further explanation. Number 6 refers to the new type detection circuit by which a single type '27 tube is made to function approximately similar to two separate two-element, or diode tubes; here the grid and cathode of V5 function as a diode type of second-detector (or "demodulator"), while its plate and cathode function as a diode type of automatic volume-control detector. Since V5 must serve a dual purpose, it is essential that exceptional care be given to the selection of a tube for this position; for the tube must possess characteristics which will meet the requirements of dual service. The audio output of V5 appears across load resistor R7; the degree of input to the audio system is under control by variation of the setting of the arm of potentiometer R1, the manual volume-control ("No. 4").

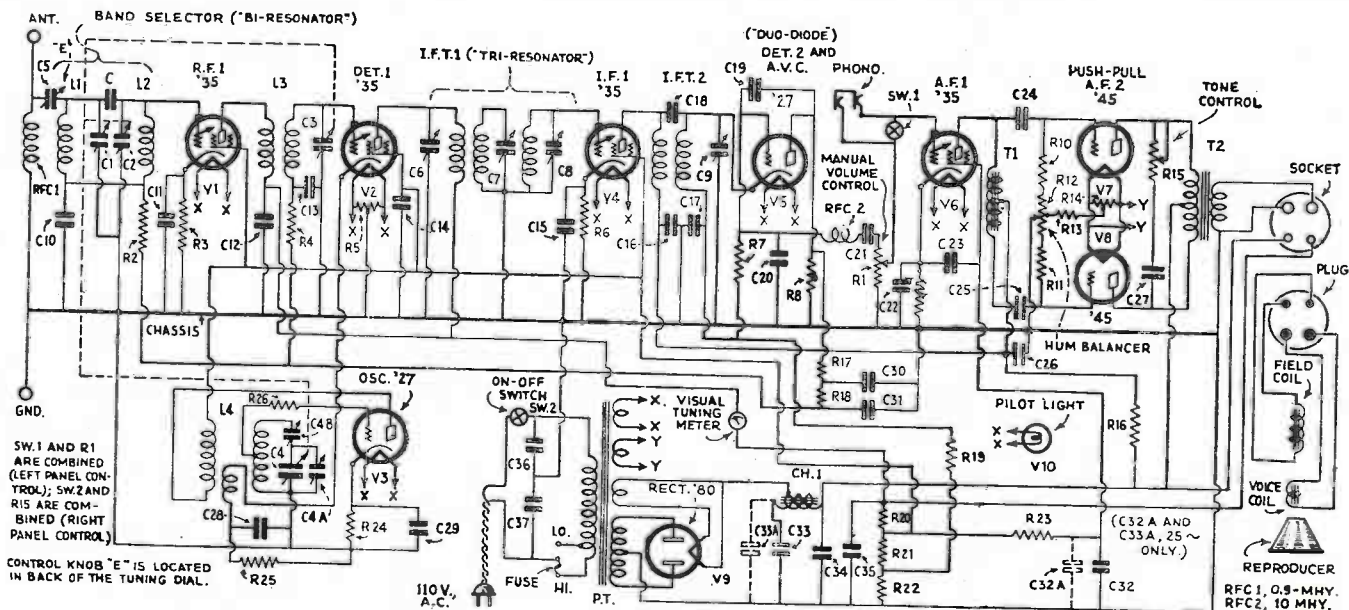
The antenna aligner, No. 8, is variable condenser C5 in the diagram; its control knob is located on top of the R.F. coils' shield can, and close to the front edge of the chassis, between the tuning knob and the off-on switch and tone-control combina-

tion knob. Tune in a weak signal at the high frequency (1500-kc.) end of the dial, and adjust this antenna condenser knob (marked E in the diagram on the label in the rear of the receiver) until maximum volume is obtained. Leave this knob set at the position of maximum response. If the antenna or ground wires are changed at any future date, this knob must be readjusted. For this purpose a very weak signal should be used, in order to obtain the best over-all sensitivity. If the signal is strong enough to operate the visual tuning meter, adjust the knob E, for greatest swing after tuning the station selector for best reception. The I.F. is 175 kc., peak-tuned.

All resistor and condenser values are as follows: Resistor R1, variable, 0.5-meg.; R2, R4, R18, R19, 0.1-meg.; R3, R6, R9, 600 ohms; R5, 3 ohms; R7, R10, R11, 0.25-meg.; R8, R15 (tone control); R17, 0.5-meg.; R12, hum balancer (center-tapped), 400 ohms; R13, 750 ohms; R14, 10 ohms; R16, R23, 10,000 ohms; R20, 2,174 ohms; R21, 2,080 ohms; R22, 340 ohms; R24, 6,500 ohms; R25, 4,000 ohms; R26, 500 ohms.

Condensers C1 to C9 include the tuning, coupling, and trimming condensers; C10, C19, .04-mf.; C11, C13, C30, C31 .05-mf.; C12, C14, C15, C17, C28, 0.3-mf.; C16, C27, 0.1-mf.; C18, C20, C29, 100 mmf.; C21, C24, C25, C36, C37, .01-mf.; C22, C35, 1. mf.; C23, .45-mf.; C26, C32, C34, 2 mf.; C33, 6 mf.

Operating current and potential values are taken with a line potential of 110 volts and the fuse in the "LO" position. It is necessary to use the meter scales specified (in parentheses) for each reading: (1), 0-4 V., A.C.; (2), 0-8 V., A.C.; (3), 0-10 V., D.C.; (4), 0-250 V., D.C.; (5), 0-750 V., D.C. Filament potential, V1 to V8, and V10, 2.48 V. (1); V9, 4.9 V., (2). Cathode-to-chassis potential, V1, V4, V6, 3 V., (3); V3, 16 V., (4). Control-grid bias, V7, V8, 50 V., across R13, (4). Plate-to-chassis potential, V1, V2, 170 V., (4); V3, 87 V., (4); V4, 220 V., (4); V6, 192 V., (4). Plate potential, V5 (measured as the voltage drop across resistor R22), 12.5 V., (4). Plate potential, V7, V8 (measured between either tube plate and the center-tap of resistor R14), 250 V., (5). Screen-grid potential, V1, V2, V3, 87 V., (4). The potential across the field coil is 127.5 V., (4); the A.C. plate-to-chassis potential of V9 is 340 V.



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The importance of the last two OFFICIAL RADIO SERVICE MANUALS to those engaged in the Radio Industry has been shown by the fact that over 52,000 copies of both editions have been purchased and are in use by manufacturers, jobbers, dealers, Service Men and experimenters. Incessant demands have encouraged us to publish a new and bigger SERVICE MANUAL for 1933.

The new manual will not contain so many full-page illustrations as in the past for the reason that not as many new sets are being put out at present, but will have in its contents important information that has not yet appeared in print. This new "dope" is invaluable to radio men. Stress has been emphasized on giving only practical material, not complicated theory. It is bound to save time and money for everyone.

The simplicity in the makeup of the 1933 Manual makes information easy to find, accurately and quickly. As in the past the size will be 9 x 12 inches, with flexible, looseleaf leatherette cover.

Many additional features will be included in the new manual. The FREE QUESTION AND ANSWER SERVICE which was extremely popular in the previous edition will also be maintained. We assure you that the 1933 OFFICIAL RADIO SERVICE MANUAL will be a revelation in radio literature.

Advanced orders are now being accepted at a most attractive pre-publication price of \$4.00. Immediately upon publication of the new MANUAL this price shall be withdrawn and the Five Dollar sales price shall prevail. Take advantage of this low price—send your order today. Be among the early ones to get a copy from the first printing. Checks or money orders accepted—register letter if it contains cash or unused U. S. Postage Stamps.

THE OFFICIAL RADIO SERVICE MANUAL  
FOR 1933 COMES TO YOU COMPLETE  
THIS YEAR—NO SUPPLEMENTS

# RADIO SERVICE MANUAL

*The following are partial contents of the 1933 Manual:*

- Complete operating notes, and hints from actual experience with radio receivers in the field, collected by practical Service Men all over the country.
- Complete actual, pictorial views of hundreds of commercial receivers with additional schematic diagrams. Location of parts on the chassis are shown, and where important adjustments must be made. This section alone is worth the price of the book.
- Values of all intermediate frequencies used in superheterodynes, and a complete section of valuable service data on superheterodynes.
- Values of resistors and condensers, to aid in replacement work.
- Latest information on combination long- and short-wave receivers, short-wave adapters and converters.
- How to tune and service short-wave receivers for best results.
- How to use the most modern servicing instruments.
- Complete section showing how the Service Man can build himself service instruments, oscillators, etc., at very low cost.
- Complete section on the construction of all test equipment, including high- and low-frequency oscillators, tube checkers, ohmmeters, etc.
- Tube-chart information on all new and old tubes, in handy form for quick reference; indicating socket connections and operating values, thereby preventing confusion.
- An entire section on money-making suggestions for Service Men, written by the Service Men themselves who have made a success of the business; giving you short cuts and commercial information on how to get the most out of the servicing game.
- Servicing information on interference elimination, with practical data and many examples of interference prevention.
- Automobile radio installation and servicing—hints on automobile radio in general. Complete data on servicing all known, commercial, automobile receivers with shorts cuts to get quickly at the seat of the trouble.
- Service kinks, servicing short cuts, and miscellaneous servicing information.
- A complete section of various radio tables of every imaginable kind, in constant use by up-to-date Service Men.
- A large section giving complete technical data on meters of every kind pertaining to servicing in general.
- Complete index and cross-index to make it easy for you to find almost anything pertaining to service *instantly*.

## FREE QUESTION AND ANSWER SERVICE

In every copy of the 1933 Manual, 24 coupons will be found, which will entitle you to 24 thorough and complete answers by mail on servicing and operating on any of the sets or circuits mentioned in the manual, as well as any others not mentioned, for which you might have need. This service alone is worth \$6.00. But it is absolutely free to manual owners.

## GERNSBACK PUBLICATIONS, INC.

98-D PARK PLACE  
NEW YORK, N. Y.

# SPARKS WITHINGTON CO.

## SPARTON MODEL 40 6-TUBE T.R.F. AUTOMOTIVE RECEIVER

(Lafoy-type Automatic Volume Control; Remote Tuning Control; Electro-Dynamic Reproducer)

To maintain constant signal output, regardless of the intensity of the incoming signal (within practical limits), to overcome the reduction in signal intensity which will occur in a given locality (due to metallic structures, ore deposits, etc.) it is necessary to incorporate some form of volume control which will operate to vary the gain in the amplification of the receiver in proportion to the loss in carrier signal strength. Most automatic volume controls or A.V.C. circuits operate to vary the control-grid of the amplifier tubes, in accordance with the A.P. modulation of the station's carrier; the "Lafoy" system, however, varies the control-grid bias more nearly in accord with the intensity variations of the station's carrier itself, the A.V.C. tube V6 in the diagram, functioning more nearly as an R.F. amplifier than as a detector.

High amplification in this set is obtained through the use of a three-stage R.F. amplifier incorporating screen-grid tubes of the "automotive" type, the output of this section feeding a screen-grid detector. The audio circuit comprises a single pentode, which is impedance- and resistance-capacity-coupled to the detector.

The values of the components are as follows: Condensers C1, C2, C3, C4, tuning units; C5, antenna compensator; C6, C8, C10, C12, 0.2-mf.; C7A, 0.3-mf.; B, 0.2-mf. C, 0.3-mf.; C9A, 0.3-mf., B, 0.2-mf., C, 0.3-mf.; C11A, 0.3-mf., C, 0.3-mf.; C13, C14, .00025-mf.; C15A, 0.3-mf., B, 0.2-mf.; C16, coupling condenser, .01-mf.; C17, .0005-mf.; C18, .006-mf.; C19, 1. mf.; C20, 0.1-mf.

Resistors R1, R2, R5, R7, 20,000 ohms; R3, R4, R6, 5,000 ohms; R8, 30,000 ohms; R9, manual volume control, 1/4-meg.; R10, 1/4-meg.; R11, 160 ohms; R12, 350 ohms.

Correct methods for installing and servicing antennas and interference suppressors have been described in past issues of RADIO-CRAFT. However, a little additional data is available.

For the aerial in collapsible type tops, we recommend that the "false top" type be employed. This type of aerial is constructed in the following manner:

Fashion two pieces of drill cloth that are the same color as the top material, as long as, and approximately six inches narrower than the roof. On one section, lay a piece

of light weight felt of the same dimensions, and then lay on top of the felt a piece of 16-mesh copper screen wire the same size. On top of this wire, lay another piece of light weight felt and over this the second section of drill cloth, then sew the edges of the combination together.

The top deck is removed from the roof bows and the aerial is placed on top of them. The top decking is then placed back over the aerial.

Where it is desired to let the top down, it is advisable to connect the aerial lead-in wire to the aerial at the rear, and let the shielding on this wire, extend only for a distance of about three feet from the receiver end. In such cases, the lead-in wire is run through the floor boards back of the seat underneath the car, up to the receiver.

Note that in this receiver there are two fuses; one of them is of 1/8-A. rating, and is connected in the "B" battery jumper wire, while the other is a 5 A unit located in the receiving unit near the ground binding post.

Interference may be distinguished by the sound: Generator noises (eliminated by bypassing the commutator) are tone frequencies quite different from the staccato tapping; sound of high-tension spark interference; high-tension interference is a sharp,

raspy sound and can be eliminated practically 100 percent by means of spark suppressors (on the distributor and spark plugs); low-tension breaker point noise is not readily distinguished from high-tension interference, but will be the sound remaining after spark suppressors have been installed. Low-tension breaker interference is difficult to eliminate. Try reversing the two primary leads to the coil; install a bypass condenser connected from the engine to the ammeter and switch lead.

The operating voltage and current characteristics of this set are to be measured with a set analyzer equipped with a voltmeter of the 1,000-ohms-per-volt type; the manual volume control must be turned to the full on position, and with no signal reception.

The filament potential of all tubes is 6 volts. Plate potential, V1, V2, V3, V5, 135 volts; V4, 132 volts; V6, zero. Control-grid, V1, V2, V3, 1.5 volts; V4, 10 volts; V5, V6, 18 volts. Screen-grid potential, V1, V2, V3, V4, 67.5 volts; V5, 135 volts; V6, zero. Plate current, V1, V2, V3, 3 ma.; V4, 0.1-ma.; V5, 8 ma.; V6, zero.

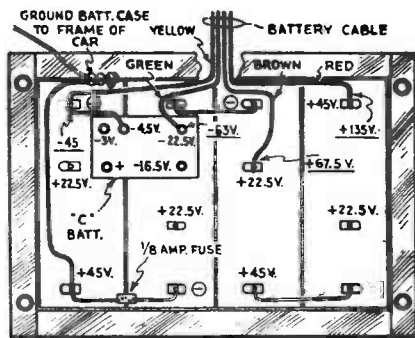
The antenna compensating condenser C5 is to be adjusted at the time the receiver is installed. Tune in a weak station between 1200 and 1400 kc., turn the volume control full on, and then, using an insulated screwdriver, adjust C5 for maximum receiver output. Never adjust either the C5, or the remaining trimmers, with the cover removed.

Circuit oscillation can be caused either by tubes or the receiver itself. Check the contact surfaces between the partitions and the rotor shaft, making sure that a good ground is obtained. Do not under any conditions oil the shaft under the contacts. Make sure that the receiver chassis is well grounded.

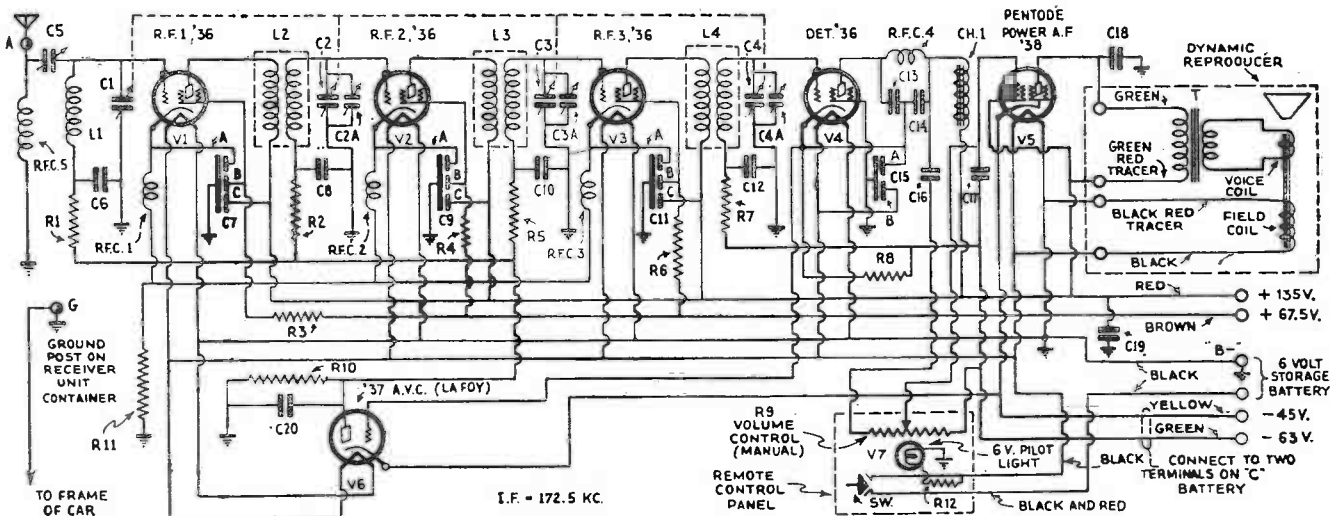
For best results it is essential that the receiver unit be located so that the remote control flexible-shaft runs direct (that is, without sharp bends).

The battery circuit for this receiver is unusual, as indicated in the diagram; an additional figure illustrates the connections.

The "A" battery consumption of this set is about 2 1/2 A.; the "B" requirements, about 20 ma.



Sketch of the battery box showing the location of the cable and the battery.



Complete schematic circuit of the Sparton model 40 receiver using the new Lafoy system of automatic volume control.