Form 214 3c-12-32-E.

No. 2123-2124 Series
12-Tube A. C. Superheterodyne Receiver
With Automatic Volume Control, Meter Tuning, Noise Suppressor and Class "B" Tubes.
SERVICE MANUAL AND PARTS LIST

CIRCUIT

THE circuit consists of an R.F. transformer with tuned secondary, feeding into a type 58 tube. The output of this tube is fed through a second R.F. transformer with tuned secondary into another 58 tube which functions as the 1st detector or mixer. The secondary of this interstage R.F. transformer is tapped to provide a better image frequency ratio.

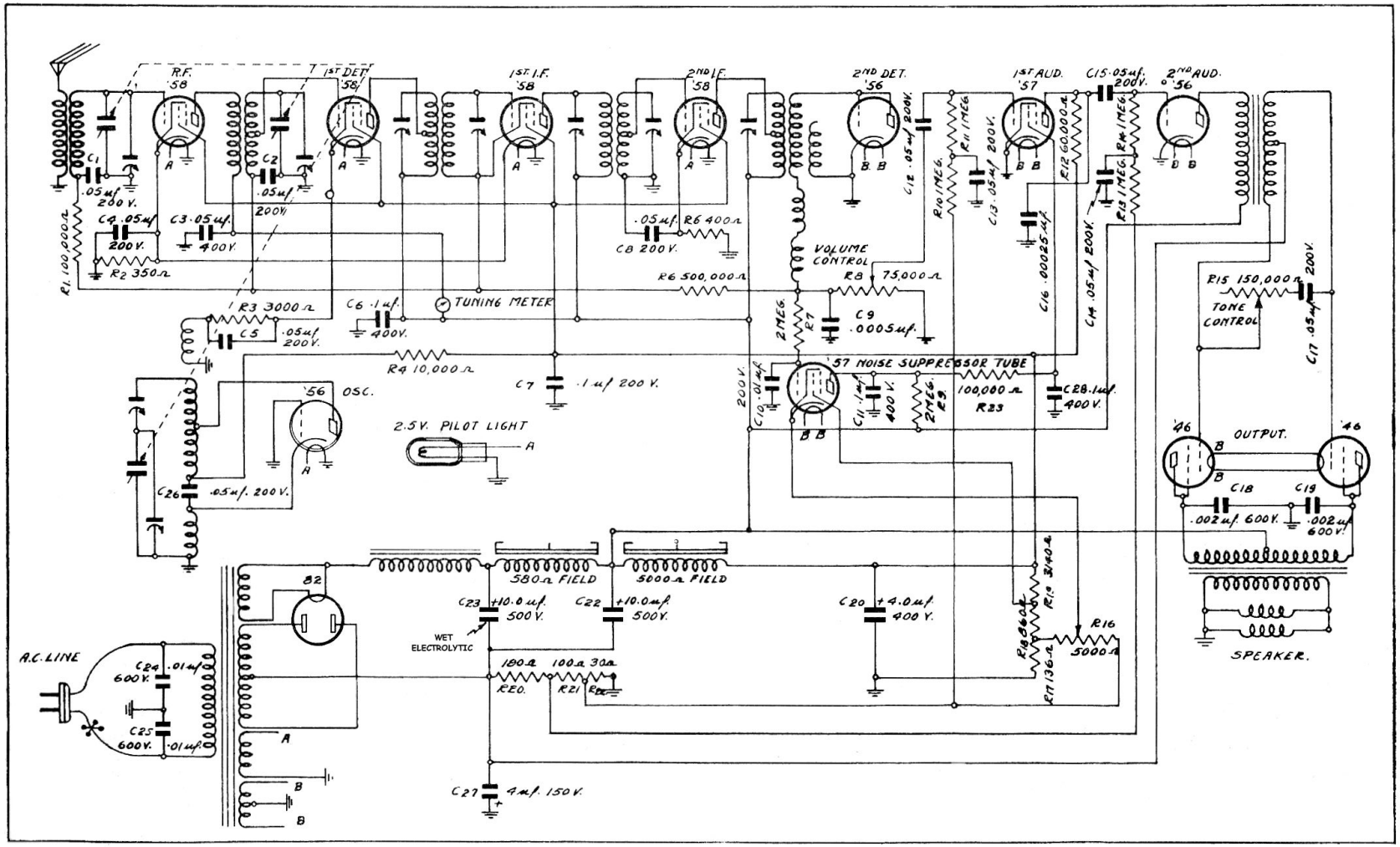
A 56 tube is used in a separate oscillator circuit. The oscillating circuit is tuned by one of the sections of the three-gang condenser and is always resonant at 175 K.C. above the frequency to which the R.F. amplifier is tuned. The oscillator circuit is provided with the customary 1400 K.C. and 600 K.C. trimmer condensers to provide satisfactory tracking with the R.F. tuned circuits. The oscillator frequency is fed into the cathode circuit of the 58 1st detector tube. This results in the intermediate or beat frequency of 175 K.C. being present in the plate circuit of this tube.

Two stages of I.F. amplification are employed, using two 58 tubes. The primaries and secondaries of the 1st and 2nd I.F transformers and the primary of the 3rd I.F. transformer are tuned by small adjustable condensers located in the I.F. assembly cans. The tapped 1st and 3rd I.F. transformer primaries and 2nd I.F. secondary provide greater selectivity.

A 56 tube functions as the 2nd detector or demodulator and also as the automatic volume control tube. The plate and grid of this tube are connected together externally so that it operates as a diode or two-element rectifier. During the positive portion of each cycle, current flows in the grid-plate circuit of this tube. The voltage drop established by this current flowing through a resistor is applied through isolating resistors to the control grids of the R.F. 58, 1st detector 58 and 1st I.F. 58 tubes, increasing the bias voltage on these tubes and thus reducing the amplification. As the signal increases, the control voltage applied increases in such a manner as to give constant output as set by the manual volume control.

The control voltage is also applied to the control grid of the noise suppressor tube as explained later.

The audio component of the signal is developed across a resistor connected as a potentiometer which serves as the manual volume control. The audio signal is applied through the movable arm which is connected through a coupling condenser to the control grid of the 57 1st audio tube. The amount of audio voltage transmitted depends on the setting of the movable arm.



Page 2 **Figure 1.—Schematic Circuit Diagram—Twelve-Tube A. C. Models Nos. 2123-4.**

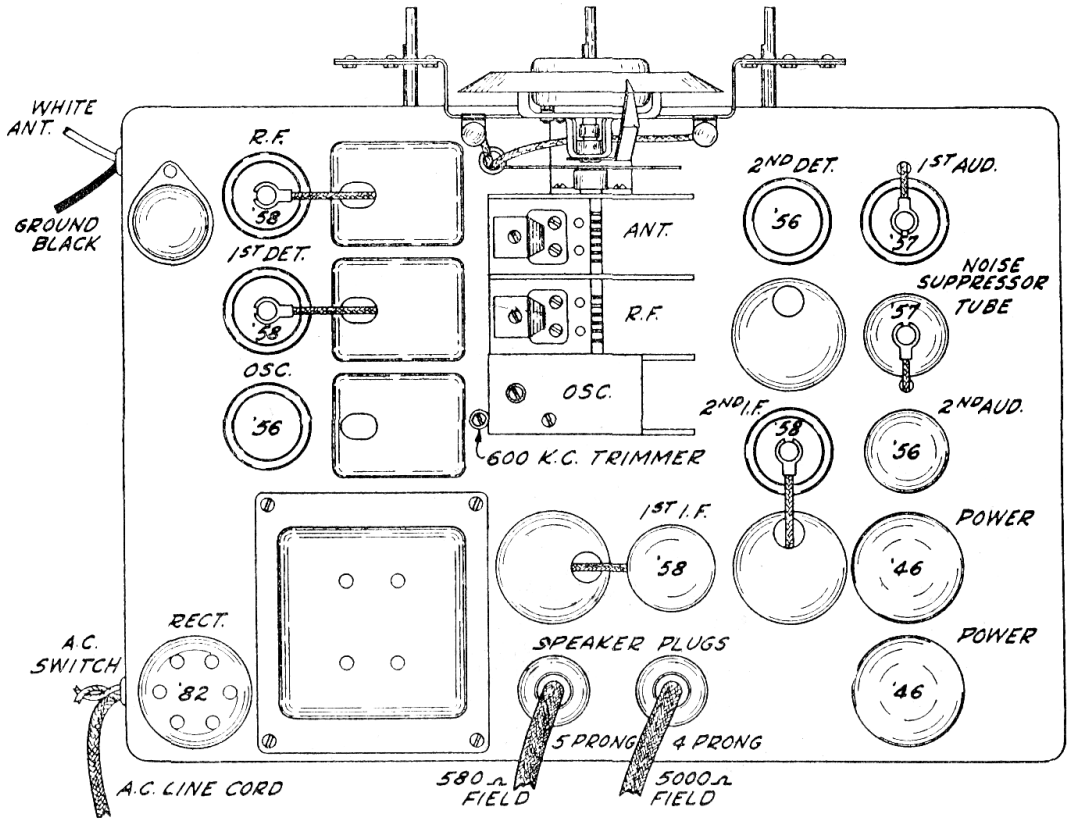
A capacity winding in the 3rd I.F. transformer serves as a bypass condenser to ground. This condenser, in conjunction with the two chokes in the grid-plate circuit of the 2nd detector tube acts as an I.F. filter.

NOISE SUPPRESSOR

Noise suppressing action, when tuning between stations, is very ingeniously obtained in this receiver by controlling the screen voltage of the 57 1st audo tube.

Referring to Fig. 1, consider the movable arm of the noise suppressor potentiometer, R-16, at the extreme left (knob at extreme clockwise position). Assume no signal being received, which would bring the control grid of the noise suppressor tube to ground potential. The cathode of this tube is sufficiently positive at this setting of the noise suppressor knob to cause cut-off in the tube. No plate current flows. The screen voltage of the 57 1st audio tube is not reduced and the tube amplifies normally. Additional bias voltage impressed on the noise suppressor tube due to a signal has no further effect, as the tube is already at cut-off.

Now consider the movable arm of the noise suppressor potentiometer, R-16, at the extreme right (knob at extreme counter-clockwise position). At this setting, the noise suppressing action is at a maximum. The cathode of the noise suppressor tube is now negative, relative to the grid. Plate current flows in this tube and the plate voltage drops due to the drop across resistor R-9. The screen voltage of the 57 1st audio tube also drops, as it feeds through the same line. The screen voltage of this tube differs



Twelve-Tube A.C.—Figure 2—This illustration shows the location of the Tubes, Connections and Controls.

from the plate voltage of the noise suppressor tube only by the drop across resistor R-23. Under no signal conditions the screen voltage of the 57 1st audio tube is sufficiently low to prevent this tube from amplifying.

When a weak signal (noise) is received, the control voltage applied to the grid of the noise suppressor tube makes this grid more negative. Less plate current flows and the voltage of the plate of the noise suppressor tube and the screen of the 1st audio tube rises. If the signal is weak, the screen voltage will not be raised sufficiently to allow the 57 1st audio tube to amplify.

When a strong signal (station) is received, there is sufficient control voltage to bring the noise suppressor tube to cut-off. This allows the screen voltage of the 1st audio tube to rise to its full amount and the tube amplifies fully.

The audio amplifier has three stages. The first stage uses the type 57 tube mentioned above. It is resistance-coupled to the 2nd audio stage which uses a 56 tube. The 2nd audio tube is transformer-coupled to the output stage, which uses two 46 tubes in a stage of semi-Class "B" amplification. At low volume the amplification is Class "A" for better tone quality, while at large volume, the output changes to Class "B" in order to get large power output.

VOLTAGES

Check the voltages at the sockets to see if the power unit is delivering the correct voltages. The antenna and ground

VOLTAGES AT SOCKETS

LINE VOLTAGE 115—ANTENNA SHORTED TO GROUND—NOISE SUPPRESSOR AT MAXIMUM CLOCKWISE POSITION.

Type of Tube	Function	Across Filament	Plate to Cathode	Screen to Cathode	Grid to Cathode	Normal Plate MA
58	R.F.	2.4	242	90	4(1)	4
58	1st Det.	2.4	250	86	7(1)	2
56	Osc.	2.4	24		0	8
58	1st I.F.(2)	2.4	252	90	4(1)	4
58	2nd I.F.(2)	2.4	254	91	3	5.7
56	2nd Det.	2.4	0		0	0
57	1st Audio	2.4	65	55	4(3)	.4
57	Noise Sup.	2.4	55	20	3(1)	0
56	2nd Audio	2.4	255		14(4)	3.3
46	Power	2.4	250	260	34	23
82	Rectifier	2.4	880 volts plate to plate			53 per plate

(1) Read from cathode to ground.
(2) If I. F. readings are made with a cord and plug, ground the control grid through a condenser to prevent oscillation and motor boating.
(3) Read Across 30 ohm section of voltage divider.
(4) Read Across 30 ohm and 100 ohm section of voltage divider.

should be disconnected and the antenna and ground leads from the set connected together.

All of the D.C. voltage readings as shown on the chart are read with a 1,000 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.

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 necessary. The procedure is as follows:

Set the signal generator for 175 K.C. Connect the signal lead from the signal generator to the grid of the 1st detector tube through a .05 mfd. condenser. Turn the tuning condenser rotor until the plates are completely out. The ground lead from the signal generator goes to the ground lead of the receiver. Then adjust the five intermediate frequency condensers for maximum output. The adjusting screws for these condensers are reached from the top of the chassis.

Next set the signal generator for a signal of exactly 1400 K.C. The antenna lead from the signal generator is, in this instance, connected to the antenna lead of the receiver. 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.

Next set the signal generator for a signal of 600 K.C. and adjust the oscillator 600 K.C. trimmer. The adjusting screw for this condenser is reached from the top of the chassis and is between the tuning condenser and the coil cans. A non-metallic screwdriver is necessary for this adjustment. Turn the tuning condenser rotor until maximum output is obtained. Then turn the rotor slowly back and forth over this setting, at the same time adjusting the 600 K.C. trimmer screw until the highest output is obtained.

Then set the signal generator again for a signal of 1400 K.C. and check the adjustment of the tuning condenser trimmers at this frequency for maximum output.

SETTING THE NOISE SUPPRESSOR

The action of the noise suppressor is to establish a certain signal strength level below which all signals are cut out, and

above which all signals come through without being reduced in intensity.

The general method of using the noise suppressor is to first turn the knob to the "Power" or right hand position. At this point there is usually considerable noise received. Turn the knob to the left until the noise is eliminated, and then continue to tune the set in the regular manner to whatever stations are wanted.

When tuning for far, distant stations, the knob should be turned to the extreme right or "Power" position, as the weak station signals may be cut out along with the noise signals if the noise suppressor is used.

When tuning in local stations the knob may be turned well toward the left hand or "Quiet" position, as the station signals are very powerful compared with the noise signals.

If the signal of a station is distorted, turn the noise suppressor knob to the right until the signal becomes clear.

LOW VOLUME

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.

Altho a short inside antenna is sometimes satisfactory, a good outside antenna 50 ft. or more in length is recommended. If the antenna system is faulty or in a shielded location, the volume may be low on distant or weak stations. This is particularly true if the antenna is in or near a steel building. In a case of this kind the antenna and lead-in should be inspected for poor connections and grounds. In a shielded location try a longer antenna in a different location.

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, defective A.V.C. system, defective noise suppressor, and various opens, grounds and shorts in the receiver assembly.

EXCESSIVE HUM

Defective tubes are very often the cause of excessive hum. Try out a complete 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, speaker field, or open filter condenser can cause excessive hum. Inspect these items for the defects named. Other causes of excessive hum are shorted choke tuning condenser, unequal rectifier plate currents, defective hum filter resistors and condensers, defective grid circuits and defective power transformer.

If Microphonic hum or howl is encountered, switch the tubes of the same type around in the sockets and try out some new ones.

DISTORTED REPRODUCTION

Defective tubes are a very common cause of distortion. Try out a new set of tubes that have been tested O.K. or have been operating satisfactorily in another receiver.

Distortion may be due to one or both of the speakers being out of adjustment. Check the speakers and try out new ones if they are available. Another cause of distortion is high or low grid voltages. Check the voltages as given in the voltage chart for this receiver.

Incorrect tuning of the receiver is a very common cause of distorted reproduction. The signal should be carefully tuned to resonance for best reproduction.

Distortion may be encountered in the case of a distant or weak station when the noise suppressor is being used, due to the fact that the signal is not strong enough at all times to be fully reproduced. If this cause of distortion is suspected, turn the noise suppressor knob in a clockwise direction to reduce or eliminate the noise suppressing action.

If there is a rattle see if all of the rubber cushions supplied are inside of the tube shields.

There are two additional causes of distortion not due to any fault of the receiver. One is due to the broadcasting station which may vary considerably in the audio quality of the signal. The other cause is due to quality fading in the signal transmission which may at times result in very bad audio distortion.

OSCILLATION AND WHISTLE

Should the set oscillate on being connected up, it may be due to tubes whose characteristics vary considerably from the standard. In case of oscillation, therefore, change the tubes around and try out some new tubes.

See if the receiver is properly grounded and if it is, try out a new ground. Investigate the line voltage to see if it is excessively high.

The tube shields must be all on and the control grid leads to the top grid connection tubes firmly in place. Otherwise oscillation may result.

An open bypass condenser or open leads to the bypass condensers are a common cause of oscillation. Check the bypass condensers for capacity and the leads to them for continuity of circuit. A quick way to check bypass condensers for opens is to take a good condenser with test leads attached to the terminals and connect the new condenser across the condenser in the chassis. Oscillation may also be caused by poor chassis ground connections, by poor tuning condenser ground contacts. It may also be caused by shorted isolating resistors.

TWENTY-FIVE CYCLE RECEIVERS

The twenty-five cycle receiver differs from the sixty-cycle receiver only in the fact that a different power transformer is used. The correct power transformer is shown in the parts list.

The twenty-five cycle chassis can be operated satisfactorily from a sixty-cycle power supply. However, the reverse is not true, the sixty-cycle receiver cannot be operated from a twenty-five cycle power supply.

REPAIR PARTS LIST FOR 12-TUBE A. C. SUPERHETERODYNE RECEIVER.

When ordering parts, the Part Number and the Serial Number of chassis must be given. If this information is not available, return the old part to insure getting the correct part. Prices on Parts not listed below may be obtained on application.

Part No.	Name	List Price
P- 1636	'56 Tube Socket	.25
P- 1635	'46 Tube Socket	.25
P- 1640	4-Prong Speaker Socket	.20
P- 1637	5-Prong Speaker Socket	.25
P- 1670	'82 Tube Socket	.25
P- 1648	'58 Tube Socket	.30
P- 1649	'57 Tube Socket	.30
P-D-102	Power Transformer Assembly 25 or 60 cycle	19.00
P-D-105	Filter Choke Assembly	3.75
P-D-104	Audio Input Transformer Assembly	5.50
P- 50522	Audio Output Transformer Assembly	3.75
P- 5050	Antenna R.F. Transformer Assembly	1.65
P- 5051	Interstage R.F. Transformer Assembly	1.65
P- 5052	Oscillator Coil Assembly	2.00
P- 5046	Double R.F. Choke Assembly	1.10
P- 5047	1st I.F. Transformer Can Assembly	3.50
P- 5048	2nd I.F. Transformer Can Assembly	3.65
P- 5049	3rd I.F. Transformer Can Assembly	3.65
P-A-103	Dial Strip 180° circular	.35
P-A-104	Dial Strip 70° full vision	.35
P- 10224	Rubber Drive Pinion	.10
P- 10240	Rubber Cushion (in tube shields)	.10
P- 1054-B	"On-Off" switch with leads	.90
P- 1349-B	Tuning Meter for use with 180° cir. dial	3.80
P- 1657	Tuning Meter for use with 70° full vis. dial	3.80
P-K-103	R.F. Aluminum Coil Shield Assembly	.35
P-K-104	Osclator Aluminum Coil Shield Assembly	.35
P- 40420	Tube Shield	.15
P- 1441	Large Knobs	.35
P- 1421	Small Knobs	.35

RESISTORS

Part No.	Resistance	Type	List Price
P-B-90912-C	100,000 ohm	Fixed	.35
P-B-90953-A	350 ohm	Fixed	.35
P-B-91034-A	3,000 ohm	Fixed	.35
P-B-91035-A	400 ohm	Fixed	.35
P-B-91037-A	10,000 ohm	Fixed	.35

RESISTORS

Part No.	Resistance	Type	List Price
P-B-90938-C	500,000 ohm	Fixed	.35
P-B-91036-C	60,000 ohm	Fixed	.35
P-B-90949-A	2 meg.	Fixed	.35
P-B-90948-C	1 meg.	Fixed	.35
P- 91033	136 ohm 860 ohm 3,140 ohm 180 ohm 100 ohm 30 ohm	Armored Wire Wound Resistor	2.15
P- 91031-A	150,000 ohm	Tone Control	1.40
P- 91030	75,000 ohm	Volume Control	1.75
P- 91032	5,000 ohm	Noise Suppressor	1.40

CONDENSERS

Part No.	Capacity	Voltage	Type	List Price
P- 80862	0.05 mfd.	200 volt	Tubular	.35
P- 80890	0.5 mfd.	400 volt	Tubular	1.35
P- 80916	10.0 mfd.	500 volt	Wet Electrolytic	2.50
P- 80894	10.0 mfd.	500 volt	Dry Electrolytic	2.20
P- 80882	4.0 mfd. 4.0 mfd.	500 volt 220 volt	Dual Dry Electrolytic	2.90
P- 80864-C	0.1 mfd.	200 volt	Tubular	.40
P- 80855	0.0005 mfd.	600 volt	Moulded	.35
P- 80808-A	0.002 mfd.	600 volt	Moulded	.45
P- 80807	0.00025 mfd.	600 vts	Moulded	.30
P- 80918	Dual 0.01 mfd.	2000 vt.	Tubular	.60
P- 80922	0.01 mfd. 0.05 mfd. 0.05 mfd. 0.1 mfd. 0.1 mfd. 0.1 mfd. 0.05 mfd.	200 volt 200 volt 200 volt 400 volt 400 volt 400 volt 200 volt	White White & Red White & Red Yellow Green Red Gr'n. & Br'n.	By-pass Condenser Block 2.65

The first four condensers in the Condenser Block List have one side grounded to the can. The last three have a common black lead.