PHOTOFACT

INDEX

AND TECHNICAL DIGEST

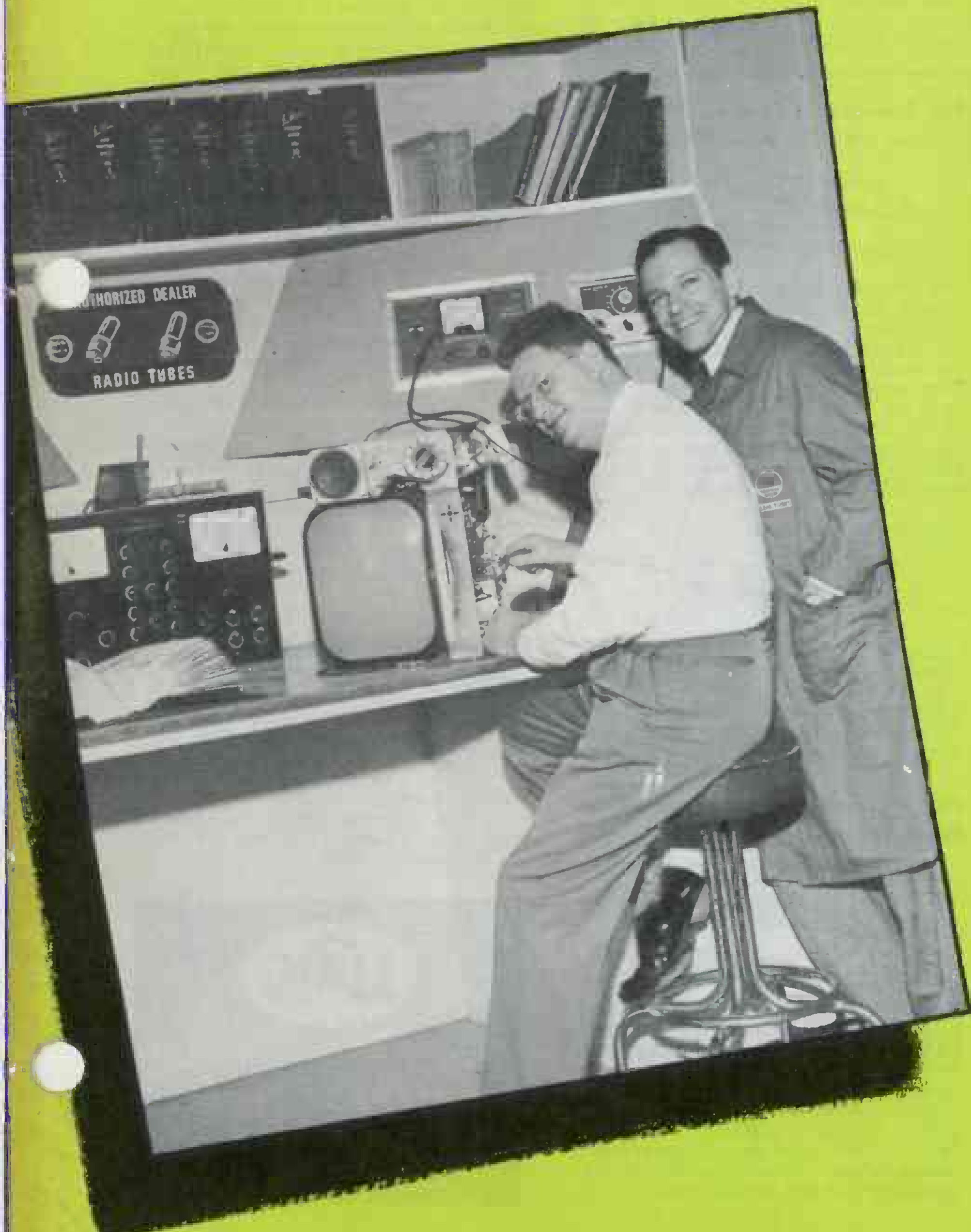
Sept. • Oct. • 1951

including

INDEX No.

28

COVERING PHOTOFACT FOLDER SETS 1 THRU 146



CONTENTS

Shop Talk
Milton S. Kiver 4

Video Detection and Amplification
W. William Hensler 5

Vertical Retrace Blanking Circuits
Merle E. Chaney 9

A Comparison of CBS Color and Present Monochrome Standards
Veral M. Shields 15

Converting the Olympic XL210
Robert B. Dunham 21

Dollar and Sense Servicing
John Marcus 31

PHOTOFACT CUMULATIVE INDEX
No. 28 Covering PHOTOFACT Folder Sets Nos. 1-146 Inclusive . . 33

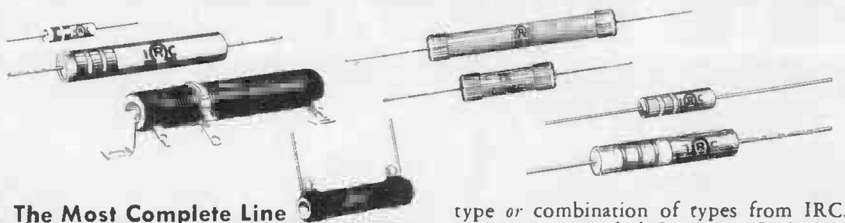
Oscilloscope Modification for 120 Cycle Synchronization
The Engineering Staff 51

Parts Lists for Impedance Measuring and Null Indicator Devices 59

+ More or Less — 62

10¢

HOW TO GET THE RIGHT COMBINATION OF LOW-COST INSULATED RESISTORS FOR ALMOST ANY PHOTOFACT CIRCUIT



The Most Complete Line of Resistors in the Industry—No Makeshifts!

Regardless of the circuit you're servicing—regardless of the characteristics needed in your resistors—you can get just the right type *or* combination of types from IRC. *There are no makeshifts* in the IRC line. Because we make the most complete variety of resistors in the industry, we can specify without bias. And this means you get just what you need—whether your problem is space, power, precision, temperatures, stability or economy!

IRC BT's Easily Meet TV Needs Meet and Beat Government Specifications

Here's the famous IRC Advanced Type BT —the *only* filament-type fixed composition. Because of its exclusive design—explained

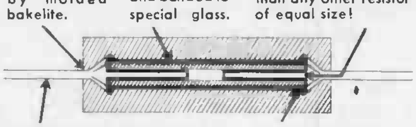
below—it actually beats tough Joint Army-Navy Specifications—and meets the rigorous requirements of television *easily!* Completely insulated, IRC BT's withstand large amounts of heat and cold shock, voltages, overloads, high humidities, salt immersions, vibrations—plus 14 additional Government tests *and* another 20 required by IRC to control quality and uniformity.

Exclusive IRC Filament Assures Extremely Low Operating Temperature and Excellent Power Dissipation

Sealed against moisture. No possibility of grounding. Element effectively sealed and insulated by molded bakelite.

IRC Filament-Type Resistance Element—resistance material permanently cured and banded to special glass.

Wire leads extend into filament, drawing heat out of resistor and aiding rapid heat dissipation. This means IRC BT's operate at lower temperatures than any other resistor of equal size!



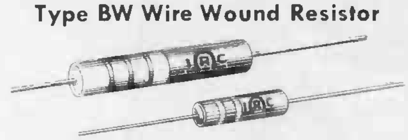
Heavily tinned copper leads provide easy soldering. Leads anchored inside insulation—cannot turn or pull loose.

Enclosed low resistance positive contact between resistance element and lead.

⅓, ½, 1 and 2 Watts Supplied in RTMA Resistance Ranges

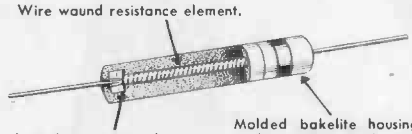
Type BT Resistors are supplied only in RTMA Resistance Ranges, subject to minimum and maximum values for each type. RTMA ranges are identical to Joint Army-Navy specified ranges. Tolerances: ±5%, and ±10% in accordance with RTMA values.

For Stability at Low Ranges IRC's Type BW Wire Wound Resistor



IRC developed this stable, inexpensive wire wound resistor especially for low range requirements. Insulated in the same way as the BT, the IRC BW Resistor features a resistance element tightly wound with uniform tension around a special core. BW's have an excellent record in television circuits, low-power ignition circuits and the like. Together with BT's, they give good coverage of *high and low ranges*, providing dependability and long life in each.

Wire wound resistance element.

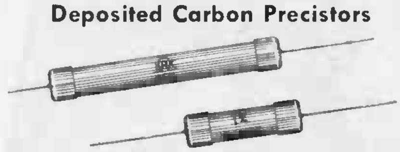


Leads securely crimped to element.

Molded bakelite housing seals out moisture. No possibility of grounding.

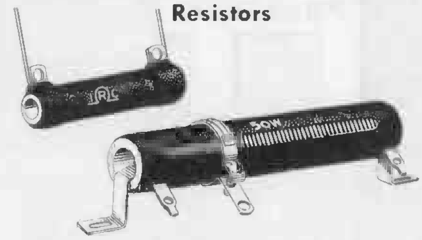
BW's are made in 3 sizes—½, 1 and 2 watts. Tolerances: ±10% standard. Values of 10 ohms and above available in ±5%.

For Accuracy and Economy in Close-Tolerance Applications IRC Deposited Carbon Precistors



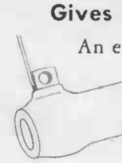
When you want precision and stability at low cost, you'll find IRC Deposited Carbon PRECISTORS deliver the goods. We developed these crystalline carbon resistors especially for critical TV circuits and similar applications where stability over long periods of time is important. You'll find PRECISTORS outstanding in many applications where carbon compositions are unsuitable and wire wound precisions too expensive. Standard limits are: Type DCF—200 ohms to 5 megohms, Type DCH—500 ohms to 20 megohms.

For Balanced Performance in Heavy-Duty Applications Fixed and Adjustable IRC Power Wire Wound Resistors



If power is your problem, here's the low-cost solution. IRC Power Wire Wounds are specially designed to handle *power*—up to full rating, for long periods without burning out. Reason: IRC PWW's are made with full-size cores and coated with exclusive rough, dark cement which dissipates heat faster and stands reasonable overloads without breakdowns or "opens". Also, IRC PWW's are processed at low temperatures which will not damage delicate wire windings or cause them to shift. This prevents hot spots and low voltage breakdown between turns. There just isn't a better power wire wound resistor; PWW's operate at consistently lower temperatures than many equally rated competing resistors.

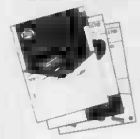
Exclusive Lug-and-Lead Terminal Gives Flexibility in Mounting



An exclusive feature of IRC PWW's is the lug-and-lead terminal for flexibility in mounting. In tight space applications, simply cut off the lug. In other applications, the leads may be clipped off. Leads are a full 1¾" and all terminals are hot tin-dipped for easy soldering.

You can get fixed and adjustable PWW's in a full range of power ratings, resistance values, sizes and terminal types. For heavy duty applications—high-voltage bleeders, bias supply, grid and filament-dropping resistors—leading technicians have specified these rugged power wire wounds for more than 15 years.

FREE DETAILS FOR THE ASKING



Your IRC Distributor will be glad to give you full particulars of IRC Advanced Type BT's, BW's, Precistors and PWW's. Write direct for complete catalog information. Specify: Catalog DC3A for Precistors, Catalog DC5B for Power Resistors or Catalog DC8B for BT and BW Insulated Resistors.

IRC

Wherever the Circuit Says —ᐱᐱᐱ—

INTERNATIONAL RESISTANCE CO.

423 N. Broad Street, Philadelphia 8, Pa.

Pick of the Trade

The other day our car was inspected by the state after having been completely overhauled by a local garage. It failed; wheels out of line. Three times the car went back to the garage before it passed its regular inspection. This probably happens dozens of times. . . . BUT —it's not news. Do we condemn the automobile service industry because of this or similar incidents?

No one would think of charging the automobile service industry with malpractice because scattered incidents or poor or unreliable service are noted. Cars are complicated mechanisms; mistakes happen. So it is with television!

Radio and Television Maintenance
July, 1951

★ ★ ★

The art of electronics is not remotely approaching static status. In fact it is undergoing a new and exciting revolution toward miniaturization, machine-made circuits and simplification. It is possibly a lucky industry, though luck of a gruesome sort. There is no question but what the design advances necessitated by World War II permitted television to establish itself with a speed that none dreamed of, much less predicted. There is no question but what mobilization, with its need for miniaturization (led by guided missiles) and expendable circuits is bringing another abnormal acceleration in design for the future.

Electronics Markets
July, 1951

★ ★ ★

"Except for certain exceptional programs, the public does not like TV. Up until now it has proven a poor substitute for motion pictures. Nevertheless, thousands upon thousands of American families have purchased their sets on the installment plan and while most of them have been disillusioned by the quality of the entertainment they have seen on the TV screen, they are, nevertheless, committed to pay for the sets and they economize by elimination of certain other luxuries. We, unfortunately, bear the brunt of this onslaught." So sayeth Darryl Zanuck of 20th Century-Fox.

Electronics Markets
June, 1951

★ ★ ★

Checkups on the rooftops and windows offer every Service Man an excellent opportunity to build sales during early fall, and in addition, introduce a means of strengthening community friendship by providing video services that even hurricanes will not be able to upset.

Service
July, 1951

★ ★ ★

The Service Technician's Life Is Not a Bed of Roses

The radio and television service technician has never been too popular with the public at large. The most important reason is that the public has always found it difficult to comprehend and appreciate the complexity of the service technician's calling.

The public has never learned that the service technician has only one thing to sell—his time. This is particularly true when he does not supply parts, but reconditions the set so that it will perform once more.

For some obscure reason, people connect radio or television servicing with parts replacements; yet the technician's time spent in locating the trouble never counts with most set owners.

Hugo Gernsback
Radio-Electronics
August, 1951

★ ★ ★

The technician-dealer doesn't need the sanction of a license. He simply requires the good will of his customers, earned by fair dealings with those that he contacts and the good will that always results from a prompt and satisfactory service to the set owners. But once he has earned a reputation in his community he must continue to sell himself as a professional and to recognize his debt to the community in which he operates. His customers do not owe him a living —rather he owes his living to his customers.

By conducting himself as a man with a professional status—his chances for success in the radio-television service business are assured.

Oliver Read, *Editor*
Radio & Television News
July, 1951

PF PHOTOFACT INDEX

AND TECHNICAL DIGEST

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CONTENTS

Shop Talk
Milton S. Kiver 4

Video Detection and Amplification
W. William Hensler 5

Vertical Retrace Blanking Circuits
Merle E. Chaney 9

A Comparison of CBS Color and Present Monochrome Standards
Veral M. Shields 15

Converting the Olympic XL210
Robert B. Dunham 21

Dollar and Sense Servicing
John Marcus 31

PHOTOFACT CUMULATIVE INDEX
No. 28 Covering PHOTOFACT Folder Sets Nos. 1-146 Inclusive 33

Oscilloscope Modification for 120 Cycle Synchronization
The Engineering Staff 51

Parts Lists for Impedance Measuring and Null Indicator Devices 59

+More or Less— 62

HOWARD W. SAMS, *Publisher*

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The PF (PHOTOFACT) INDEX is published every other month by Howard W. Sams & Co., at 2201 E. 46th Street, Indianapolis 5, Indiana, and is available from PHOTOFACT Distributors in the United States and Canada.

ABOUT THE COVER: The photograph is of John R. Horn, (left) and Sam Goldish, service manager and owner, respectively, of Brookside Radio and Television Service, Tulsa, Oklahoma. Mr. Goldish writes: "PHOTOFACT is truly monumental in its scope and represents a priceless asset to any modern, well equipped service shop. Let me say I can well appreciate the vast amount of research and detail that enters into the compilation of such a series and the price set on each Folder is quite low indeed."

MILTON S. KIVER

President, Television Communications Institute

Shop Talk

> Editor's Note: The following quoted portion of "Shop Talk" is an excerpt from a forthcoming book by Mr. Kiver entitled "Servicing TV in the Customer's Home." This book, to be published by Howard W. Sams & Co., Inc., is scheduled for early fall release. Distribution dates will be announced in the very near future.

Whenever you are servicing an unfamiliar receiver, your first job is to become acquainted with the location of the various stages in the receiver. Possibly the best way to achieve this familiarity is with the complete service manual for the particular set. The next best solution is to refer to the Howard W. Sams' "Television Tube Location Guide" books. But suppose you have neither of these publications on hand. What then? Then, the next best approach is to trace the path of the various signals through the set by a combination of tube pulling plus common sense deductions.

To illustrate this method, consider the tube layout of a modern television receiver shown in Figure 1. You will know, from your experience with other television receivers, that the tuner is almost invariably placed at the right-hand side of the chassis. In fact, even if you have had hardly any experience at all servicing television receivers, you will know that the shaft of the RF tuner is directly connected to the selector switch or dial and this will locate the tuner for you.

The tuner consists of three stages, namely, an RF amplifier, an oscillator, and a mixer. These functions may be accomplished by three tubes, or by two tubes if multipurpose tubes are employed. When two tubes are used, the oscillator and mixer are combined within one envelope: never the RF amplifier and mixer or the RF amplifier and the oscillator. If three tubes are used, the oscillator generally possesses an external shield; the other two tubes may or may not. Oscillators are invariably triodes and so are the mixers. RF amplifiers may be triodes although pentode RF amplifiers predominate.

Following the tuner assembly are the IF stages. In a conventionally operated dual IF circuit (in contrast to Intercarrier sets), the sound IF stages receive their input from some point in the video IF system and so generally these two sections exist side-by-side. See Figure 1. In Intercarrier receivers, where the sound take-off point is beyond the video second detector, there is less possibility that the sound IF amplifiers will be physically positioned beside the video IF amplifiers. Typical examples are shown in Figures 2 and 3. Still, this practice is not universal and consequently the physical layout, while important as a clue, should not be taken as conclusive evidence for or against a particular system. Additional testing, as described below, is still required.

When the stages are laid out as they are in Figure 1, the differentiation between the two IF systems is readily carried out. When you come to the point where you suspect the separation occurs, pull out one of the tubes and observe whether you lose the picture or the sound or both. If the picture only is lost, then the tube you have pulled out is in the video system beyond the point of signal separation. To locate the exact stage in which the separation occurs, go back one stage and pull this tube out. If both sound and video are lost, then you have located the separation point as existing between the present stage and the previous tube pulled out. If only the video is affected, repeat the foregoing procedure, moving back one more toward the front-end tuner.

By this process it is readily possible to trace the video signal right up to the picture tube and the sound signal to the loudspeaker.

The remaining sections of the receiver consist primarily of the sync separators, the vertical sweep system and the horizontal sweep system. Removal of any tube in the sync separator stages will throw both vertical and horizontal sweep systems out of sync.

♦ ♦ Please turn to page 55 ♦ ♦

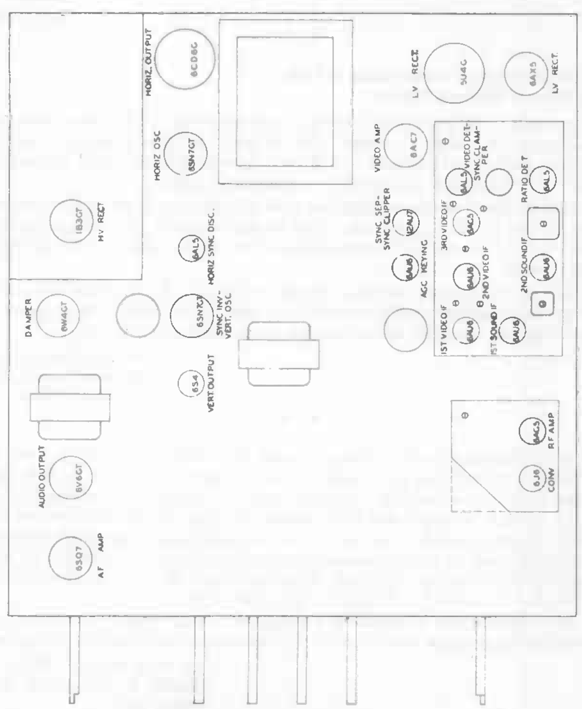


Fig. 1. Tube Layout Diagram of a Conventional Separate Channel IF Television Receiver.

Video Detection and Amplification

by W. William Hensler

A discussion of requirements and commercial application of Video detectors and amplifiers.

The purpose of the video detector in a television receiver is to detect the modulation signal from the video IF carrier. This is accomplished in a manner similar to that used in detecting audio signals in broadcast receivers. The composition of the detected video signal in television, however, requires a detector capable of handling a range of frequencies from about 30 cycles to 4 megacycles per second.

To correctly reproduce the modulation signal a video detector should possess the following capabilities.

1. Linear operating characteristics.
2. Low interelectrode capacity.
3. Low dynamic resistance.
4. Good frequency response.

For a detector to operate in a linear manner, all variations of signal amplitude must be reproduced in the detector output. High level amplitudes occur during sync pulse time, while low levels are present when a signal results from the scanning of a light area. Inability of a detector to follow amplitude variations would result in a picture of poor quality.

Low dynamic resistance of a detector makes available more video signal in the detector output.

Low interelectrode capacity of a detector is particularly important because of the high frequencies contained in the video signal. The effect of the capacitance is to shunt a portion of the signal in the detector output. This is especially true at high modulation frequencies since the reactance of a capacitance decreases with an increase of frequency ($X_C = \frac{1}{2\ fc}$). Therefore too large an interelectrode capacity in the detector would shunt the high frequencies of the signal to ground causing a severe loss of detail in the picture. Good frequency response is vital for correct detector operation. The response is mainly dependent upon the characteristics of the detector circuit and the interelectrode capacity.

Detector Circuit Operation

The primary function of a video detector is to rectify an alternating current to produce a uni-directional signal in the output. The most popular type video detector is a half-wave rectifier. It normally consists of one section of a dual diode tube, such as a type 6AL5, or it may be a germanium crystal diode. Figure 3-1 shows four basic circuits using either a diode tube or crystal diode for the detector. The diodes of Figures 3-1A and 3-1B are connected as series detectors while a shunt connected detector is shown in Figures 3-1C and 3-1D. Signal polarity at the output is determined by the diode element to which the video IF signal is applied. In the case of the series detector a positive-going video signal is obtained when the input is fed to the diode plate and a negative-going signal results when the input is applied to the cathode. The opposite polarity results when a shunt detector is used. When the input is connected to the diode plate, a negative signal is obtained, while applying the signal to the cathode gives a positive signal.

The rectified signal is developed across the diode load resistor. The value of this resistor is

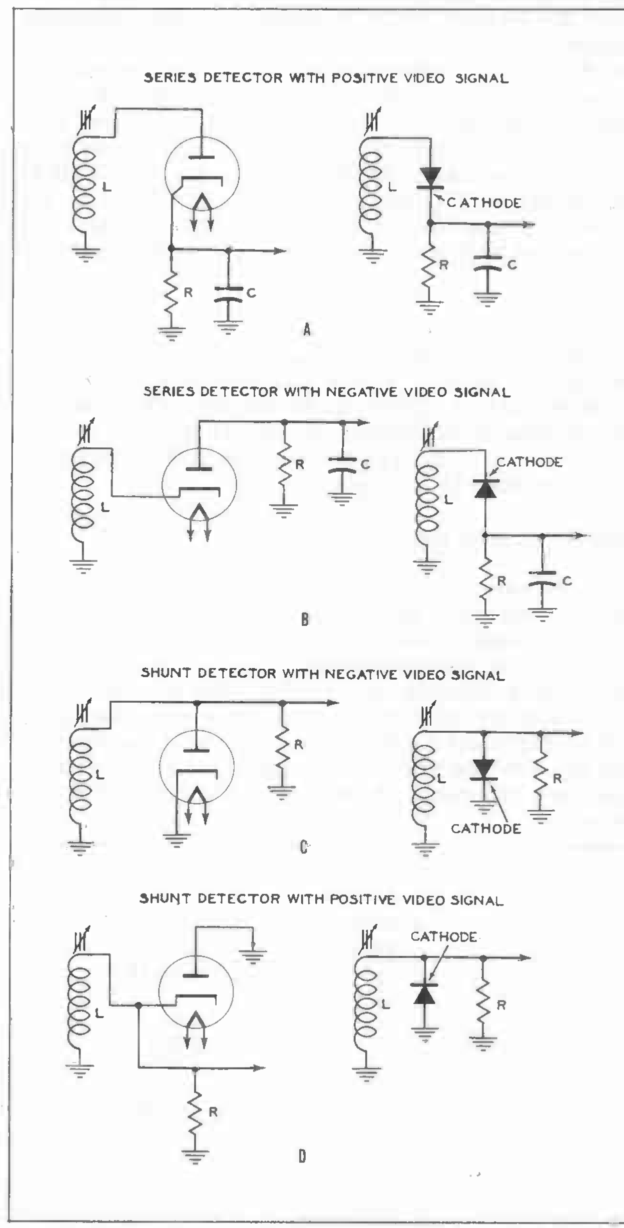


Figure 3-1. Basic Video Detector Circuits.

around 4000 ohms which is quite small as compared to diode load resistor in broadcast receivers. There is also a loss of gain resulting from the low value resistor and this loss must be compensated for by the use of multistage video IF amplifiers to increase the signal level at the input of the detector. However, the low-value diode load resistor aids in maintaining a flat frequency response.

Video IF components are still present across the diode load. In other words the amplitude of each video IF pulse is determined by the amount of modulation signal present at that time. Since this video IF signal acts only as the carrier of the modulation information it is no longer required and therefore is bypassed to ground. A small value capacitor of about 5 mmf. is usually employed as an AF filter. The reactance of this capacitor is sufficiently small at IF frequencies that they are shunted to ground. Further discussion of the elimination of video IF components from the detector output is given under high frequency compensation. Another explanation of the action of the RF filter in producing the desired modulation signal would be that each rectified video IF pulse charges the capacitor to a certain level. Using Figure 3-1A, for example, the cathode would then have a positive potential almost equal to the amplitude of the rectified IF pulse. The time constant of the RF filter and the diode load is such that the capacitor discharges only partially before the next IF pulse is present.

The RF filter, however, must discharge at a rate sufficient to follow variation of the modulation envelope. Too long a time constant of the filter network introduces distortion in the detector output resulting from peak clipping of video IF pulses. The RF filter thus acts to free the picture modulation signal from the video IF components.

High Frequency Compensation

To extend the high frequency response of video detector circuits, small inductors are used in the output. These inductors, or peaking coils, may be connected as series-peaking coils or shunt-peaking coils, or a combination of both. The peaking coils, along with the distributed capacity of the components and wiring, the interelectrode capacity of the detector and input to the succeeding stages, are designed to approach resonance at the highest modulation frequencies.

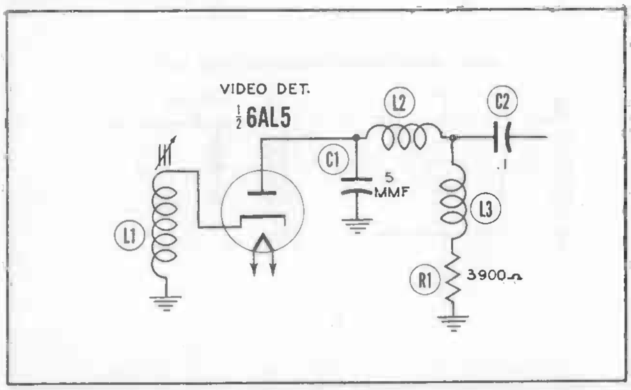


Figure 3-2. Diode Detector Having Negative Signal Output.

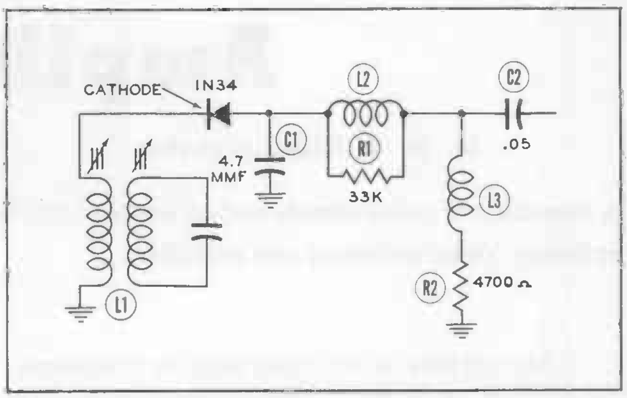


Figure 3-3. Crystal Detector Having Negative Signal Output.

Shunt peaking coils are connected in series with the diode load resistor. At the higher modulation frequencies the increasing reactance of the peaking coil tends to counteract the decreasing reactance of the shunt capacity, thus keeping the load constant and extending frequency response.

Series peaking coils are connected between the detector output and the input to the following stages. A series peaking coil together with the detector output capacity and the input capacity of the succeeding stage forms a low pass network. All picture modulation frequencies are passed by this network while higher video IF frequencies are attenuated. The series inductor also isolates the input capacity of the video amplifier from the detector output, permitting a larger value of load resistor to be used.

To achieve maximum efficiency in a video detector circuit, a combination of both series and shunt peaking coils is used.

Video Signal Polarity

The manner in which a diode is connected in a video detector circuit determines the polarity of the video signal. By noting that signal polarity reverses when passing through a video amplifier tube, it is possible to connect a diode detector so that the required polarity of signal is available at the modulated element of the picture tube. To modulate the cathode of a picture tube, a positive-going signal is required, while a negative-going signal is necessary when the grid is modulated.

Typical Video Detector Circuits

Figure 3-2 shows a video detector circuit employing one section of a type 6AL5 dual diode tube as a detector. The input consists of a resonant circuit composed of a video IF coil, Li, and the input capacity of the detector. A negative-going signal obtained at the detector plate is passed through the low pass filter made up of a 5 mmf. capacitor (C1), a series peaking coil (L2), and the input capacity to the following stage. A shunt-peaking coil for extending frequency response at high modulation frequency is in series with R_L, a 3900 ohm diode load resistor. The signal developed across L3 and R_L is coupled by C2, a 1 mfd. capacitor, to the input of the following video amplifier stage.

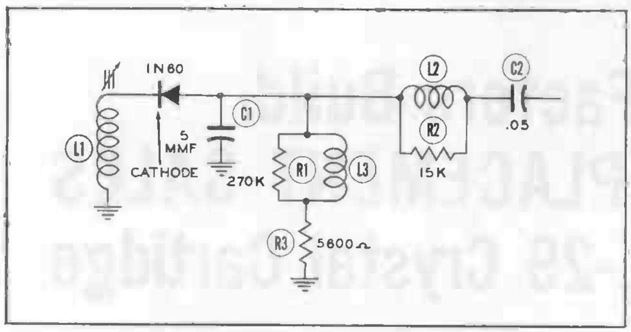


Figure 3-4. Detector with Peaking Coils and Shunt Resistors

A similar circuit is shown in Figure 3-3. However, an absorption trap is coupled to L1 for rejecting sound IF frequencies. The detector used in Figure 3-3 is a germanium crystal diode type 1N34. R_L, shunting L2, is a 33K ohm resistor that damps out self-oscillation, which may tend to occur at certain frequencies.

A type 1N60 crystal diode is used as the video detector in Figure 3-4. Both the series and shunt peaking coils have parasitic suppressor resistors across them. The shunt and series peaking coils are shunted with 270K ohms and 15K ohms respectively. Since the value of the resistors is several times that of the coils, the total impedance remains essentially the same.

In Figures 3-2, 3-3, and 3-4, it is observed that the diodes are connected as series detectors. With the IF signal applied to the cathode and the output taken off at the plate, a negative-going video signal is obtained. Figure 3-5 has a series-connected diode,

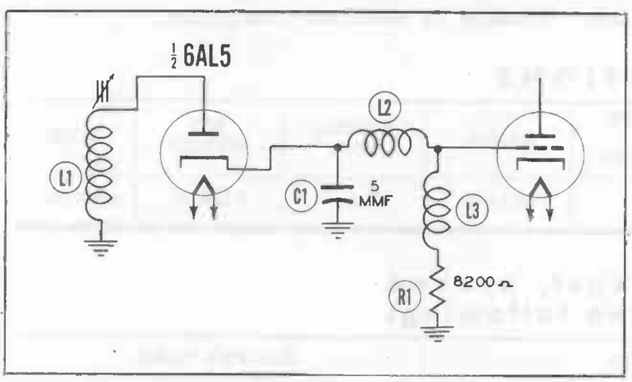


Figure 3-5. Diode Detector Having Positive Signal Output.

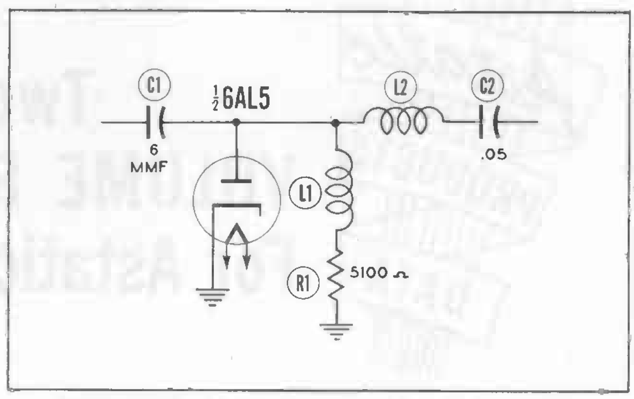


Figure 3-6. Shunt Connected Diode Detector.

but the IF signal is applied to the plate and a positive-going signal results at the cathode.

A shunt-connected diode detector is shown in Figure 3-6. A positive IF signal on the plate causes diode conduction which effectively places a low-resistance shunt across the signal. On negative pulses the diode will not conduct and therefore a negative signal appears in the video output.

Germanium Crystal Diodes as Video Detectors

Germanium crystal diodes play an important part in television receiver circuitry. A few uses for the crystals are as video detectors, DC restorers, AGC and bias rectifiers. In the application of germanium crystal diodes as video detectors, certain properties make them acceptable for wide useage. Their small size, low dynamic resistance, high efficiency, low internal capacity, and the fact that they require no filament current, are some of their important features.

Due to the small size of germanium crystals they may be connected directly in the circuit in which they are used. Low dynamic resistance and high efficiency of germanium crystals result in a greater amount of signal in the detector output. The nominal shunt capacity of 1 mmf. for germanium crystals reduces shunting effect on high modulation frequencies to a minimum. Since filament current is not required to operate the crystals, and mounting sockets and hardware are not needed, there is a saving in materials, and space limitations present no problem.

Germanium crystal type 1N34 has been frequently used as a video detector in television receivers. Later type crystals specifically designed to operate as video detectors are types 1N60 and 1N64.

VIDEO AMPLIFIERS

The amplitude of the signal required to modulate the picture tube depends upon the type of picture tube employed. A seven-inch tube, having approximately 4000 volts applied as high voltage, will require a video signal level of 33 to 40 volts for full contrast. A ten- or twelve-inch tube, with a high voltage of 9000 volts, will require a video signal of 45 to 60 volts for full modulation. The 11,000 to 14,000 volts used on larger tubes make necessary even a greater amplitude of video signal.

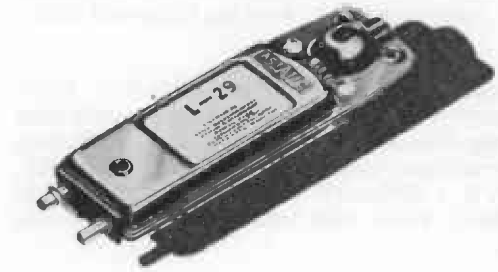
In order to see why a greater amplitude video signal is required as the high voltage is increased, compare the operation of the picture tube with that of a conventional vacuum tube. The reproduction of a black portion of a picture is accomplished by cutting off the electron beam in the picture tube. In the conventional tube a signal of sufficient negative polarity can be applied to the grid to cut off all plate current. Assume for the moment that a negative DC potential is applied to the grid of a triode tube. The bias level

♦ ♦ Please turn to page 25 ♦ ♦

Astatic PRODUCTS DATA

Two Factors Build VOLUME REPLACEMENT SALES For Astatic L-29 Crystal Cartidge

Astatic's new L-29 Cartridge is one of those units in which the development engineers take exceptional pride . . . for truly marked advancement in fidelity and general reproduction quality. But it is two additional, entirely different factors that assure the L-29 of vast demand as an improved replacement cartridge. First, it replaces Astatic's L-92-33 Cartridge, one of the most widely used cartridges in recent years. Second, the L-29 is being extensively used as original equipment, thus building still further its broad replacement market.



The L-29 is designed to play all record types. Furnished without stylus, it has a standard chuck to receive conventional shank needles with proper tip for the record type to be played. Provides maximum output consistent with high compliance and other performance factors necessary for full, rich reproduction. Housing is stamped aluminum.

SPECIFICATIONS

MODEL	ELEMENT TYPE	MINIMUM NEEDLE PRESSURE	OUTPUT VOLTAGE 1KC 1.0 MEGOHM LOAD	RANGE	NEEDLE TYPE	NET WEIGHT	CODE
L-29	Crystal	10 Grams	3.0	50-5,000	Conv.	8 Grams	ASWTS

The L-29 is an exact, proved replacement for the following:

SHURE			WEBSTER	ELECTRO VOICE
W53MG	P89	P93D	F1P	50
W56A	P90D	P93MG	F3P	60
W57A	P93	P94	F5P	
P87	P93B	P94B	F7P2	
P87B	P93C	P95MG	F10P1	

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Vertical Retrace Blanking Circuits

by MERLE E. CHANEY

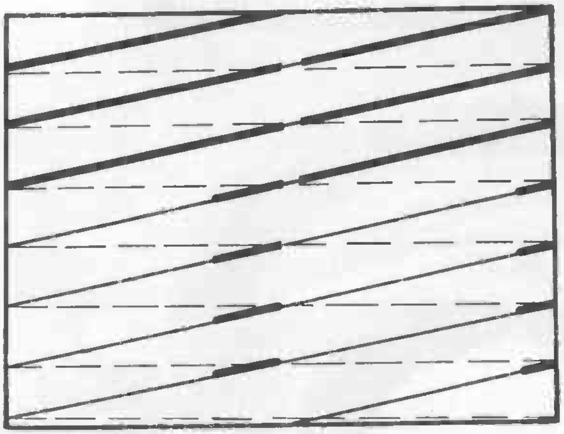

Figure 1. Visible Vertical Retrace Lines.

An interesting circuit used in many television receivers is one which provides for positive blanking of the beam in the picture tube during the period of vertical flyback or retrace. When these retrace lines are visible they are evidenced as several white lines extending across the face of the tube from left to right in an upward direction. These lines may be solid white or under some conditions blank spaces may exist in the lines due to the intensity modulation effect of equalizing or vertical sync pulses. Figure 1 illustrates these lines as they may appear during retrace period.

It is true that the transmitted signal incorporates its own provision for blanking of the beam during both horizontal and vertical retrace, but the effectiveness of the signal in accomplishing this purpose is occasionally restricted by various conditions which may exist at the receiver. Perhaps the chief cause of visible retrace lines is improper setting of the controls. Other contributing factors may be the result of insufficient signal strength present at the receiver due to the distance from the transmitting station, a poorly connected antenna, the nature of the antenna itself and its orientation in reference to the transmitter. The above circumstances may result in visible retrace lines because the blanking level in the received signal is insufficient to eliminate them. These lines may also be observed if the DC restorer fails to restore the correct DC component on the modulated element of the picture tube.

In order to further understand the nature of retrace lines it might be well to observe their make-up. The easiest way in which to see the retrace lines is to turn the vertical hold control so the vertical oscillator is operating free running. The vertical blanking bar will then be observed moving vertically on the picture tube. Vertical flyback then occurs during a time when the beam is unblanked, thus making the vertical retrace lines visible. The vertical oscillator may then be returned to a sync condition and retrace lines again can be seen if the brightness control is advanced too high resulting in an incorrect bias on the picture tube. The blanking provision of the signal would then be insufficient to effect beam cutoff.

Greater emphasis has been placed on vertical retrace lines than on horizontal retrace lines. The reason is that horizontal retrace lines are not so readily apparent. However, there is some picture degradation when horizontal retrace lines are present.

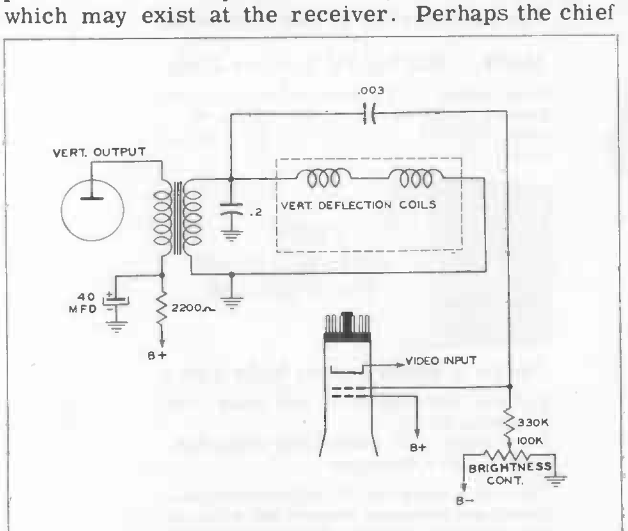

Figure 2. Retrace Blanking Applied to Picture Tube Grid.

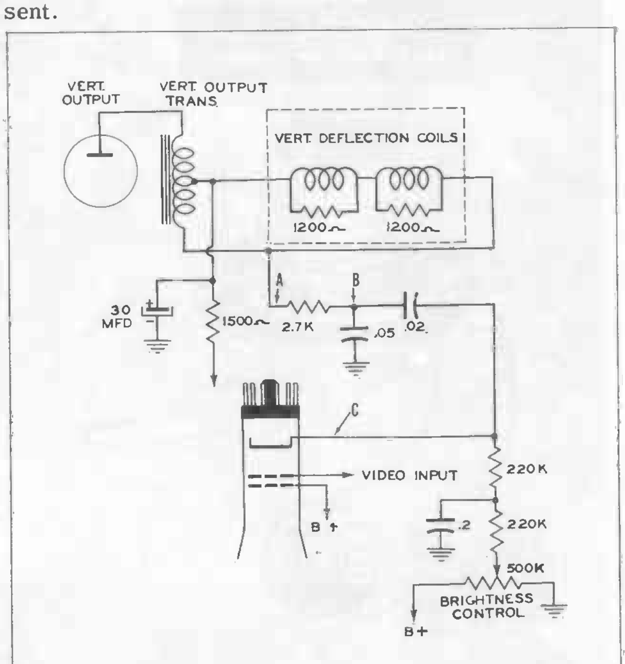

Figure 3. Retrace Blanking Applied to Picture Tube Cathode.


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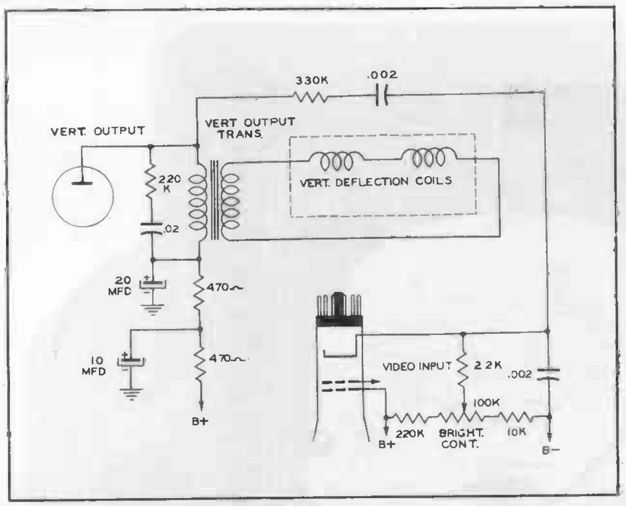

Figure 4. Blanking Pulse Taken From Vertical Output Tube.

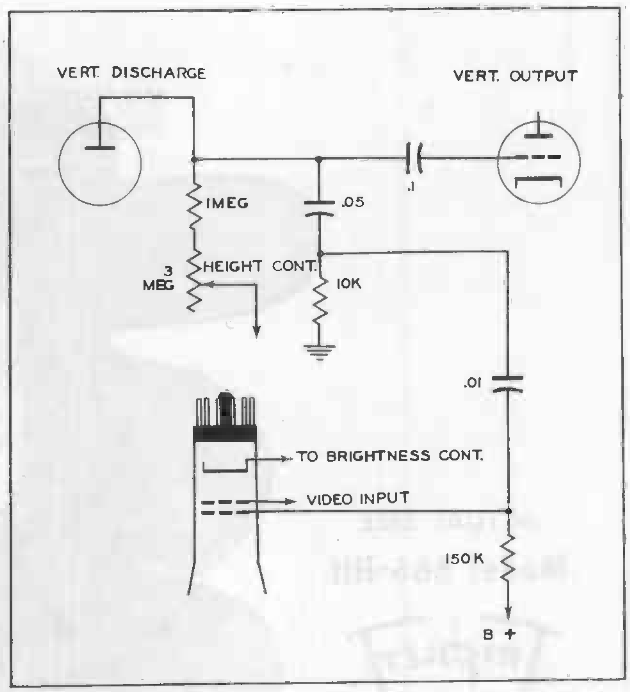

Figure 6. Blanking Voltage Taken from Vertical Discharge Network.

It should be understood that those lines commonly referred to as vertical retrace lines, actually are forward horizontal traces occurring during the vertical flyback period. For the purpose of designation, however, they are condisered as vertical retrace lines.

The method employed in many receivers to eliminate vertical retrace lines consists basically of a circuit to couple a pulse voltage from the vertical deflection circuit to one of the elements of the picture tube. This pulse is the result of the induced voltage present when the field of the magnetic elements in the vertical deflection circuits collapses during flyback. The vertical flyback voltage may be further acted upon by a differentiating circuit to remove the vertical scanning component, and by an integrating filter to remove high-frequency components. When this pulse, of proper polarity and amplitude, is applied to the picture tube, the electron beam is cut off. It is obvious then that the retrace lines are blanked out at all times regardless of the amount of signal strength available, or the setting of the receiver controls.

There are a number of ways in which the picture tube may be driven beyond beam cutoff during the vertical retrace period. A description of a few of the representative circuits used in television receivers to accomplish this purpose follows.

Figure 2 shows a circuit for applying a blanking pulse from the secondary of the vertical output transformer to the grid of the picture tube. Bias is also applied to the grid while the cathode is modulated by the video signal. For this circuit to be effective in blanking retrace, lines it is necessary that a negative-going pulse be applied to the grid of the picture tube.

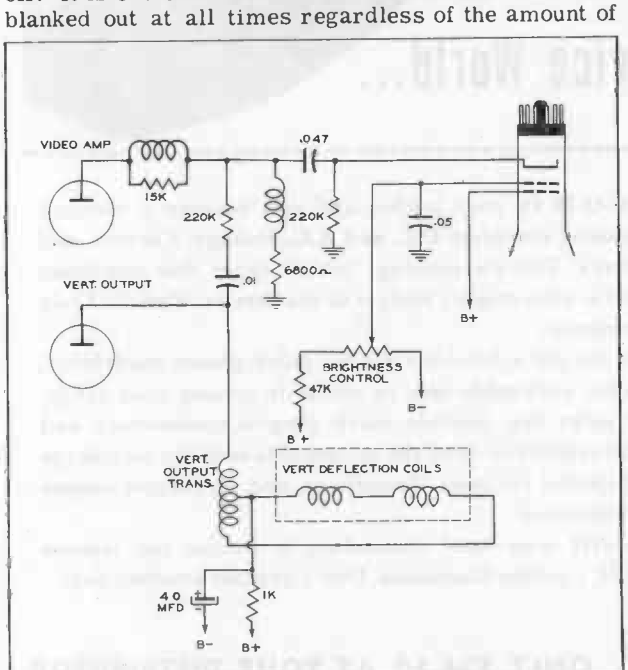

Figure 5. Blanking Pulse Applied to Video Output.

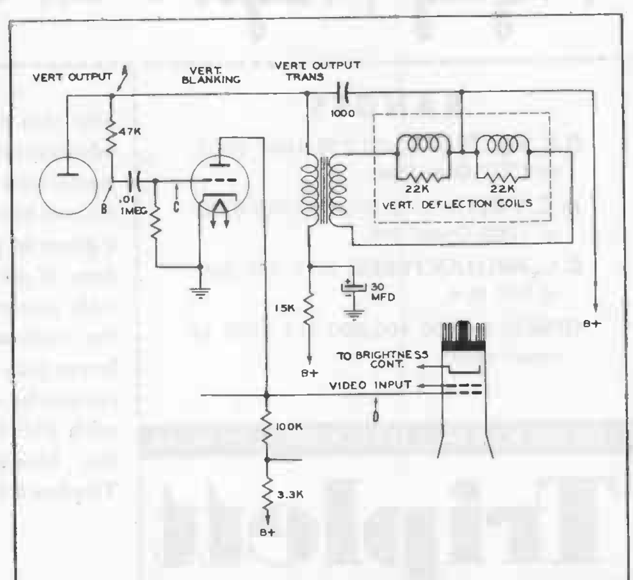

Figure 7. Additional Tube Used to Generate Blanking Signal.

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A positive-going blanking pulse is applied to the cathode of the picture tube in Figure 3, with bias connected to the same element. In this instance an auto-type vertical output transformer is used in the vertical deflection circuit.

Another source of blanking voltage is shown in Figure 4 where the pulse is obtained at the plate of the vertical output transformer and then applied to the picture tube cathode. Modulation of the same element in the picture tube by both the video signal and the vertical blanking voltage is shown in Figure 5.

The vertical discharge network may also be a source of blanking voltage as in Figure 6. Beam cutoff occurs when the pulse reduces the positive potential on the accelerating anode of the picture tube.

A rather elaborate means for obtaining retrace blanking is used in the circuit of Figure 7. The signal from the plate of the vertical output tube is connected through a decoupling network to the grid of a vertical blanking tube. The plate of the blanking tube is connected to the accelerating anode of the picture tube. The vertical flyback pulse is modified by the blanking tube to give a sharp pulse of sufficient magnitude to insure beam cutoff in the picture tube.

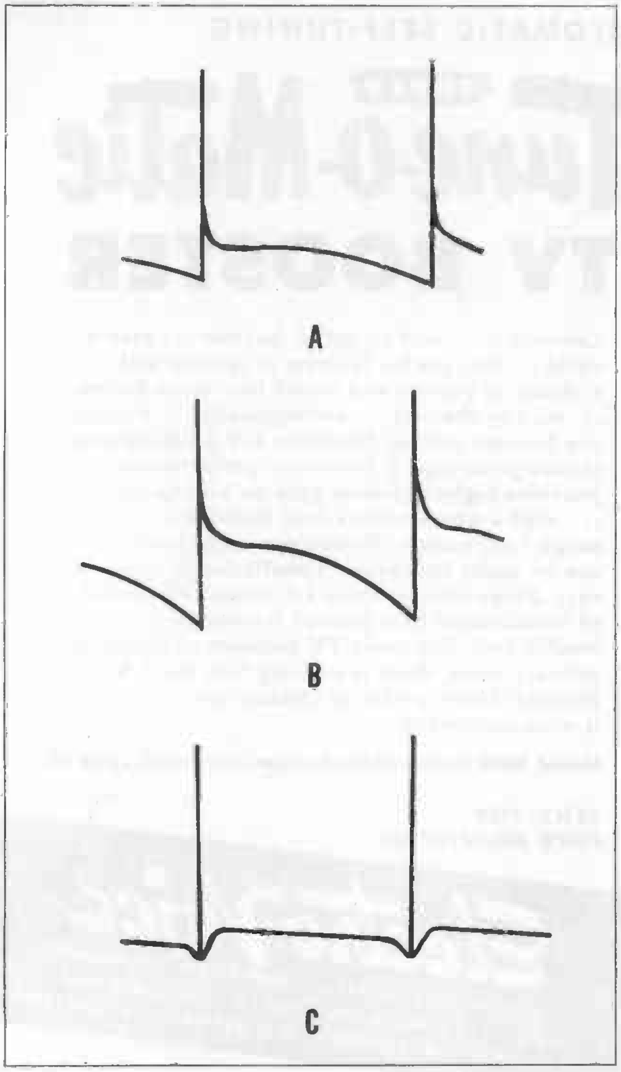

Figure 8. Waveforms in the Circuit of Figure 3.

It might be interesting to note some of the waveforms that are present in vertical blanking circuits. Figure 8A, B, C, shows waveforms observed in the circuit of Figure 3. The points to which each waveform applies is designated on the schematic of Figure 3. In Figures 9A through 9D are waveforms present at the designated points of Figure 7.

Examination of the schematics and waveforms for some of the representative vertical retrace blanking circuits should be helpful in acquainting one with their operation and purpose.

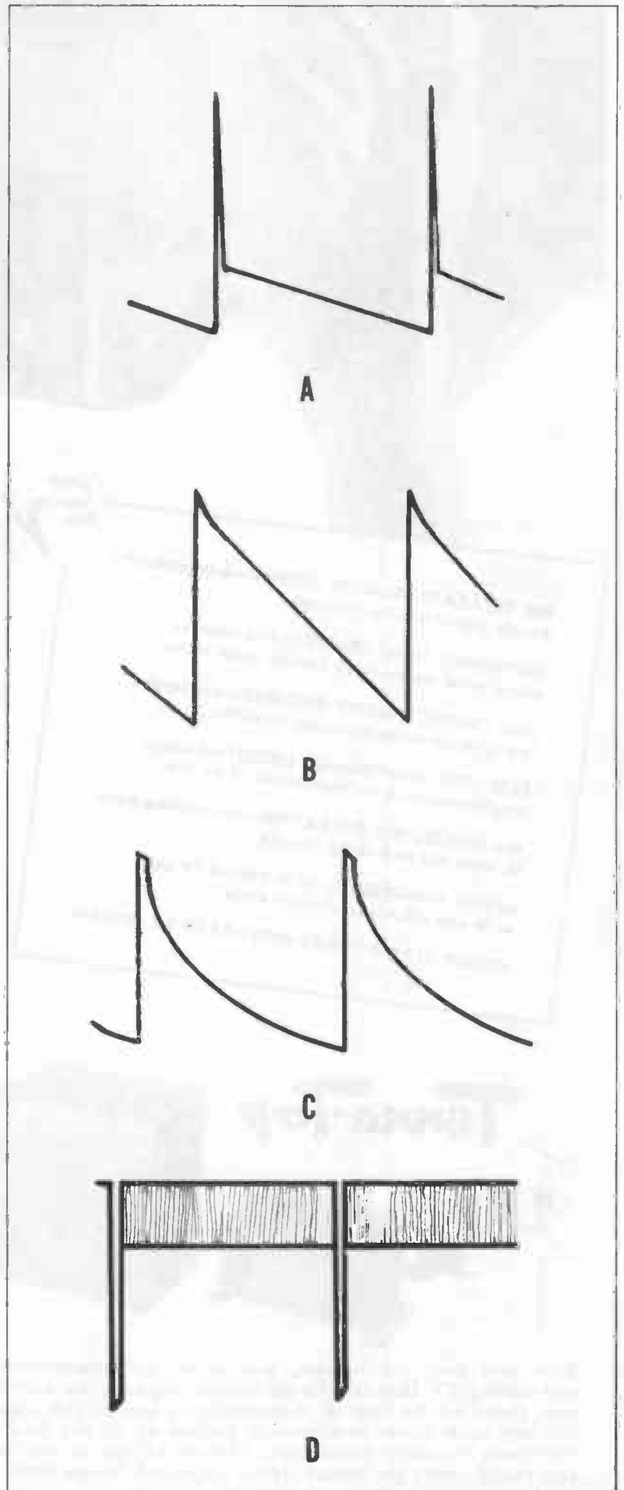

Figure 9. Waveforms in the Circuit of Figure 7.

A Comparison of CBS Color and Present Monochrome Standards

by **VERAL M. SHIELDS**

In order to understand the techniques employed to produce a color picture with the CBS system, it is necessary to become familiar with the nature of the transmitted signal. Also, a comparison of these standards with those of the present monochrome system will provide a basic knowledge of the changes required to adapt existing television sets to receive CBS color telecasts in color or black and white. The following description will assist in these objectives.

In the present black and white or monochrome television system, only the relative light intensity of the picture image is transmitted and reproduced at the receiver. The picture image is scanned element by element and the amplitude level of the transmitted signal is inversely proportional to the light intensity of the element being scanned. The picture is reproduced on a luminescent screen in black and white or in shades of gray.

The addition of color to the television picture requires the reproduction of the many different colors distinguishable to the eye. The actual reproduction of the many different colors is greatly simplified by the fact that all colors can be very closely reproduced by combining just three colors, known as additive primary colors. These colors are red, blue, and green. By combining these primary colors in the proper proportion, it is possible to reproduce any color. The color match can be made so faithfully that only simultaneous inspection of the original color and the reproduction will reveal any difference.

In the CBS color system, the color picture is evaluated for the individual light intensity of each of the primary colors and is transmitted and reproduced one after the other, in time sequence. The color camera is alternately made sensitive to each of the primary colors - red, blue, and green. When the camera tube is photosensitive to a particular color, the signal output of the camera tube at that instant is representative of only that particular color.

The color camera used in the CBS color system is similar to the conventional black-white camera. The chief difference is the insertion of a rotating color filter disk between the lens and the photosensitive plate of the camera tube. The filter disk contains transparent color filter segments that permit light to pass on to the sensitive plate of the camera tube. This filter disk contains six filter segments, two for each of the primary colors - red, blue, and green.

The color of the filter segment in front of the camera tube at any particular instant and the color, as well as the brightness, of the object being televised, determine the intensity of light that reaches the camera. Whenever the red filter segment is between the color object and the sensitive plate of the camera tube, only the red content of the color object is passed through the filter. The output of the camera tube and the transmitted signal at that instant will be representative of the amplitude level of the red content of the color object. The same is true for the blue and green filter segments, the blue passes blue content and the green passes green content to the camera tube.

At the receiver, the signal appears in black and white on a conventional black and white picture tube. However, by placing a rotating color filter disk (similar to that used at the camera) between the viewer and the luminescent picture tube, color is restored to the conventional black and white picture. By synchronizing the disk rotation at the receiver with the disk rotation at the camera tube, the red filter segment will be between the viewer and the receiver screen when the red filter segment at the camera is between the televised scene and the sensitive plate of the camera tube.

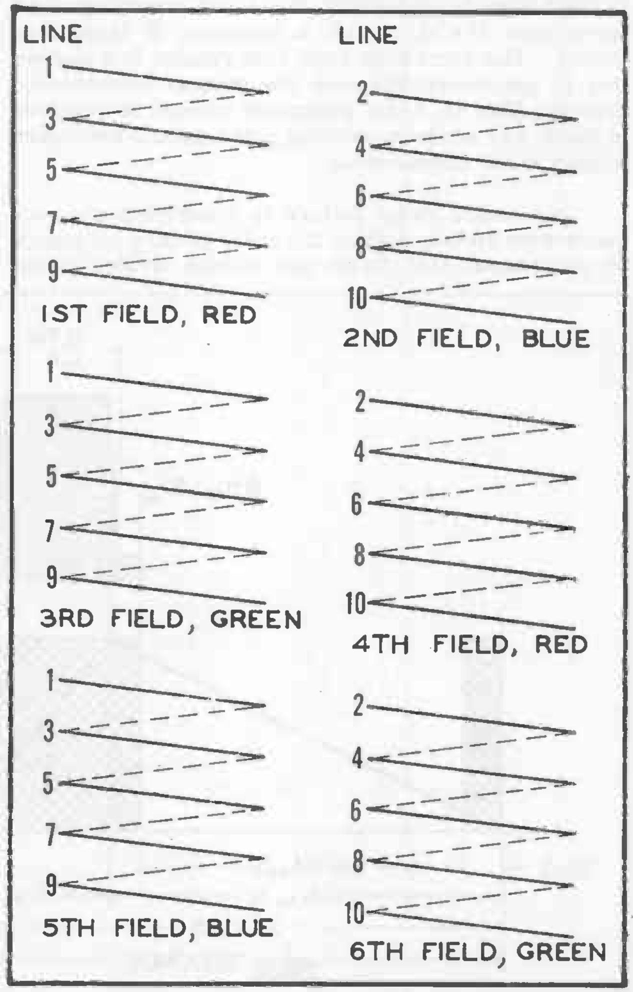

Fig. 1. Field Sequential Color System Scanning Pattern.

The viewer will be observing a black and white picture that is representative of the red content of the televised scene, through a red filter. Consequently, the picture will appear as red to the viewer. The same is true when the blue and green filter segments are between the viewer and the receiver screen. Although the viewer is alternately observing a red, blue, and green picture, persistance of vision and the rapid rate of color change cause the picture to appear to blend as though all three colors existed simultaneously.

Field Sequential Scanning

Color shift (making camera sensitive to each of the primary colors in a definite order) in the CBS color system is performed after each field, hence the name field sequential system. As in the monochrome system, line interlace is used to increase vertical resolution. Figure 1 shows the scanning pattern of the field sequential color system.

All the lines of one field are scanned in red, the next field in blue, the next in green and so on, in the sequence red, blue, green. After six successive fields, all lines have been scanned and evaluated in each of the primary colors. This represents a complete scanning cycle and is termed a "Color Picture."

The fields are scanned at the rate of 144 per second. This is considerably higher than the 60 CPS field rate of the monochrome system. The increase in field rate is necessary to allow scanning of all three color fields with a minimum of large area flicker. The increased field rate results in a system that is not compatible with the present monochrome system. That is, color programs cannot be received in black and white on existing monochrome receivers without some modification.

An entire color picture is completed after six successive fields, making the color picture frequency 24 per second (144 fields per second divided by six fields per picture). This corresponds to the 30 cycle frame frequency of the monochrome system.

With the increased field rate of the color system, it is necessary to reduce the number of horizontal lines per frame in order to meet the FCC requirement that the color system operate in a six megacycle channel. The number of horizontal lines per frame of the color system is 405, divided into two fields of 202-1/2 lines each. This compares with the 525 lines per frame, 262-1/2 lines per field, of the monochrome system. The horizontal line rate is 29,160 lines per second (202-1/2 lines per field times 144 fields per second). This corresponds to the 15,750 lines per second of the monochrome system. Table A gives a standards comparison of the CBS color and monochrome systems.

Color Disk

The synchronized rotating disk contains six color filters arranged in the order red, blue, green, red, blue, green. The disk rotates at 1440 revolutions per minute making 8,640 (1440 x 6) filter segments move past the sensitive plate of the camera per minute. Dividing by 60 provides the field rate of 144 per second.

To prevent color contamination, it is necessary that the color disk proceed down in front of the screen, moving parallel with the scanning lines. When the line at the top of a field is being scanned by a red signal, the bottom of the red filter should move into position and follow the scanning lines as they proceed down the screen. When the last line of the red field is completed, the red filter should cover over the previous scanned lines of that field so that the viewer sees a complete red picture. The blue filter should move into position at the instant that the blue signal arrives for the top line. If this condition is not met, the viewer will observe certain lines through one color filter while the same lines are being scanned by another color signal.

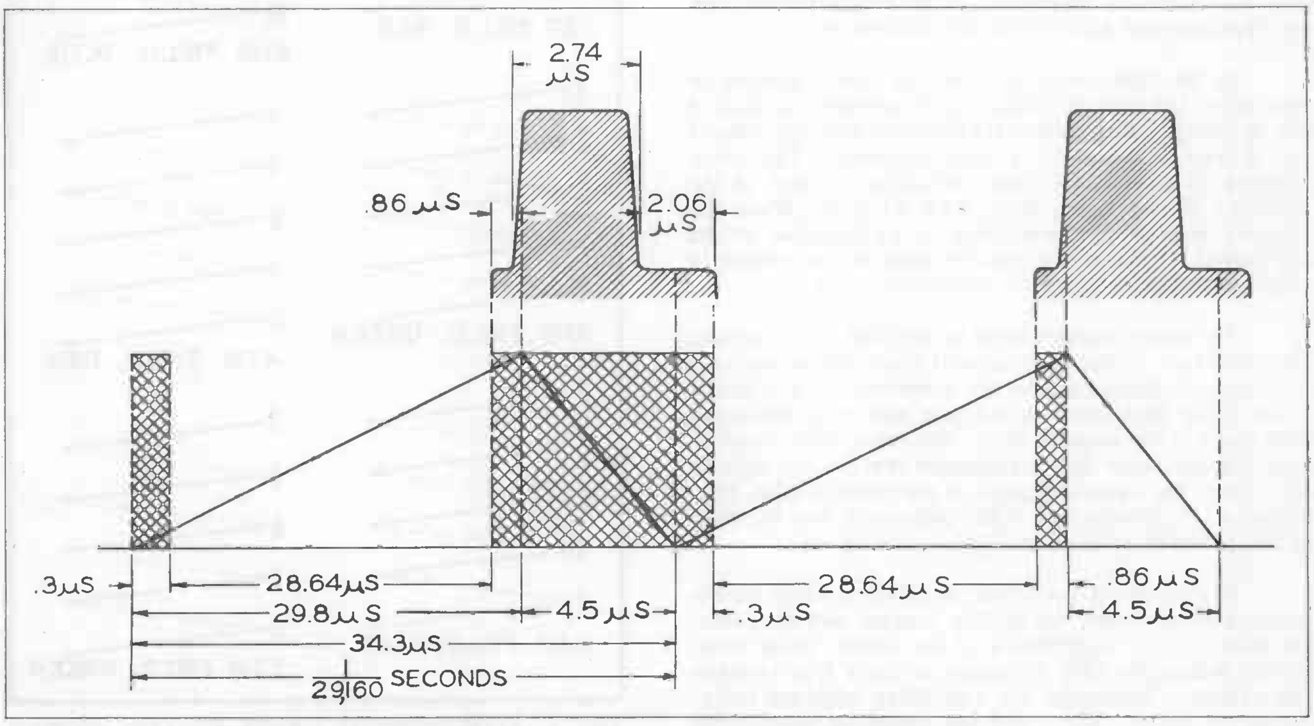

Fig. 2. CBS Color System Horizontal Scanning Wave.

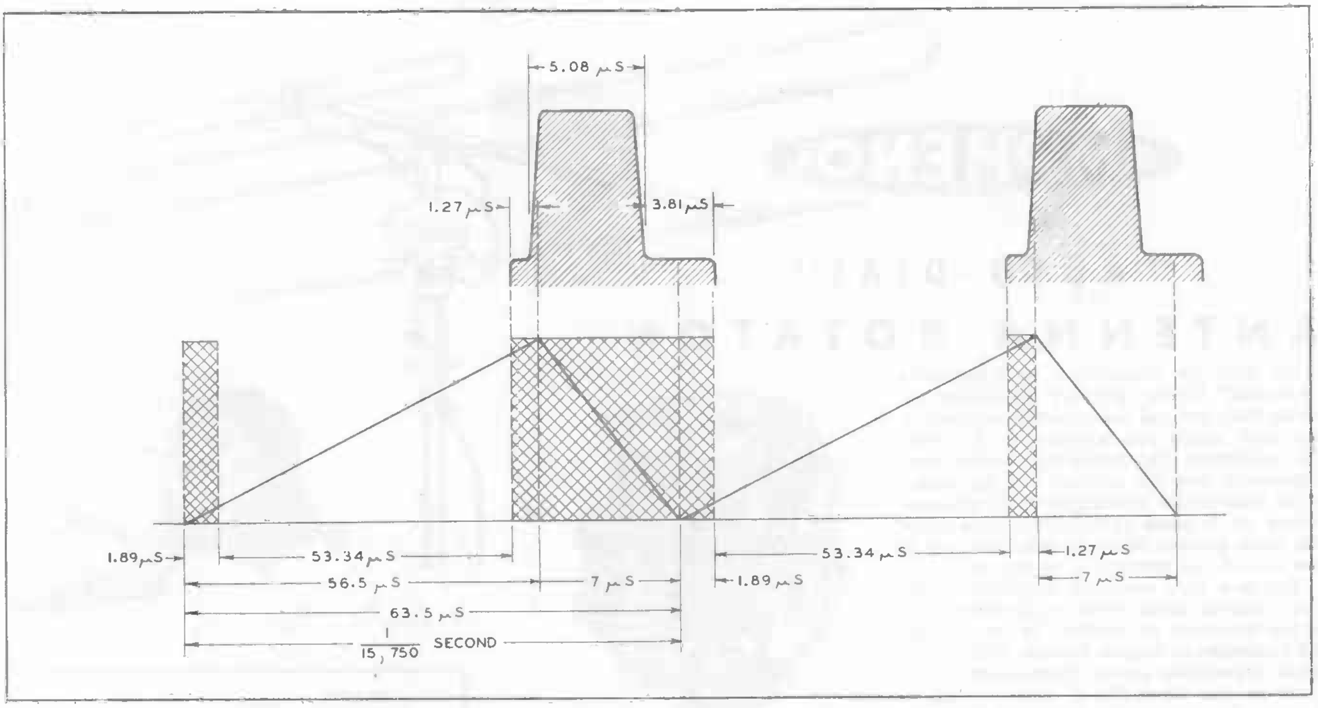

Fig. 3. Monochrome System Horizontal Scanning Wave.

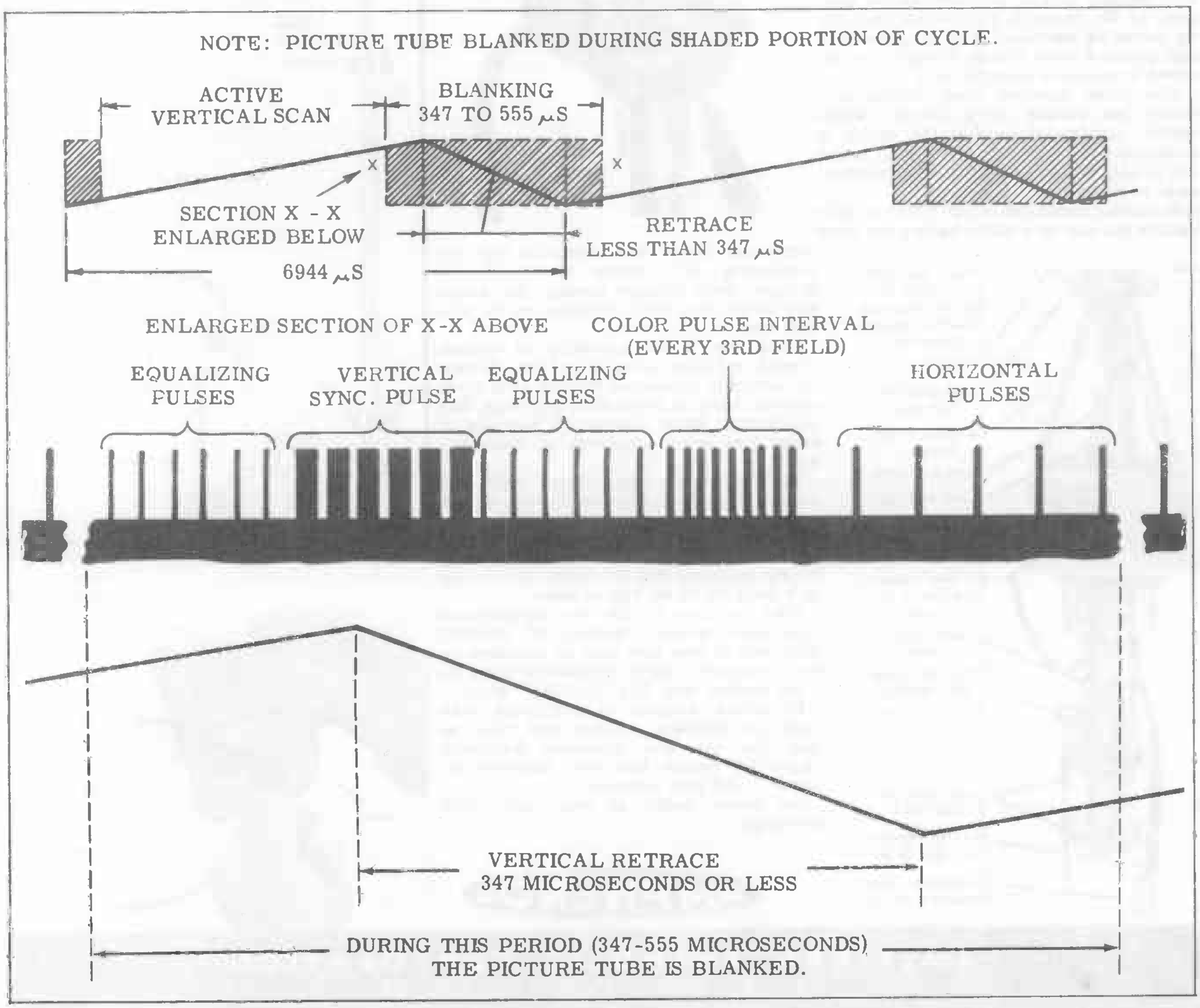

Fig. 4. CBS Color System Vertical Scanning Wave.

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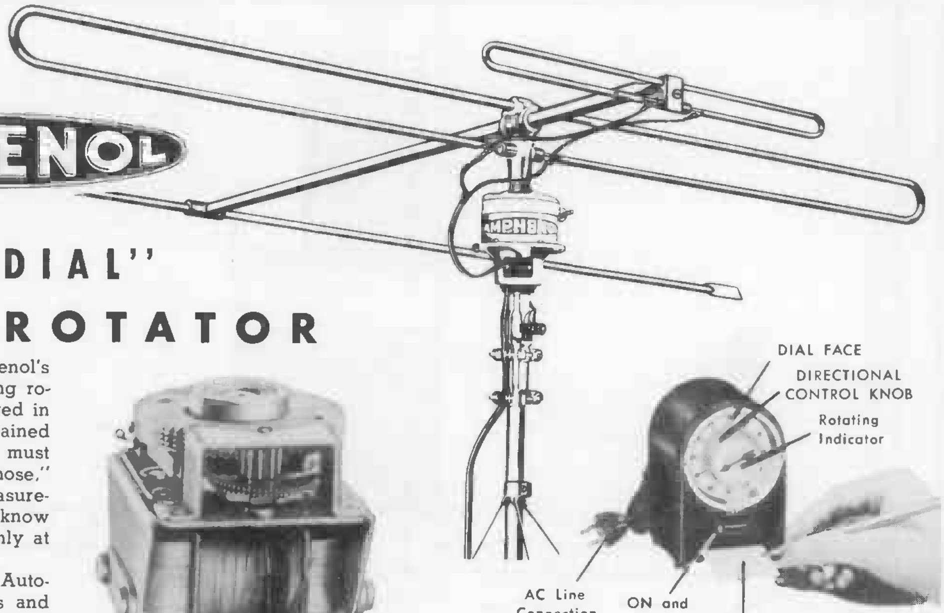

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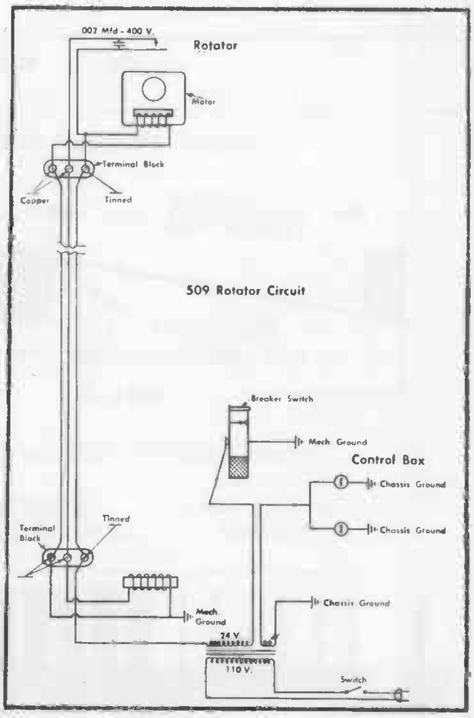

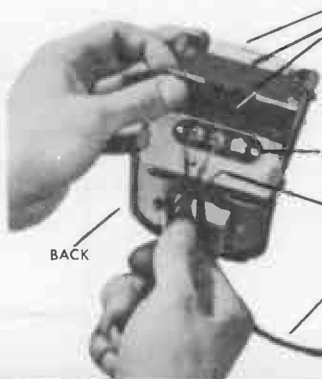

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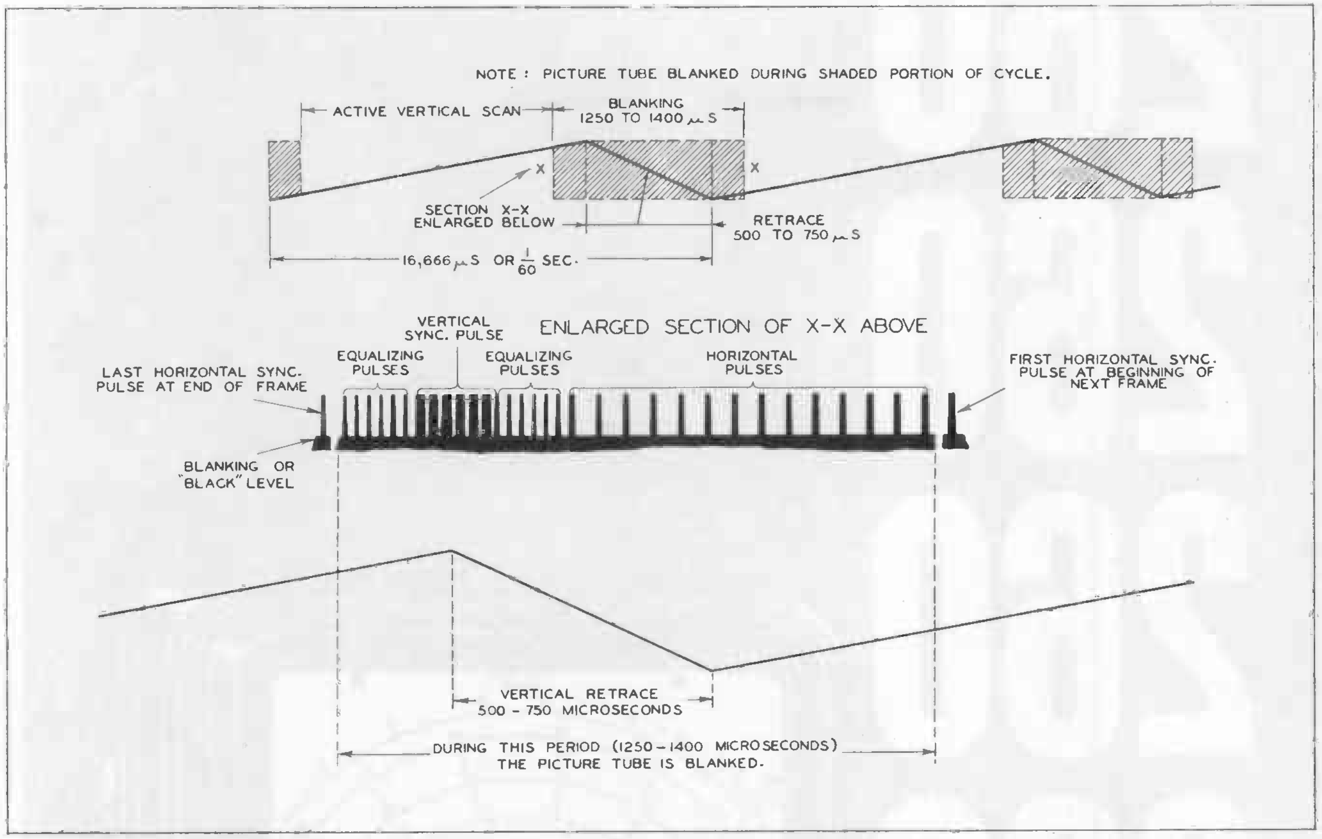

Fig. 5. Monochrome System Vertical Scanning Wave.

A motor is used to drive the color disk. The motors at the camera and at the receiver are locked in synchronism with the field scanning rate. A motor control unit compares the speed of the motor with the field scanning rate and automatically locks them in synchronism. A pushbutton or automatic color phasing circuit may be used in conjunction with this motor control unit to insure the correct color phase.

Synchronization Generator Waveforms

An examination of Figures 2, 3, 4, and 5 shows the similarity of the CBS color and the monochrome synchronizing waveforms. The horizontal, equalizing, and vertical sync pulses of the color system are of the same general form and they perform the same functions as they do in the monochrome system. However, the time interval of the blanking and sync pulses of the color system are of much shorter duration.

As shown in Figure 4, color sync pulses have been inserted immediately following the equalizing pulses of every third field. These pulses are used to automatically insure the correct color phase and motor speed. However, color phase and motor speed may be controlled without the use of the color pulse signal.

Similarity of Monochrome and Color Receivers

Some sections of the standard black and white receivers may be utilized in CBS color system receivers. No substantial changes are required in the tuner, video IF amplifiers, video amplifiers, sound IF and audio amplifiers. Possibly some additional filtering may be used in these circuits to reduce hum difficulties arising from three beat frequencies: 12, 24, and 84 CPS.

In the field sequential color system, the scene is scanned once in each of the three primary colors during three fields or in 3/144th (1/48th) seconds. Whenever the intensities of the primary colors are not the same in each field, a strong 48 CPS component may be present in the video signal. If a 60 CPS hum component is also present, a 12 CPS beat frequency appears. This results in an annoying 12 cycle flicker.

The 84 CPS appears as a beat between the 60 CPS power supply and the 144 per second field scanning rate. The 24 CPS hum component is the result of the second harmonic of the power supply (120 CPS) and the field rate. The 24 and 84 CPS hum components do not appear as flicker as they are above the fusion frequency, but they can readily produce a shimmer or jitter of the scanning lines if any 60 CPS or 120 CPS hum component is present in the deflection circuit.

The sync amplifier and separator circuits are essentially the same as in the conventional black and white receiver. The higher field rate of the CBS color system necessitates some changes in the vertical integrator, vertical oscillator, and vertical output circuits of the color receiver. The vertical oscillator is designed to operate at 144 CPS. Since the retrace time is 347 microseconds, or less, for the color system, as compared to 833 microseconds, or less, in the monochrome system, it is necessary to make some changes in the discharge elements to accomplish the faster retrace.

The horizontal line rate of the color system is 29,160 lines per second. Consequently, the horizontal oscillator circuit is redesigned to operate at this frequency. The retrace time of the horizontal sweep is also greatly reduced. Retrace must be accomplished in 4.5 microseconds, as compared to 8.3 microseconds for the monochrome system. Thus the

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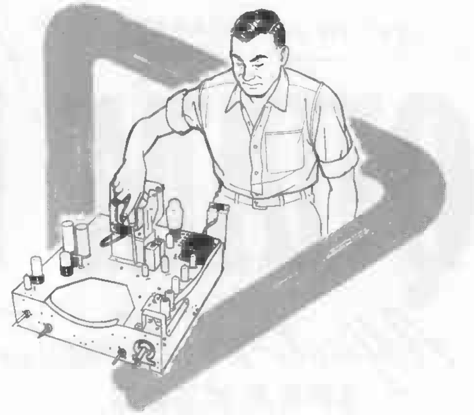

Figure 1. Receiver in Cabinet Before Conversion.

The dimensions of the Olympic Model XL-210 (See Figure 1) are such that a 16" rectangular, or larger, picture tube, cannot be mounted in the cabinet. Since this conversion was made for a 20CP4A picture tube, with the completed assembly (Shown in Figure 2) to be mounted in a custom installation, the original cabinet was not retained.

A partial schematic of the original circuit is shown in Figure 3. To make the necessary changes in the HV compartment (See Figure 4) the cover and the tubes in the cage were removed. The complete cage was lifted from the chassis after unsoldering the leads to the fuse, to the HV filter capacitor, to terminals 4 and 5 on the horizontal output transformer and removing the five self tapping screws securing the cage to the chassis. The transformer and width coil were then removed after taking out the four 8-32 machine screws holding the transformer to the cage, slipping the width coil out of its mounting bracket and

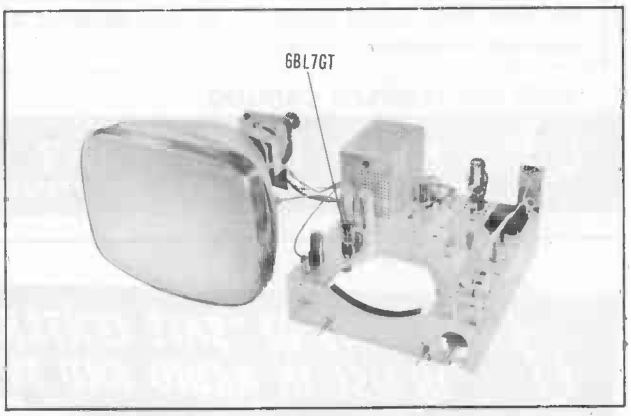

Figure 2. Chassis and 20CP4A After Conversion.

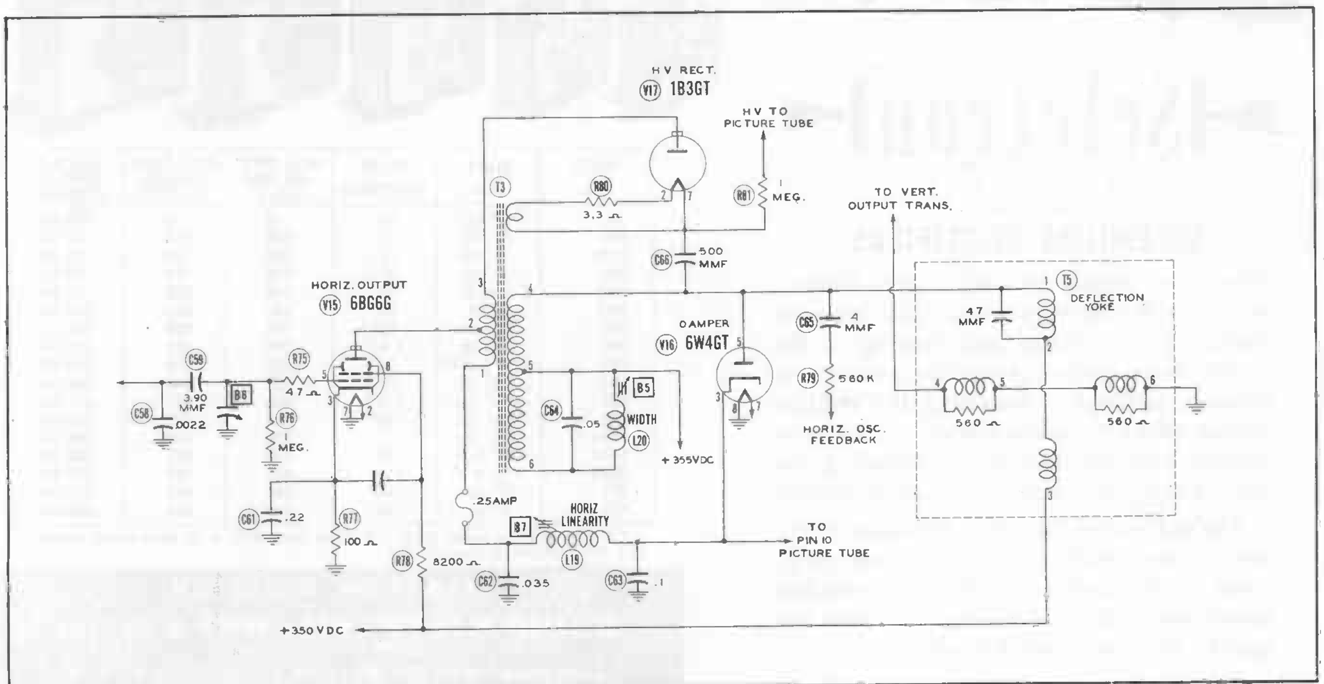

Figure 3. Schematic Before Conversion.

unsoldering the filament leads to the HV rectifier socket and the fuse.

At this time the mounting hole for the width coil was enlarged to fit the Merit MWC-1 coil which was then clipped into the bracket to replace the original unit.

The Merit HVC-7 horizontal output transformer, used in this conversion, was installed on the HV cage in the space formerly occupied by the original transformer, using the same mounting holes and screws. The high voltage lead was unsoldered from its terminal on the rectifier socket mount and a new lead, long enough to connect to the picture tube in its operating position, was connected in its place. The filament leads were then soldered to the proper terminals on

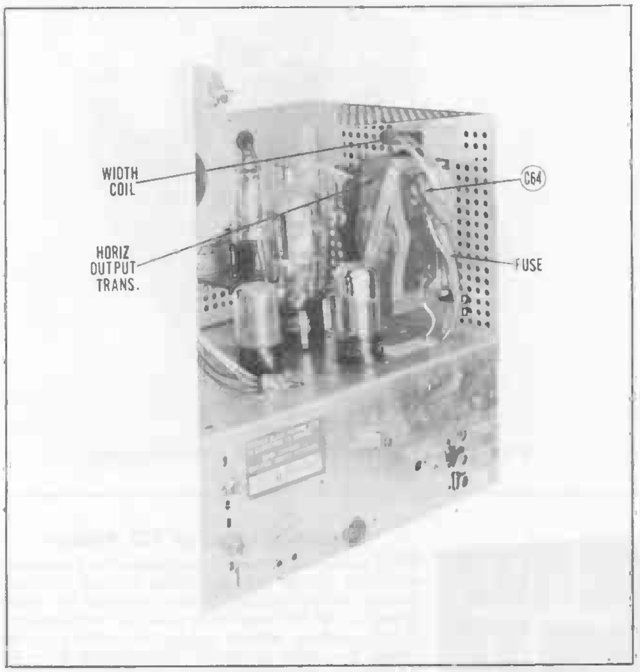

Figure 4. HV Compartment Before Conversion.

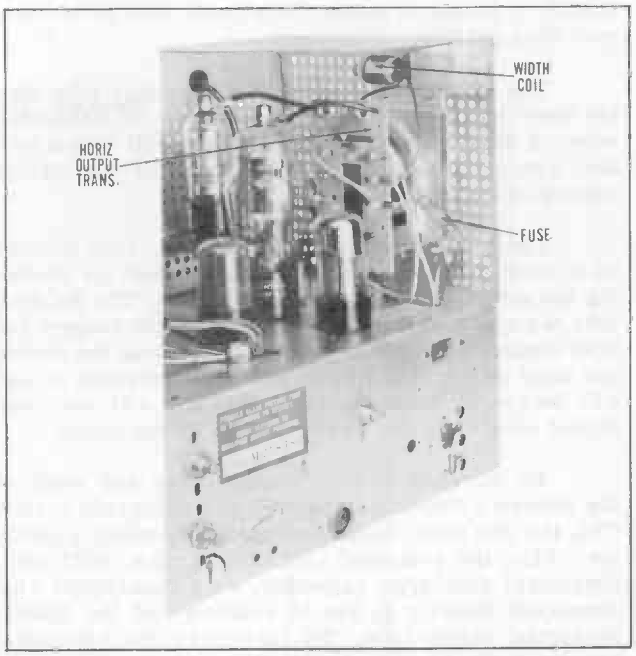

Figure 5. HV Compartment After Conversion. (Type HVO-7)

the rectifier tube socket and the HV cage mounted back in position on the chassis (See Figure 5).

The fuse was connected to the blank terminal (#7) on the transformer, as a tie point, and a lead connected from there to terminal #1, placing the fuse in the circuit. The wiring of this portion of the circuit was then completed as shown in Figure 6.

The damping capacitor and resistors were installed in a Merit MD70-F deflection yoke; following the manufacturer's instructions. The yoke and focus coil mounting assembly (See Figure 7) was taken off the chassis by removing the four sheet metal screws securing it. The original yoke was disconnected and the MD70-F yoke installed in its place with leads of

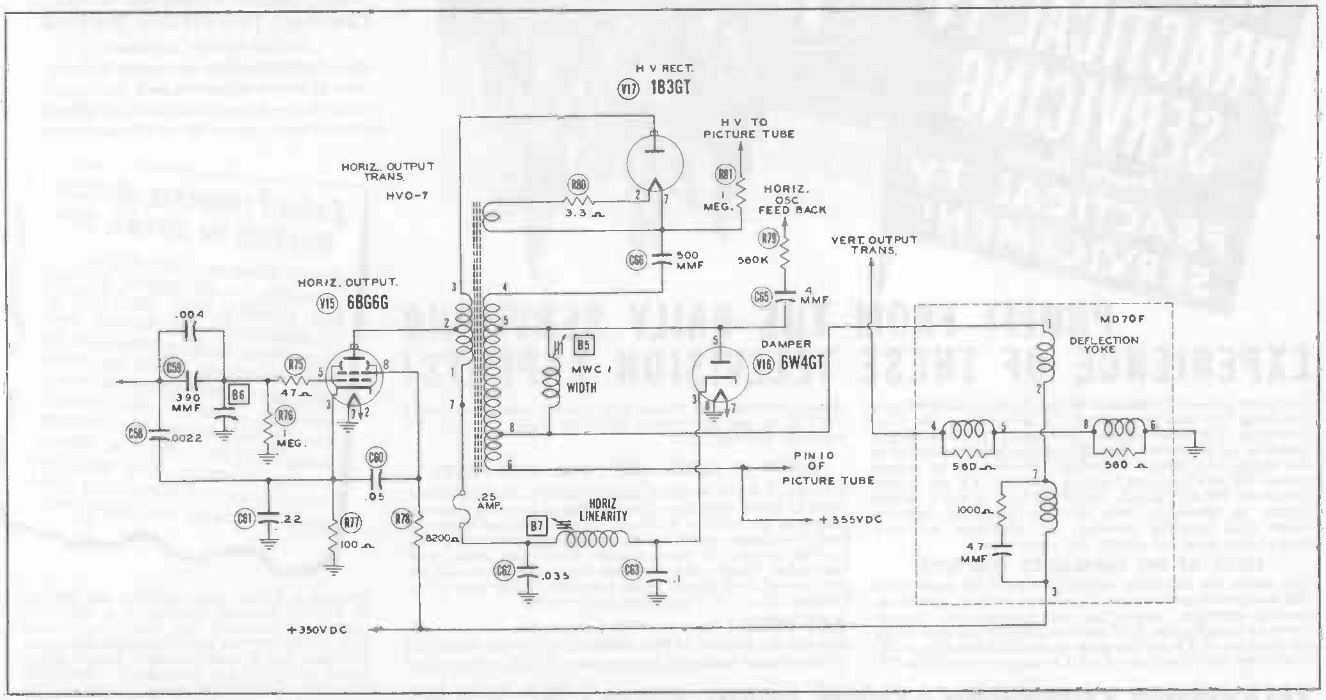

Figure 6. Schematic After Conversion (Type HVO-7)

sufficient length to mount the picture tube in its final operating position.

The leads to the focus coil and picture tube socket were lengthened to match those on the deflection yoke. A lead from the yoke and focus coil mount was also connected to the chassis, to ground the outside coating of the picture tube.

The yoke and focus assembly was then blocked up to form a temporary picture tube mount for checking the actual operation of the receiver. The 20CP4A tube was mounted in the yoke, a single magnet ion trap magnet installed on the tube, replacing the double one used on the 12LP4 tube, the socket plugged on and all necessary connections made. The set was then turned on and checks were made on its operation.

To increase the horizontal drive and width of the picture a .004 mfd. capacitor was connected across C59, the 390 mmf. horizontal sweep coupling capacitor. Also, the grounded lead of C58, the .0022 mfd. horizontal discharge capacitor, was unsoldered and connected directly to pin #3 (cathode) of the 6BG6G horizontal output tube. To improve the horizontal centering the 33 ohm 1 watt filter resistor was removed and replaced with a 39 ohm 1 watt resistor, with a .5 mfd. capacitor connected across it for bypassing.

To increase the vertical sweep, a 6BL7GT tube was used as a direct replacement for the 6SN7GT vertical oscillator and output tube. The 56,000 ohm shunt resistor across the primary of the vertical output transformer was removed. To improve height and linearity, a 3300 ohm 1/2 watt resistor was connected across the vertical linearity control, the 560 ohm vertical output cathode resistor was replaced with a 390 ohm 1/2 watt resistor and the vertical blocking oscillator plate resistor was changed from 1 megohm to 470,000 ohms 1/2 watt.

Operation was also checked with a 14BP4A and a 16TP4 picture tube with very satisfactory results.

Conversion with STANCOR A-8129

The conversion to operation with the 20CP4A was also made by replacing the original horizontal

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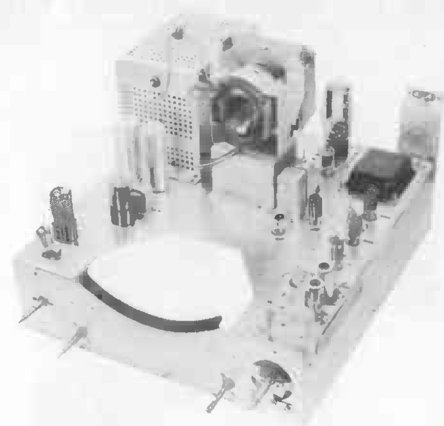

Figure 7. Chassis Before Conversion.

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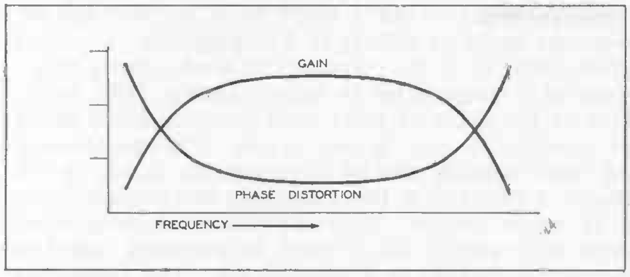

Figure 4-1. Amplitude and Phase Distortion Curves.

is adjusted to a point where the plate current just reaches zero. If the supply voltage to the plate of the tube were increased, plate current would then flow and a greater negative bias would be required to again cut off the plate current. This also applies in the case of picture tubes. With a higher voltage (similar to plate voltage in the conventional tube) a higher amplitude of the modulating signal will be required.

The gain of the video amplifier need only be in the order of 20 or 30 and it would seem that very little difficulty would be experienced in its design. The complexity of the video signal, however, makes necessary the design of an amplifier having a flat response over a wide range of frequencies. In order to faithfully reproduce the transmitted picture, all frequencies from 30 cps to 4 megacycles must receive equal amplification. This requires a video amplifier having a flat response within this range. There must also be a minimum of phase shift at all frequencies to prevent displacement of picture elements from their proper positions. A variation in gain of an amplifier is caused by the change in reactance of the inductive and capacitive components in the circuit. This change in reactance also causes phase shift which is inversely proportional to the gain of the amplifier. The relationship of these two curves is shown in Figure 4-1.

At the low modulation frequencies, keeping the phase angle of the signal at a minimum is of much greater importance than at the higher modulation frequencies. Due to the longer time required for one cycle at the low frequencies, a phase displacement of only a few degrees results in considerable time delay. For instance, a phase shift of only 5 degrees of a 60-cycle signal results in a time delay of 231 microseconds. Such a time delay would displace the picture element nearly four lines, which would have a smearing effect on the picture.

At the higher modulation frequencies, however, phase shift is much less harmful. In order to reproduce fine detail in the picture these high modulation frequencies must be present and any loss in their amplitude will result in loss of fine detail. Due to the short time duration of each cycle at high frequencies, considerable phase shift can be experienced without impairment of the picture. As an example, a 10-degree phase shift at 3 megacycles results in the displacing of a picture element only .02 inches in a 16-inch tube.

From the qualifications set forth, it can be seen that the video amplifier should meet the following requirements:

1. Adequate gain to modulate the picture tube at full contrast.

2. Amplification of all frequencies from 30 cps to 4 megacycles with a minimum of amplitude and phase distortion.

High Frequency Compensation

The decrease in gain at the higher frequencies in the uncompensated amplifier is caused by the capacitive reactance of the shunt capacity in the circuit. As the frequency increases, the capacitive reactance decreases and since it is effectively in parallel with the load of the tube, it tends to decrease the gain. Figure 4-2A is a schematic of an uncompensated amplifier. The dotted capacitors represent the shunt capacities which are present in the circuit. The total shunt capacity is made up of C out, C stray, C in and the dynamic input capacitance of the tube produced by the Miller Effect, which is stated as $C_{gp}(A+1)$. As long as the capacitive reactance of the shunt capacity is large as compared to the plate load, no decrease in gain is experienced. At the higher frequencies, however, the capacitive reactance approaches the value of the plate load resistor and in some cases may be even less, which results in a loss of gain at the high frequencies. By using as low a value of plate load as possible, the gain at the high end can be held more constant.

There is a limit as to how low the plate load can be reduced, however, since the gain of the stage is proportional to the value of the plate load. This relationship is shown in Figure 4-3. If the plate load is too low, the stage will not provide sufficient gain.

Shunt Peaking

By adding a reactive component, whose reactance increases as frequency increases, in series

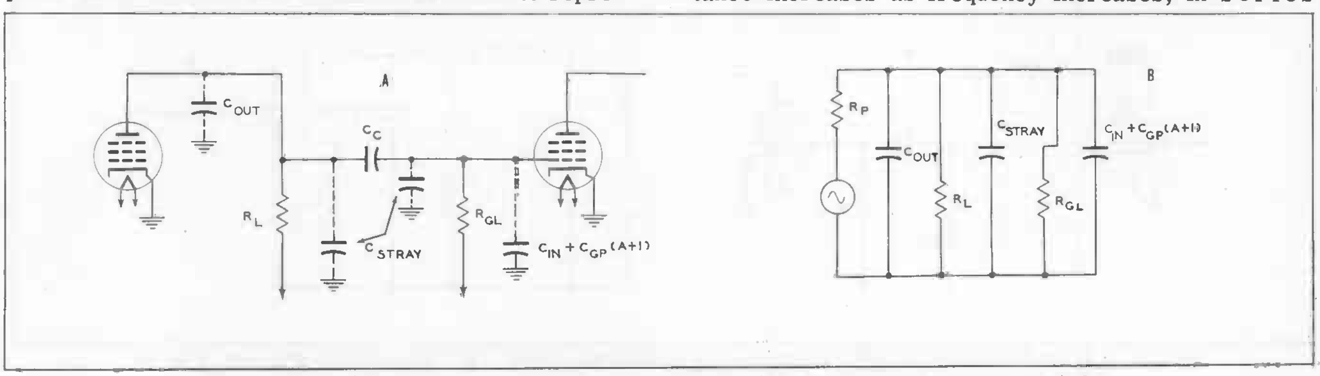

Figure 4-2. (A) An uncompensated Amplifier. (B) Equivalent Circuit of 4-2A.

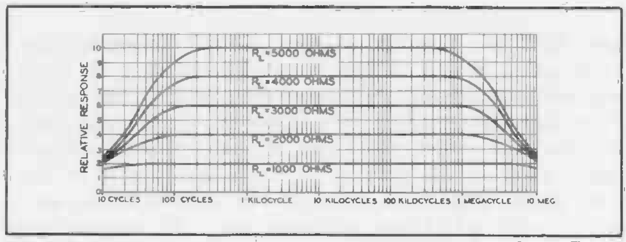

Figure 4-3. Effect of Varying the Plate Load on Gain and Bandwidth.

with the plate load, the gain of the stage can be held up at the high-frequency end. The insertion of a peaking coil in series with the plate load resistor accomplishes this. Circuitry of this type is known as shunt peaking.

In circuit design, the value of the plate load is made equal to the reactance of the shunt capacity at the upper frequency limit. A peaking coil is selected whose inductive reactance is equal to one-half the value of the load resistor. Under these conditions the load impedance at the upper frequency limit is equal to the resistive value of the plate load resistor. At the lower frequencies, the capacitive reactance of the shunt capacity is of so high a value that it can be disregarded. Likewise the inductive reactance of the peaking coil is so low that it too can be disregarded. Thus it can be seen that the load at the lower frequencies is purely resistive. If the load impedance at the upper limit is equal to the plate load, the response of the amplifier will be essentially flat up to the desired upper limit. Figure 4-4A shows a video amplifier employing shunt peaking for high frequency compensation.

Let us assume that in the case of the circuit shown in Figure 4-4A a 6AU6 is to be used and the response is to be flat up to 4 megacycles. The total shunt capacity in the circuit is 30 mmf., whose reactance at 4 megacycles is approximately 1300 ohms. This is the value of plate load resistor which would be selected for use in the circuit. The reactance of the shunt peaking coil at 4 megacycles should be 650 ohms. A coil having this reactance has an inductance of 26 micro-henrys. If these values of components were employed in this circuit, its response would be essentially flat up to 4 megacycles. The equivalent circuit is shown in Figure 4-4B.

It would seem that this would be an ideal amplifier and that no further compensation would be required. This type amplifier has one deficiency, however, in that it has very low gain. When a low value of plate load is used with a pentode tube, which has a high value of plate resistance, the gain of the stage is equal to the product of the load and the transconductance of the tube, or Gain = Gm x R_L. The gain of this particular circuit then is approximately 5. The gain can be increased by either selecting a tube having a higher transconductance or by increasing the value of the plate load. In actual practice tubes having a high transconductance value are usually used which means that the only method of increasing the gain would be to increase the value of the plate load. Referring again to Figure 4-4A, it should be remembered that the values of L and R_L were dependent upon the shunt capacity in the circuit. By reducing the shunt capacity in the circuit, the values of both L and R_L can be increased resulting in greater gain in the stage.

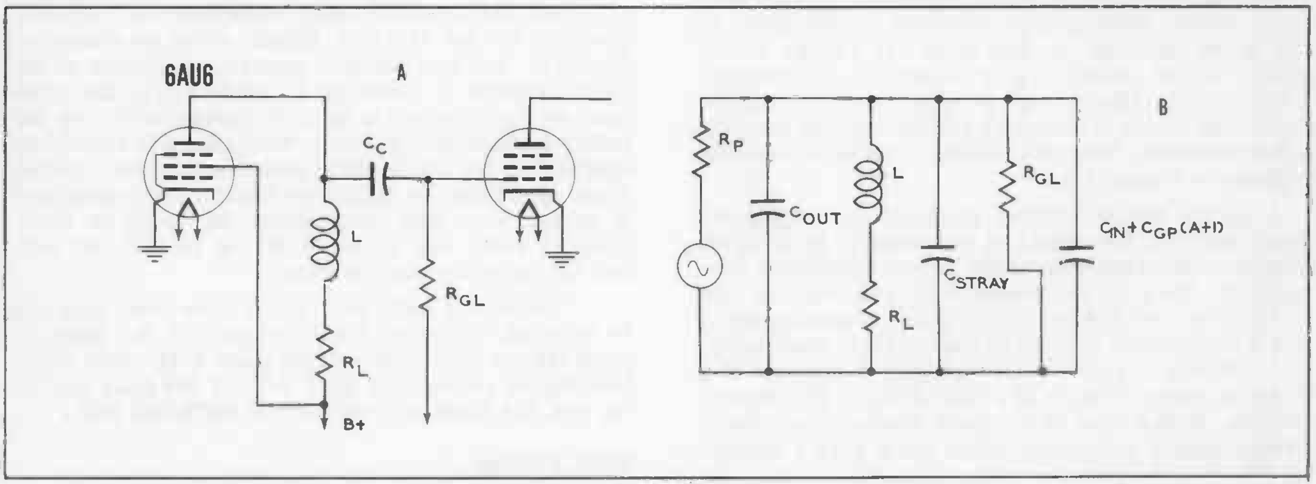

Figure 4-4. (A) Video Amplifier Employing Shunt Peaking. (B) Equivalent Circuit of 4-4A.

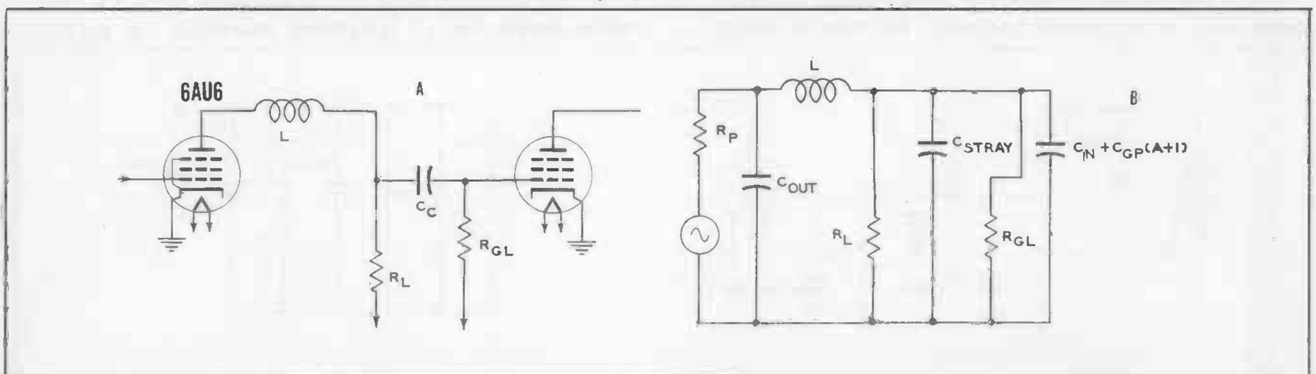

Figure 4-5. (A) Video Amplifier Employing Series Peaking. (B) Equivalent Circuit of 4-5A.

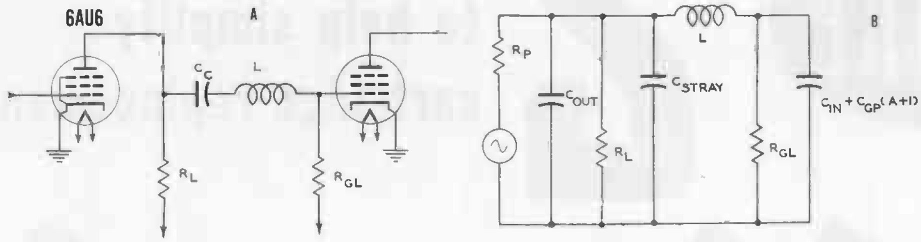

Figure 4-6. (A) Video Amplifier Employing Series Peaking with Peaking Coil in Grid of Following Stage. (B) Equivalent Circuit of Figure 4-6A.

Careful placement of wiring and components will be helpful in holding shunt capacity to a minimum.

Series Peaking

The addition of a peaking coil in series with the video amplifier output circuit and the input of the following stage, isolates the input and output capacities. Since this reduces the shunt capacity across the output of the stage, a larger value of plate load can be used, resulting in higher stage gain. This type of compensation, shown in Figure 4-5, is known as series peaking.

Seemingly, the presence of a peaking coil in series with the signal path would oppose passage of the signal. Such is not the case. If the coil selected produces resonance (with the stray capacitance) at the upper frequency limit, an actual increase in signal to the following stage is possible. Normally, through series peaking, the plate load can be increased by 50% over the value used with shunt peaking.

The ideal condition for a minimum of phase distortion is to have a ratio of 2 to 1 between C in and C out. This ratio may usually be obtained through careful placement of parts or by connecting the series coil so that the stray capacity can be added to C in or C out. The series peaking coil of Figure 4-5A is connected so that stray capacity in the circuit is in parallel with the input capacity of the following stage. The coil can be moved to the other side of the coupling capacitor (Figure 4-6A) placing most of the stray circuit capacity in parallel with the output capacity of the stage. (See Figure 4-6B). In some cases this is done to obtain proper ratio between C in and C out and in rare instances a very small capacity is added to obtain the desired stray capacity.

Combination Shunt & Series Peaking

By combining the advantages of series and shunt peaking, the desired frequency response can be obtained with an even further increase in gain. In view of its greater gain, the combination circuit is the most widely used in commercial receivers.

A video amplifier using combination peaking is shown in Figure 4-7. Let's compare the gain which is possible with this circuit to that obtainable with shunt peaking alone, as in Figure 4-4A. The plate load resistor can be increased to 2900 ohms by selecting proper values of shunt and series peaking coils, resulting in 80% greater gain of the stage.

The shunt resistor, R_S, placed across the series peaking coil, lowers the Q and prevents overpeaking, which might occur at the high frequency end. This resistor is normally 5 to 10 times the value of R_L. R_S is usually the coil form for the series peaking unit. The shunt peaking coil often uses a resistor form, however; its value, normally 1 megohm or greater, has no electrical function in the circuit.

Video amplifier circuit values used for high frequency compensation are dependent on the amount of shunt capacity in the circuit. In servicing, care should be taken that wiring and components be undisturbed, or returned to their original positions. Where extra long leads are employed on parts to be replaced, provide the same lead length on the new unit, for proper positioning.

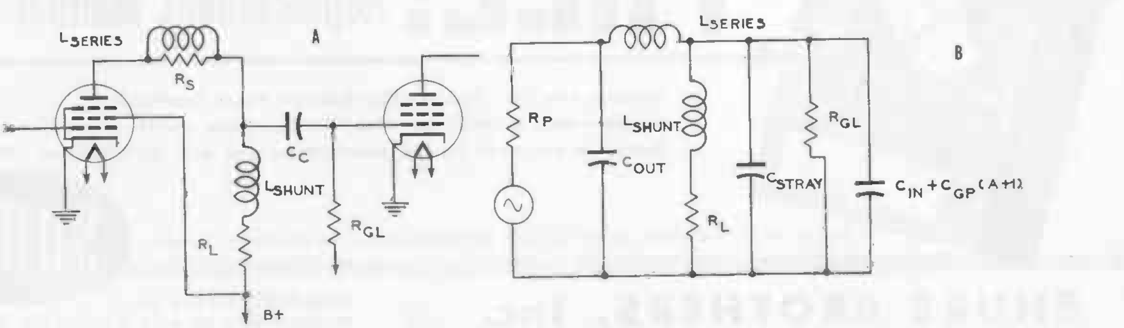

Figure 4-7. (A) Video Amplifier Employing Combination Peaking. (B) Equivalent Circuit of Figure 4-7A.

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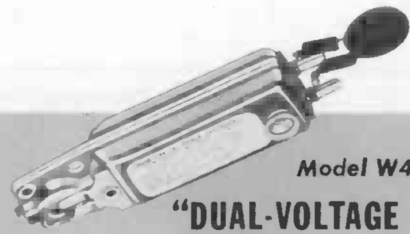

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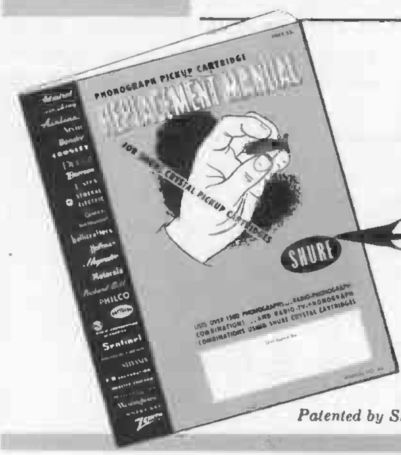

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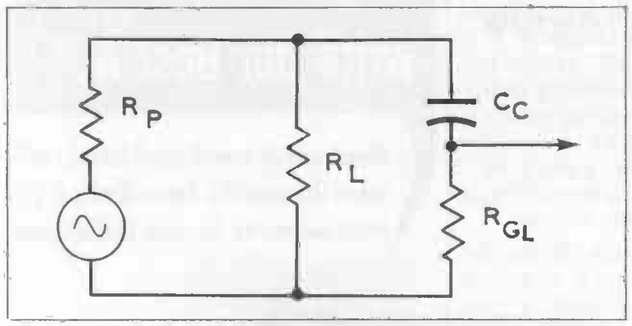

Figure 4-8. Equivalent Circuit of A Video Amplifier at Low Frequencies.

Low Frequency Compensation

In addition to good high frequency response in the video amplifier, good low frequency amplification is necessary to provide a faithful reproduction of the transmitted picture. Large areas are produced by signals of the lower frequency range and their loss may result in excessive shading or smearing of the picture.

The majority of video amplifiers are of the resistance-capacitance coupled type. The high capacitive reactance of the coupling capacitor at the lower frequencies, forms a voltage divider network. Figure 4-8 is the equivalent circuit of such an amplifier at low frequencies. The shunt capacity in the circuit is not shown, since its high reactance has negligible effect at the lower modulation frequencies. As the reactance of C_c increases, more signal develops across it and less signal appears across R_{gL}, resulting in loss of gain. Also, the low frequency signals across R_{gL} will have a leading phase angle resulting in displacement of low frequency components of the picture. The shorter the time constant of the coupling network, C_c and R_{gL}, the greater the loss and phase distortion in the circuit.

In receiver design, these component values are made as high as possible. There are limitations, however. If the resistance in the grid circuit is too high, there is a possibility of reverse grid current flow caused by gas content of the tube. Maximum grid resistor values vary with different tubes. Therefore, types having inherently low gas content are usually chosen as video amplifiers, so that the grid resistor value can be relatively high.

Large value coupling capacitors will also increase the grid circuit time constant. Larger capacitance values, however, have larger physical size, tending to increase shunt or stray capacity in the circuit, in turn affecting high frequency response. Maximum coupling capacitor value may also be limited by leakage current, which becomes greater as the capacitance increases. The use of hermetically sealed, molded paper capacitors holds this deficiency to a minimum and such units are used almost exclusively for this application in commercial receivers.

The average time constant of the coupling circuit is usually between .05 and .1 second, providing a minimum distortion at low frequencies. This value of time constant can be obtained without exceeding the grid resistor and coupling capacitor limitations, just discussed.

Other points where low frequency distortion may be introduced are in the screen and cathode circuits and across the impedance of the power supply. Figure 4-9 shows a video amplifier employing circuitry to minimize this distortion.

The deficiency easiest to correct is that of the impedance in the screen circuit. The low screen current of the tube allows a fairly high value of R_{sg} and with bypassing of a 10 to 20 mfd. electrolytic capacitor, the screen circuit impedance is made very low.

Another method of correcting screen grid degeneration is that of connecting the screen directly to a B+ supply. Most receivers have several B+ lines and connection of the screen to a line of the correct potential will hold degeneration to a minimum because of the low impedance of the power supply.

Note that in Figure 4-9 a decoupling network consisting of R_d and C_d has been added in the plate circuit. One function of this network is to decouple the plate circuit from the power supply. Selection of proper values in this circuit can also compensate for distortion introduced in the cathode circuit and the coupling network.

The cathode resistor, R_k, is bypassed with C_k. Assume that R_k is 100 ohms and that - for the moment - C_k is removed. The unbypassed cathode resistor would cause degeneration at all frequencies and no compensation would be required. There would be considerable loss in the stage, however, making necessary the use of a bypass capacitor. If C_k were sufficiently large, very little degeneration would occur even at very low frequencies. However, there is a limit to the value of C_k, both from economic and space standpoints.

No matter how large the value of C_k, some degeneration will be present. Compensation can be made for this in the plate circuit decoupling network. Although R_d-C_d and R_k-C_k are similar networks, the plate current of the tube flows through them in opposite directions. Thus, the decoupling network can compensate for cathode circuit loss by making the time constant of both circuits equal.

100% correction is obtained when the decoupling resistor exceeds the cathode resistor by an amount equal to the gain of the stage; and the cathode bypass capacitor exceeds the decoupling capacitor by the same ratio. Assume that C_k has a value of 100 ohms to provide proper bias, and that the gain of the circuit shown in Figure 4-9 is 10. The decoupling resistor would then need to be 1000 ohms. Similarly, if C_d is

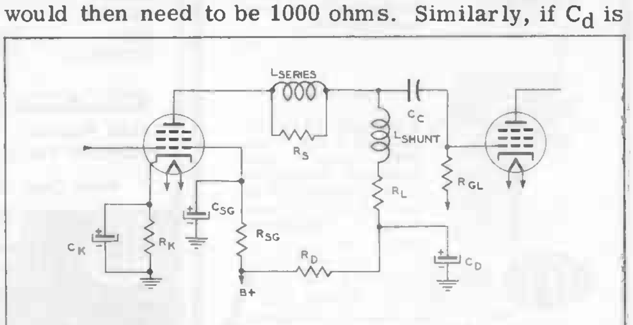

Figure 4-9. Video Amplifier Employing both High and Low Frequency Compensation.

10 mfd., then C_k will be 100 mfd. Under these conditions (equal network time constant) a change of 1/10 volt at the cathode will result in 1 volt additional signal being developed across the decoupling network. This additional signal makes the gain of the stage the same as it would have been had no degeneration occurred in the cathode circuit.

The phase angle of the decoupling network is such that it is corrective for phase shift if produced in the coupling network (C_c-R_{gL}). Therefore, selected values of R_d and C_d can compensate for distortion in both the cathode circuit and the coupling network.

The use of fixed bias eliminates the need for cathode resistors. However, most tubes require lower grid circuit resistance when fixed bias is applied. If the recommended value makes the time constant of the coupling circuit too low, cathode bias must be used.

Component values for both high and low frequency compensation are determined during receiver design. Servicing these circuits involves only proper replacement to restore them to original operation.

John Markus   Editor-in-Chief, McGraw-Hill Radio Servicing Library

Dollar and Sense Servicing

FOAM. Down the grapevine comes word that the super-size direct-viewing picture tubes of the future will have thick walls made out of foam glass, lighter yet stronger than solid glass. Tap the tube with a hammer and you get just a powdery dent, with no crack, no implosion and no loss of vacuum. The face plate will still be transparent solid glass, and the neck will probably also be of solid glass to keep the deflection coils close to the electron beam.

COLORED SOLDER. Need for applying colored lacquer to each joint during inspection of high-quality communication and electronic equipment is said to be eliminated by use of an English-made solder that is available with four different colors of flux. When solder is used, the colored flux runs to edges of joint and remains as permanent easily-seen indicator that the joint has been soldered.

MIRRORS. On the wall at the back of a workbench, running the full width of the bench, a mirror speeds TV repairs by telling when the picture is "fairest of all" during back-of-set adjustment and alignment procedures. This is as good an excuse as any for doing that long-planned rebuilding of the bench. For consoles, a mirror on an empty wall where it can extend to within two feet of the floor is equally useful for the same reason. Wall-mounted mirrors are far safer from breakage than precariously propped framed mirrors borrowed from a hall or bedroom.

DOG DAYS. On these most trying days of the year, when customers and help both are touchy, when heat and humidity combine to get you down, and when there's everywhere a distinct lack of appreciation for what you're trying to do, think of the candle. It is of no earthly practical use unless it is being consumed. A serviceman, too, is of most use to the world when putting into his work so much in the way of effort that he feels consumed too. A preacher expresses it thusly: "Let me be consumed, that I may be of use."

ANTENNA TAX. Reasoning that a rooftop antenna was a sign of affluence as regards more than average personal property, a Ridgewood, N. J., tax assessor made an antenna survey of his town and boosted the personal property valuation $200 for each home having a TV antenna. When the tax bills came out, immediate and vociferous protests of some 4,000 irate TV owners made the town a bit hot for the assessor and the village commissioners, and finally resulted in their rescinding the tax. Arguments against the tax were many and varied. Some claimed it unfair because it did not take into account the wide range in prices from the cheapest used 7-incher to the newest Scott limited-edition 24-incher or DuMont 30-incher in the several-thousand-dollar price class. Others claimed it unfair because it let neighbors get away scot-free who chose to spend their money for new refrigerators or suchlike instead of TV.

TV POWER BOOST. New FCC ruling permits TV stations to radiate up to 50 kw effective radiated power with heights up to 2,000 feet under certain conditions. Stations running transmitters at less than rated output can get FCC permission practically by return mail to run their full 50 kw. Purchase of higher-power transmitters is not intent of ruling because transmitter manufacture would conflict with military electronic production, but in many cases the permitted boost can be achieved by installing new transmitting antenna with higher gain and/or higher tower. Power boosts are temporary, however, and have no influence on final powers to be authorized at end of freeze.

BETTER TV MOVIES. Up to now, U. S. movies on TV have been inferior in technical quality to those telecast in England because British TV has 25 frames per second (close to movie's 24) whereas U. S. TV has 30 frames per second. New Bell Labs scanner described in July issue of ELECTRONICS, using two electronic servos to eliminate jitter and flicker, promises to give tremendous improvement in film quality by permitting flying-spot scanning of 24-frame film at 60 fields per second. New scanner is still under development.

VANISHING AMERICANS. Almost unnoticed, one by one quite a few small TV manufacturers have been quietly closing up shop this year. Prospects are that more will vanish, now that the TV industry is well into its first seasonal slump. So far, though, none of the well-known brand-name manufacturers

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Chassis 6F1 .... *
Chassis 6J2 ....**140**—2
Chassis 6L1 .... **26**—2
Chassis 6M1 .... **25**—1
Chassis 6Q1 .... **78**—1
Chassis 6R1 .... **54**—1
Chassis 6S1 ....**107**—1
Chassis 6V1 .... **62**—1
Chassis 6W1 .... **71**—1
Chassis 6Y1 .... **75**—1
Chassis 7B1 .... **18**—2
Chassis 7C1 .... **25**—2
Chassis 7E1 .... **36**—1
Chassis 7G1 .... **54**—2
Chassis 8B1 .... *
Chassis 8C1 (See Ch. 8D1) **67**
Chassis 8D1 .... **67**—1
Chassis 9A1 .... **32**—1
Chassis 9B1 .... **49**—2
Chassis 9E1 .... **68**—2
Chassis 10A1 .... **3**—30
Chassis 19A1 Tel. Rec.... **59**—2
Chassis 19A1 Tel. Rec. Prod. Chge. Bul. 5....**106**—1
Chassis 20A1, 20B1, Tel. Rec. .... **77**—1
Chassis 20T1 Tel. Rec....**117**—2

Set No. Folder No.

ADMIRAL—Cont.

Chassis 20T1 Tel. Rec. Prod. Chge. Bul. 15 ...**126**—1
Chassis 20T1 Tel. Rec. Prod. Chge. Bul. 26...**146**—1
Chassis 20V1 Tel. Rec. (See Ch. 20T1).......**117**
Chassis 20V1 Tel. Rec. Prod. Chge. Bul. 15...**126**—1
Chassis 20V1 Tel. Rec. Prod. Chge. Bul. 26...**146**—1
Chassis 20X1, 20Y1, 20Z1 Tel. Rec. ....**100**—1
Chassis 20Z1 Tel. Rec. Prod. Chge. Bul. 7....**110**—1
Chassis 21A1 Tel. Rec.... **77**—1
Chassis 21B1, 21C1, 21D1, 21E1 Tel. Rec.........**118**—2
Chassis 21B1, 21C1, 21D1, 21E1 Tel. Rec. Prod. Chge. Bul. 25.........**144**—1
Chassis 21F1, 21G1 Tel. Rec. ....**135**—2
Chassis 21H1, 21J1 Tel. Rec. (See Ch. 21B1)...**118**
Chassis 21H1, 21J1 Tel. Rec. Prod. Chge. Bul. 25 ....**144**—1
Chassis 21K1, 21L1 Tel. Rec. (See Ch. 21F1)...**135**
Chassis 21P1, 21Q1 Tel. Rec. (See Ch. 21F1)...**135**
Chassis 24D1, 24E1, 24F1, 24G1, 24H1 Tel. Rec...**103**—2
Chassis 24D1, 24E1, 24F1, 24G1, 24H1 Tel. Rec. Prod. Chge. Bul. 9....**114**—1
Chassis 30A1 Tel. Receiver **57**—2

Set No. Folder No.

ADMIRAL—Cont.

Chassis 30B1, 30C1, 30D1 Tel. Rec.......... **71**—2
Model 4D11, 4D12, 4D13 (See Ch. 4D1)......... **49**
Models 4H15, 4H16, 4H17 (A or B) Tel. Rec. (See Ch. 20A1)........ **77**
Models 4H15, 4H16, 4H17, 4H18, 4H19 (S or 5N) Tel. Rec. (See Chassis 30B1) **71**
Models 4H18, 4H19 (C or CN) Tel. Rec. (See Ch. 20A1) **77**
Models 4H115, 4H116, 4H117 (S or SN) Tel. Rec. (See Ch. 30B1) **71**
Models 4H126A, B, C or CN Tel. Rec. (See Ch. 20A1) **77**
Model 4H126 (S or SN) Tel. Rec. (See Ch. 30B1) **71**
Models 4H137 (A or B) Tel. Rec. (See Ch. 20A1) **77**
Model 4H137 (S or SN) Tel. Rec. (See Ch. 30B1) **71**
Models 4H146, 4H147 (A or B) Tel. Rec. (See Ch. 20A1)....... **77**
Models 4H145, 4H146 (C or CN) Tel. Rec. (See Ch. 20A1)....... **77**
Models 4H145, 4H146, 4H147 (S or SN) Tel. Rec. (See Chassis 30B1). **71**

Set No. Folder No.

ADMIRAL—Cont.

Models 4H155, 4H156, 4H157 (A or B) Tel. Rec. (See Ch. 20A1)... **77**
Models 4H155, 4H156, 4H157 (S or SN) Tel. Rec. (See Chassis 30B1). **71**
Models 4H165, 4H166, 4H167 (A or B) Tel. Rec. (See Ch. 20A1)... **77**
Models 4H165, 4H167 (C or CN) Tel. Rec. (See Ch. 20A1)....... **77**
Models 4H165, 4H166, 4H167 (S or SN) Tel. Rec. (See Chassis 30B1). **71**
Models 4R11, 4R12 (See Ch. 4R1)........**108**
Model 4T11 (See Ch. 4T1).........**143**
Models 4W18, 4W19 (See Ch. 4T1)........**143**
Models 5E21, 5E22, 5E23 (See Ch. 5E2).........**139**
Models 5F11, 5F12...... **57** (See Ch. 5F1)
Models 5G21, 5G21/15, 5G22, 5G22/15, 5G23, 5G23/15 (See Ch. 5G2) **137**
Models 5J21, 5J22, 5J23 (See Ch. 5J2).........**136**
Models 5R11, 5R12, 5R13, 5R14 (See Ch. 5R1).... **59**
Model 5T12 (Ch. 5T1).... **68**
Models 5W11, 5W12 (See Ch. 5W1) **79**
Models 5X11, 5X12, 5X13, 5X14 (See Ch. 5X1)... **76**

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ADMIRAL—Cont.

Models 6A21, 6A22, 6A23 (See Ch. 6A2) 103
Model 6C11 (See Ch. 6C1) 53
Model 6C71 (See Ch. 10A1) 3
Models 6F10, 6F11, 6F12 *
Models 6J21, 6J22 (See Ch. 6J2) 140
Model 6P32 (See Ch. 6E1, 6E1N) 6
Models 6Q11, 6Q12, 6Q13, 6Q14 (See Ch. 6Q1)... 78
Model 6R11 (See Ch. 6R1) 54
Model 6RP48, 6RP49, 6RP50 (See Ch. 3A1) ... 2
Models 6RT41, 6RT42, 6RT43 (See Ch. 5B1 Phono)... 4
Model 6RT41A, 6RT42A, 6RT43A (See Ch. 5B1A) 18
Model 6RT44 (See Ch. 7B1) 18
Models 6S11, 6S12 (See Ch. 6S1)........ 107
Model 6T01 .... 1—19
Model 6T02, 6T04 .... 1—20
Model 6T05 (See Ch. 6A1) 1
Model 6T06, 6T07 (See Ch. 4A1) 3
Model 6T11 (See Model 6T02)...... 1
Model 6T12 (See Ch. 4A1) 3
Models 6V11, 6V12 (See Ch. 6V1)........ 62
Models 6W11, 6W12 (See Chassis 6W1) 71
Models 6Y18, 6Y19 (See Chassis 6Y1)........ 75
Model 7C60B, 7C60M, 7C60W (See Ch. 6B1).. 48
Model 7C61, 7C62, 7C62UL (See Ch. 6M1) 25
Model 7C63, 7C63-UL (See Ch. 7C1) 25
Model 7C64 .... *
Models 7C65B, 7C65M, 7C65W (See Ch. 7E1) .. 36
Model 7C73 (See Ch. 9A1) 32
Models 7G11, 7G12, 7G14, 7G15, 7G16 (See Ch. 7G1)........ 54
Model 7P32, 7P33, 7P34, 7P35 (See Ch. 5H1) ... 26
Model 7RT41, 7RT42, 7RT43 (See Ch. 6L1) ... 26
Models 7T01, 7T01M-UL, 7T04, 7T04-UL (See Ch. 5N1) 31
Model 7T06, 7T12 (See Ch. 4B1) 24
Model 7T10, 7T14, 7T15 (See Ch. 5K1)........ 30
Models 8C11, 8C12, 8C13 [See Chassis 30A1 (Set 57) and 8D1 (Set 67)] Tel. Rec.
Models 8C14, 8C15, 8C16, 8C17 (See Ch. 8D1)... 67
Models 8D15, 8D16 (See Ch. 8D1)........ 67
Model 8RP46 (See Chassis 3A1) 2
Model 9B14, 9B15, 9B16 (See Ch. 9B1)........ 49
Models 9E15, 9E16, 9E17 (See Ch. 9E1)..... 68
Models 12X11, 12X12 Tel. Rec. (See Ch. 20X1)... 100
Models 14R11, 14R12 Tel. Rec. (See Ch. 20T1)... 117
Model 15K21 (See Ch. 20T1)........ 117—2
Models 16R11, 16R12 Tel. Rec. (See Ch. 21B1)... 118
Models 17K11, 17K12 Tel. Rec. (See Ch. 21F1)... 135
Models 19A11S, 19A11SN, 19A12S, 19A12SN, 19A15S, 19A15SN (See Ch. 19A1) Tel. Rec.... 59
Models 20X11, 20X12 Tel. Rec. (See Ch. 20X1)... 100
Model 20X122 Tel. Rec. (See Ch. 20X1)........ 100
Model 20X136 Tel. Rec. (See Ch. 20X1)........ 100
Models 20X145, 20X146, 20X147 Tel. Rec. (See Ch. 20X1)........ 100
Model 22X12 Tel. Rec. (See Ch. 20X1)........ 100
Models 22X25, 22X26, 22X27 Tel. Rec. (See Ch. 20X1)........ 100
Models 24A11, 24A12 Tel. Rec. (See Ch. 20A1)... 77
Model 24A125 Tel. Rec. (See Ch. 20A1) 77
Model 24A125AN Tel. Rec. (See Ch. 20X1)........ 100
Models 24A126, 24A127 (See Ch. 20A1) Tel. Rec. 77
Models 24C15, 24C16, 24C17 Tel. Rec. (See Ch. 20A1)........ 77
Models 24R11, 24R12 Tel. Rec. (See Ch. 20T1)... 117
Models 24X15, 24X15S, 24X16, 24X16S, 24X17S Tel. Rec. (See Ch. 20X1 and 4L1)........ 100
Models 25A15, 25A16, 25A17 Tel. Rec. (See Ch. 20A1)........ 77
Models 26R11, 26R12 Tel. Rec. (See Ch. 21B1)... 118
Models 26R25, 26R26 Tel. Rec. (See Ch. 24D1)... 103
Models 26R25A, 26R26A Tel. Rec. (See Ch. 21B1)........ 118
Models 26R35, 26R36, 26R37 Tel. Rec. (See Ch. 24D1) 103

ADMIRAL—Cont.

Models 26R35A, 26R36A, 26R37A Tel. Rec. (See Ch. 21B1)........ 118
Models 26X35, 26X36, 26X37 Tel. Rec. (See Ch. 24D1) 103
Models 26X45, 26X46 Tel. Rec. (See Ch. 24D1)... 103
Models 26X55, 26X56, 26X57 Tel. Rec. (See Ch. 24D1)........ 103
Models 26X55A, 26X56A, 26X57A Tel. Rec. (See Ch. 21B1)........ 118
Models 26X65, 26X66, 26X67 Tel. Rec. (See Ch. 24D1)........ 103
Models 26X65A, 26X66A, 26X67A Tel. Rec. (See Ch. 21B1)........ 118
Models 26X75, 26X76 Tel. Rec. (See Ch. 24D1)... 103
Models 26X75A, 26X76A Tel. Rec. (See Ch. 21B1)........ 118
Models 27K12 Tel. Rec. (See Ch. 21F1)........ 135
Models 27K15, A, B, 27K16, A, B, 27K17, A, B Tel. Rec. (See Ch. 21F1)........ 135
Models 27K25, A, B, 27K26, A, B, 27K27, A, B Tel. Rec. (See Ch. 21F1)........ 135
Models 27K35, A, B, 27K36, A, B Tel. Rec. (See Ch. 21F1)........ 135
Models 27K46, A, B Tel. Rec. (See Ch. 21F1)... 135
Models 29X15, 29X16, 29X17 Tel. Rec. (See Ch. 24D1)........ 103
Models 29X25, 29X26, 29X27 Tel. Rec. (See Ch. 24D1)........ 103
Model 29X25A Tel. Rec. (See Ch. 21B1)........ 118
Models 30A12, 30A13 (S or SN) Tel. Rec. (See Ch. 30A1)........ 57
Models 30A14, 30A15, 30A16, Television Receivers (See Ch. 30A1). 57
Models 30B15, 30B16, 30B17 (S or SN) Tel. Rec. (See Ch. 30B1) 71
Models 30C15, 30C16, 30C17 (S or SN) Tel. Rec. (See Ch. 30B1) 71
Models 30F15, A, 30F16, A, 30F17, A Tel. Rec. (See Ch. 20A1)........ 77
Models 32X15, 32X16 Tel. Rec. (See Ch. 20X1 and 4S1) 100
Models 32X26, 32X27 Tel. Rec. (See Ch. 20X1 and 5B2) 100
Models 32X35, 32X36 Tel. Rec. (See Ch. 20X1 and 5B2) 100
Models 34R15, A, 34R16, A Tel. Rec. (See Ch. 20T1)........ 117
Model 36R37 Tel. Rec. (See Ch. 21B1)........ 118
Models 36R45, 36R46 Tel. Rec. (See Ch. 21B1)... 118
Models 36X35, 36X36, 36X37 Tel. Rec. [See Ch. 24D1 (Set 103) and Radio Ch. 5B2 (Set 100)]
Models 36X35A, 36X36A, 36X37A Tel. Rec. [See Ch. 24D1 (Set 103) and Radio Ch. 5D2 (Set 118)]
Models 37F15, A, B, 37F16, A, B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 37F27, A, B, 37F28, A, B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 37F35, A, B, 37F36, A, B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 37K15, A, B, 37K16, A, B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Models 37K27, A, B, 37K28, A, B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Models 37K35, A, B 37K36 A B Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Models 39X16A, 39X17A Tel. Rec. [See Ch. 24D1 (Set 103) and Radio Ch. 5B2 (Set 100)]
Models 39X16B, 39X17B Tel. Rec. [See Ch. 24D1 (Set 103) and Radio Ch. 5D2 (Set 118)]
Model 39X17C Tel. Rec. (See Ch. 21B1)........ 118
Models 39X25, 39X26 Tel. Rec. [See Ch. 24D1 (Set 103) and Radio Ch. 5D2 (Set 118)]
Models 39X25A, 39X26A Tel. Rec. (See Ch. 21B1)........ 118
Models 39X35, 39X36, 39X37 Tel. Rec. (See Ch. 21B1)........ 118

ADMIRAL—Cont.

Models 221K16, 221K16A Tel. Rec. (See Ch. 21F1) 135
Models 221K26, 221K28 Tel. Rec. (See Ch. 21F1) 135
Models 221K35, 221K36 Tel. Rec. (See Ch. 21F1) 135
Models 321F15 321F16, 321F18 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 321F27 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 321F35, 321F36 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 321F46, 321F47, 321F49 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 5D2 Set 118)
Models 321K15, 321K16, 321K18 (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Model 321K27 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Models 321K35, 321K36 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)
Models 321K46, 321K47, 321K49 Tel. Rec. (See Ch. 21F1 Set 135 and Ch. 3C1 Set 117)

AERMOTIVE

181-AD .... 12—1

AIRADIO

SU-41D .... 11—1
SU-52A, B, C (Receiver) .. 13—2
TRA-1A, B, C (Transmitter) 13—1
3100 .... 37—1

AIRCASTLE

C-300 .... 136—3
DM-700 .... 85—1
EV-760 (See Model DM-700) 85
G-516, G-518 .... 48—3
G-521 .... 54—3
G-724 .... 52—25
G-725 .... 50—1
K1 .... 93—1
P-20 .... 71—3
P-22 .... 87—1
PAM-4 .... 101—1
PC-8, PC-358 .... 99—1
PM-78 .... 100—2
PM-358 .... 98—1
PX .... 13—35
REV248 .... 127—2
RZU248 (See Model REV248) 127
SC-448 .... 62—2
TD-6 .... 103—3
WEU-262 .... 91—1
WRA1-A .... 47—1
WRA-4M .... 60—1
XB702, XB703 Tel. Rec... 93A-1
XL750, XP775 Tel. Rec... 93A-1
OA-358-VM (See Model 358VM)... 127
06-F, 06-L .... 135—3
7B .... 52—1
9 .... 50—2
10C, 10T Tel. Rec. (See Model 14C)........ 140
12C, 12T Tel. Rec. (See Model 14C)........ 140
14C, 14T Tel. Rec.........140—3
15 .... 67—2
16C, 16T Tel. Rec. (See Model 14C)........ 140
17C, 17T Tel. Rec. (See Model 14C)........ 140
79A .... 137—3
88 .... 142—2
101 .... 86—1
102B .... 98—2
106B .... 13—3
150, 153 .... 126—2
171, 172 .... 96—1
198 .... 83—1
200 .... 139—3
201 .... 81—1
211 .... 65—1
212 .... 68—3
213 .... 63—1
2271, 227W .... 84—1
312 Tel. Rec. .... *
316 Tel. Rec. .... *
350 .... 136—4
358VM .... 127—3
412 Tel. Rec. .... *
416 Tel. Rec. .... *
568 .... 14—1
568.205, 568.305 .... 141—2
572 .... 55—1
594-935 (See Model 935). 128
602-182144 .... 114—2
603-PR-8.1 .... 133—2
604 .... 53—2
606-400WB .... 119—2
607-314, 607-315 .... 122—2
607.316, -1, 607.317, -1. 138—2
610.D200 .... 142—3
610.F100 .... 138—3
621 (Ch. FJ-91) .... 14—2
626 .... 18—3
641 .... 17—1
651 .... 15—1
9151, W .... 129—2
935 .... 128—2
9651, W, 965K1, W (See Model 9151)..... 129
1400C, 1400T Tel. Rec. (See Model 14C)........ 140

AIRCASTLE—Cont.

1700C, 1700T Tel. Rec. (See Model 14C)........ 140
2000C Tel. Rec. (See Model 14C)........ 140
3170 Tel. Rec. (See Model 14C Set 140 and Model 150 Set 126)
4170 Tel. Rec. (See Model 14C Set 140 and Model 350 Set 136)
5000, 5001 .... 16—2
5002 .... 19—1
5003, 5004, 5005, 5006.. 20—1
5008, 5009 .... 46—1
5010, 5011, 5012 (Ch. 110) .... 13—4
5015.1 .... 118—3
5020 .... 16—3
5022 .... 123—2
5024 .... 45—1
5025 .... 24—2
5027 .... 49—3
5028 .... 44—1
5029 .... 51—1
5035 .... 46—2
5036 .... 72—2
5044 .... 121—2
5050 .... 48—4
5052 .... 45—2
5056-A .... 120—2
6042 .... 61—1
6050 .... 74—1
6053 .... 97—1
6514 .... 18—4
6541 .... 17—2
6544, 6547 (See Model 6541) 17
6611, 6612, 6613, 6630, 6631, 6632, 6634, 6635 15—2
7000, 7001 .... 14—3
7004 .... 19—2
7014, 7015 .... 57—3
7015 Early .... 47—2
7553 .... 45—3
90081, 9008W .... 99—2
90091, 9009W .... 97—2
90121, 9012W .... 94—1
10002 .... 56—1
10003-1 .... 56—2
10005 .... 62—3
10021-1, 10022-1 .... 59—3
10023 .... 58—1
10024-1 .... 58—2
108014, 108504 .... 57—4
121104 .... 73—1
121124 .... 61—2
127084 .... 55—2
131504 .... 60—2
132564 .... 69—1
138104 .... 54—3
138124 .... 64—1
139144 .... 59—4
147114 .... 56—3
149654, 150084 .... 71—4
159144 (See Model 139144) 59

AIR CHIEF (See Firestone)

AIR KING

A-400 (Ch. 470) .... 23—1
A-403 .... 20—2
A-410 .... 34—1
A-410 (Revised) .... 40—1
A-426 .... 43—1
A-450 .... *
A-501, A-502 (Ch. 465-4) 31—3
A-510 .... 24—3
A-511, A-512 .... 30—2
A-520 .... 49—4
A-600 .... 26—3
A-604 .... 81—2
A-625 .... 50—3
A-650 .... 45—4
A-1000, A-1001 Tel. Receiver .... 58—3
A1001A Tel. Rec. .... 75—2
A1016 Tel. Rec. .... 91—2
A2000, A2001, A2002 Tel. Rec. (See Model A1001A) 75
A2010 Tel. Rec. (See Model A1001A) 75
A-2012 Tel. Rec. (See Model A1001A) 75
12C1 Tel. Rec. (See Model 16C1)..... 121
12T1, 12T2 Tel. Rec. (See Model 16C1)..... 121
16C1, 16C2, 16C3 Tel. Rec. .... 121—3
16M1 Tel. Rec. (See Model 16C1) 121
16T1, Tel. Rec. (See Model 16C1) 121
16T1B Tel. Rec. (See Model 16C1)..... 121
19C1 Tel. Rec. (See Model 16C1) 121
71BR Tel. Rec. (See Model 16C1) 121
800 .... 66—1
2017R Tel. Rec. .... 111—2
4601 (See Model 4609).... 11
4603 .... 3—36
4604 .... 4—25
4604D (See Model 4604).. 4
4607, 4608 .... 3—1
4609, 4610 Early (See Model 4607)..... 3
4609, 4610 .... 11—2
4625 .... 13—8
4700 .... 39—1
4704 .... 12—2
4705, 4706 .... 9—1
4708 (See Model 4704)... 12

AIR KNIGHT (SKY KNIGHT)

CA-500 .... 17—4
CB-500P .... 17—31
N5-RD291 .... 17—3

AIRLINE

05BR-3021B Tel. Rec.... *
05BR-3021C Tel. Rec.... *

AIRLINE—Cont.

05BR-3024B Tel. Rec..... *
05BR-3024C Tel. Rec..... *
05BR-3027A Tel. Rec..... *
05BR-3027B Tel. Rec..... *
05BR-3034A Tel. Rec..... *
05BR-3041A Tel. Rec..... 145—1A
05BR-3044A Tel. Rec..... *
05GAA-992A .... 125—2
05GCB-1540A, 05GCB-1541A .... 131—2
05GCB-3019A Tel. Rec... 116—2
05GHM-1061A .... 133—3
05GSE-3020A Tel. Rec... 117—3
05GSE-3037A Tel. Rec. (See Model 05GSE-3020A) 117
05WG-1811B (See Model 94WG-1811A) 99
05WG-1813A .... 127—4
05WG-2748C, D, E (See Model 94WG-2748A).. 90
05WG-2748F .... 139—4
05WG-2749D .... 129—3
05WG-2752 .... 100—3
05WG-3016A, B Tel. Rec. (See Model 94WG-3006A Set 72 and Set 110 Folder 2)
05WG-3030A Tel. Rec.... 119—3
05WG-3031A Tel. Rec.... 109—1
05WG-3031B Tel. Rec.... *
05WG-3036A, B Tel. Rec. *
05WG-3038A Tel. Rec.... 129—4
05WG-3039A, B Tel. Rec. *
05WG-3040 Tel. Rec..... *
05WG-3042A Tel. Rec.... *
05WG-3045A Tel. Rec. (See Model 05WG-3038A) 129
15BR-1536B, 15BR-1537B. 146—2
15BR-1543A, B, 15BR-1544A, B .... 145—2
15BR-1547A .... 143—3
15BR-3035A Tel. Rec..... *
15BR-3053A, B Tel. Rec.. *
15GHM-936A, 15GHM-937A .... 134—2
15GSE-3043A Tel. Rec... *
15GSE-3047A, B Tel. Rec. *
15GSE-3047C Tel. Rec... *
15GSE-3052A Tel. Rec... *
15WG-2745C .... 130—2
15WG-2758A .... 144—2
15WG-2765A (See Model 15WG-2745C) 130
15WG-3046A, B Tel. Rec. 142—4
15WG-3050A, B Tel. Rec. 145—3
15WG-3051A, B Tel. Rec. (See Model 15WG-3046A) 142
54BR-1501A, 54BR-1502A. 2—26
54BR-1503A, B, C; 54BR-1504A, B, C .... 3—4
54BR-1505A, B; 54BR-1506A, B .... 2—34
54KP-1209A, B .... 8—1
54WG-1801A, 54WG-1801B .... 4—33
54WG-2500A, 54WG-2700A .... 4—15
64BR-916A .... 3—34
64BR-916B (See Model 74BR-916B) 17
64BR-917A .... 10—1
64BR917B (See Model 64BR917A) 10
64BR-1051A .... 2—32
64BR1051B (See Model 64BR1051A) 2
64BR-1205A, 64BR-1206A. 10—3
64BR-1208A .... 16—4
64BR-1503B, 64BR-1504B (See Models 54BR-1503A, B, C; 54BR-1504A, B, C)........ 3
64BR-1513A, B; 64BR-1514A, B .... 24—4
64BR-1808A .... 16—5
64BR-2200A (See Model 64BR-1208A) 16
64BR-7000A .... 51—2
64BR-7100A, 64BR-7110A, 64BR-7120A .... 57—5
64BR-7300A, 64BR-7310A, 64BR-7320A .... 54—4
64BR-7810A, 64BR-7820A 53—3
64WG-1050A .... 10—2
64WG-1050B, 64WG-1050C, 64WG-1050D (See Model 64WG-1050A) 10
64WG-1052A .... 9—2
64WG-1052B (See Model 64WG-1052A) 9
64WG-1207B .... 18—5
64WG-1511A, 64WG-1511B, 64WG-1512A, 64WG-1512B .... 5—5
64WG-1801C (See Models 54WG-1801A, B) 4
64WG-1804A, B .... 4—27
64WG-1804C (See Model 64WG-1804A) 4
64WG-1807A, 64WG-1807B .... 5—4
64WG-1809A, 64WG-1809B (See Models 64WG-1511A, B; 64WG-1512A, B) 5
64WG-2007A, 64WG-2007B .... 5—6
64WG-2009A, 64WG-2009B .... 6—2
64WG-2010B .... 18—6
64WG-2500A (See Model 54WG-2500A) .. 4
64WG-2700A, 64WG-2700B (See Models 54WG-2500A; 54WG-2700A) 4
74BR-916B .... 17—5
74BR-1053A .... *
74BR-1055A .... *
74BR-1501B, 74BR-1502B. *

AIRLINE—Cont.
74BR-1507, 74BR-1508A . *
74BR-1513B, 74BR-1514B (See Models 64BR-1513A, B; 64BR-1514A, B) 24
74BR-1812A (See Model 74BR-1812B) 22
74BR-1812B ..... 22—2
74BR-2001A (See Model 74BR-2001B) 23
74BR-2001B ..... 23—2
74BR-2003A ..... *
74BR-2701A ..... 24—5
74BR-2702A (See Model 74BR-2702B) 25
74BR-2702B ..... 25—3
74BR-2707A ..... *
74BR-2708A ..... *
74BR-2715A ..... *
74BR-2717A ..... *
74GSG-8400A, 74GSG-8700A ..... 60—3
74GSG-8810A, 74GSG-8820A ..... 52—2
74HA-8200A ..... 58—4
74KR-1210A ..... 41—1
74KR-2706B ..... 35—1
74KR-2713A ..... 43—2
74WG-925A ..... 24—6
74WG-1050C, D (See Model 64WG-1050A) .. 10
74WG-1052B (See Models 64WG-1052A, B) 9
74WG-1054A ..... 22—1
74WG-1054B (See Model 74WG-1054A) 22
74WG-1056A ..... 29—1
74WG-1057A ..... 32—2
74WG-1207B (See Model 64WG-1207B) 18
74WG-1509A, 74WG-1510A ..... 27—1
74WG-1511B, 74WG-1512B (See Models 64WG-1511A, B; 64WG-1512A, B) 5
74WG-1802A ..... 25—4
74WG-1803A (See Model 74WG-1802A) 25
74WG-1804C (See Models 64WG-1804A, B) 4
74WG-1807A, 74WG-1807B (See Models 64WG-1807A, B) 5
74WG-2002A ..... 26—4
74WG-2004A ..... 27—2
74WG-2007B, 74WG-2007C (See Models 64WG-2007A, B) 5
74WG-2009B (See Models 64WG-2009A, B) 6
74WG-2010A (See Model 64WG-2010B) 18
74WG-2010B ..... 18—6
74WG-2500A (See Model 54WG-2500A) 4
74WG-2504A ..... 28—1
74WG-2504B, 74WG-2504C (See Model 74WG-2504A) 28
74WG-2505A ..... 18—7
74WG-2700A, 74WG-2700B (See Model 54WG-2700A) 4
74WG-2704A, 74WG-2704B, 74WG-2704C (See Model 74WG-2504A) 28
74WG-2705A, 74WG-2705B (See Model 74WG-2505A) 18
74WG-2709A ..... 26—5
74WG-2711A (See Model 74WG-2505A) 18
84BR-1065A ..... *
84BR-1503D, 84BR-1504D *
84BR-1515A, 84BR-1516A *
84BR-1517A, 84BR-1518A *
84BR-1815B, 84BR-1816B . 55—3
84BR-2005A ..... *
84BR-2715B ..... *
84BR-2719A ..... *
84BR-2726B ..... *
84BR-3004 Tel. Rec. ..... *
84GAA3967A ..... 91—3
84GCB-1062A ..... 52—26
84GDC-963B ..... 51—3
84GDC-987A ..... 53—4
84GHM-926B ..... 55—4
84GSE-2730A, 84GSE-2731A ..... 70—1
84GSE-3011A Tel. Rec.... 82—1
84HA-1527A, 84HA-1528A (See Model 94HA-1527C) 67
84HA1529A, 84HA1530A . 85—2
84HA-1810A, 84HA-1810C ..... 69—2
84HA-2727A ..... *
84HA-3002A, 84HA-3002B Tel. Rec. ..... 99—3
84HA3007A, B, C Tel. Rec. *
84HA-3010A, B, C Tel. Rec. ..... 94—2
84HA-3010A, B, C Tel. Rec. Prod. Chge. Bul. 11 ..... 118—1
84KR-1209A ..... *
84KR-1520A ..... 56—4
84KR-2511A ..... 68—4
84WG-1060A ..... 42—1
84WG-1060C (See Model 84WG-1060A) 42
84WG-2015A ..... 38—1
84WG-2506 (See Model 84WG-2721A) 46
84WG-2506B ..... 58—5
84WG-2712A ..... 43—3
84WG-2712B (See Model 84WG-2712A) 43
84WG-2714A ..... 36—2
84WG-2714F, G, H, I ... 56—5
84WG-2718A, 84WG-2718B, 84WG-2720A .. 45—5

AIRLINE—Cont.
84WG-2721A, B ..... 46—3
84WG-2724A (See Model 84WG-2718A) .. 45
84WG-2728A (See Models 84WG-2718A, B; 84WG-2720A) 45
84WG-2732A, B (See Model 84WG-2712A, B) 43
84WG-2734A (See Models 84WG-2718A, B; 84WG-2720A) 45
84WG-3006, 84WG-3008, 84WG-3009, (See Model 94WG 3006A) Tel. Rec. 72
94BR-1525A, 94BR-1526A ..... *
94BR-1533A ..... 88—1
94BR-2740A, 94BR-2741A, B ..... 89—1
94BR3004, C, 94BR3005, C Tel. Rec.. 91A-3
94BR-3017A Tel. Rec..... 89—2
94BR-3017B Tel. Rec. Prod. Chge. Bul. 7.... 110—1
94BR-3021, 94BR-3024A Tel. Rec. ..... *
94GAA3654A ..... 95—1
94GCB-1064A ..... 96—2
94GCB-3023A, B, C Tel. Rec. (See Model 05GCB-3019A) 116
94GDC-989A ..... *
94GSE-2735A, 94GSE-2736A ..... 72—3
94GSE-3011, B (See Model 84GSE-3011A) 82
94GSE-3015A Tel. Rec... 107—2
94GSE-3018A Tel. Rec... 93A-2
94GSE-3025A Tel. Rec.... *
94GSE-3033A Tel. Rec.... *
94HA-1527C, 94HA-1528C 67—3
94HA1529A, 94HA1530A (See Model 84HA1529A) 85
94WG-1059A ..... 75—3
94WG-1804D ..... 86—2
94WG-1811A ..... 99—4
94WG-2742A, C, D ..... 71—5
94WG-2745A ..... 76—4
94WG-2746A, B; 94WG-2747A (See Model 94WG-2742A) . 71
94WG-2748A, 94WG-2749A ..... 90—1
94WG-2748C (See Model 94WG-2748A) 90
94WG-3006A Tel. Rec... 72—4
94WG-3006B Tel. Rec... 85—3
94WG-3008A, 94WG-3009A Tel. Rec. (See Model 94WG-3006A) .. 72
94WG-3009B Tel. Rec. (See Model 94WG-3006B) .. 85
94WG-3016A, B, C Tel. Rec. (See Model 94WG-3006A Set 72 and Model 05WG-3016A Set 110 Folder 2)
94WG-3022A Tel. Rec. (See Model 94WG-3006B) .. 85
94WG-3026A Tel. Rec. (See Model 94WG-3006B) .. 85
94WG-3028A Tel. Rec. (See Model 94WG-3006) ... 72
94WG-3029A Tel. Rec. (See Model 94WG-3006B) .. 85

ALGENE
AR5U ..... 22—3
AR6U ..... 22—4

ALTEC LANSING
ALC-101 ..... 84—2
ALC-205, ALC-206 Tel. Rec. ..... 105—3
A323B ..... 66—2
A-323C (See Model ALC-101) 84

AMBASSADOR
14MC, 14MT Tel. Rec. (Similar to Chassis).... 117—8
16MC, 16MT, 16MXC, 16MXCS, 16MXT, 16MXTS Tel. Rec. (Similar to Chassis).... 117—8
17MC, 17MT, 17MXC, 17MXCS, 17MXT, 17MXTS Tel. Rec. (Similar to Chassis).... 117—8

AMC
114C, 114T Tel. Rec. (Similar to Chassis).... 111—3
116C, 116CD, 116T Tel. Rec. (Similar to Chassis) 111—3
125P ..... 3—27
126 ..... 16—1

AMERICAN COMMUNICATIONS
(See Liberty)

AMPLIFIER CORP. OF AMERICA
ACA-100DC, ACA-100GE. 63—2

AMPLIPHONE
10 ..... 21—1
20 ..... 21—12

ANDREA
BT-VK12 Tel. Rec. ..... 76—5
CO-U15 ..... 27—3
CO-VK15, COVK16 (Ch. VK1516) Tel. Rec. ..... 103—4
CO-VK16 Tel. Rec. Prod. Chge. Bul. 8.... 112—1
COVK-125 Tel. Rec. (See Model BT-VK12).. 76
COVL-16 (Ch. VL16) Tel. Rec. ..... 125—3
C-VK19 Tel. Rec. (Supp. to CO-VK16) Prod. Chge. Bul. 8 ..... 112—1
CVK-126 Tel. Rec. (See Model BT-VK12).. 76

ANDREA—Cont.
CVL-16 (Ch. VL16) Tel. Rec. (See Model COVL-16) 125
C-VL17 Tel. Rec. ..... *
P-163 (Ch. 163) ..... 18—8
T16 ..... 21—2
T-U15 ..... 24—7
T-U16 ..... 21—3
T-VK12 Tel. Rec. (See Model BT-VK12).. 76
TVK-127B, M Tel. Rec. (See Model BT-VK12).. 76
TVL-12 Tel. Rec. ..... 123—3
TVL-16 (Ch. VL-16) Tel. Rec. (See Model COVL-16) 125
T-VL17 Tel. Rec. ..... *
VJ-12, VJ-12-2 Tel. Rec... *
VJ-15 Tel. Rec. ..... *
2C-VL17 Tel. Rec. ..... *
Ch. VK1516 (See Model CO-VK15) 103
Ch. VL16 (See Model COVL-16) 125

ANSLEY
32 ..... 5—27
41 (Paneltone) ..... 4—38
53 ..... 24—8
701 Tel. Rec. ..... 71—6

APEX
4B5 ..... 37—2
192A ..... 17—6

APPROVED ELECTRONIC INSTRUMENT CORP.
FM Tuner ..... 41—2

ARC
601 ..... 25—5

ARCADIA
37D14-600 ..... 9—3

ARIA
554-1-61A ..... 7—2

ARLINGTON
30T14A-056 Tel. Rec. (Similar to Chassis).... 119—3
38T12A-058 Tel. Rec. (Similar to Chassis).... 109—1
317T3 Tel. Rec. (Similar to Chassis).... 72—4
318T4 Tel. Rec. (Similar to Chassis).... 85—3
318T4S Tel. Rec. (Similar to Chassis).... 85—3
318T4-872 Tel. Rec. (Similar to Chassis).... 85—3
318T6A Tel. Rec. (Similar to Chassis).... 85—3
318T6A-950 Tel. Rec. (Similar to Chassis).... 85—3
318T9A-900 Tel. Rec. (Similar to Chassis).... 78—4
518T6A Tel. Rec. (Similar to Chassis).... 85—3
518T9A-918 Tel. Rec. (Similar to Chassis).... 78—4
518T10A-916 Tel. Rec. (Similar to Chassis).... 78—4
2318T6A-954 Tel. Rec. (Similar to Chassis).... 85—3
2318T9A-912 Tel. Rec. (Similar to Chassis).... 78—4

ARTHUR ANSLEY
LP-2, LP-3 ..... 62—4
LP-4A ..... 82—2
LP-5 (See Model P-5).... 108
LP-6, LP6-S ..... 136—5
LP-7 ..... 134—3
P-5 ..... 108—4
SP-1 ..... 60—4

ARTONE
AR-23TV-1 Tel. Rec. ..... 80—1
524 ..... 76—6

ARVIN
140-P (Ch. RE-209) ..... 25—6
150-TC, 151-TC (Ch. RE-228) (Late).... 25—7
150TC, 151TC (Ch. RE-228-1) ..... 39—2
152-T, 153-T ..... 33—1
160T, 161T (Ch. RE-232).. 49—5
182TFM (Ch. RE-237).... 32—3
240-P (Ch. RE-243) ..... 42—2
241P, 244P, 2410P (Ch. RE-244, RE-254, RE-255, RE-256, RE-259) ..... 47—3
242T, 243T (Ch. RE-251). 52—3
250-P (Ch. RE-248) ..... 43—4
253T, 254T, 255T, 256T (Ch. RE-252) ..... 53—5
264T, 265T (Ch. RE-265) 64—2
280TFM, 281TFM (Ch. RE-253) ..... 44—2
341T (Ch. RE-274) ..... 84—3
350P (Ch. RE-267) ..... 69—3
350-PB (Ch. RE-267-1), 350-PL (Ch. RE-267-2) . 100—4
351P (Ch. RE-267) (See Model 350P) 69
351-PB (Ch. RE-267-1), 351-PL (Ch. RE-267-2) (See Model 350-PB).... 100
352-PL, 353-PL (Ch. RE-267-2) (See Model 350-PB) 100
355T (Ch. RE-213) (See Model 356T) 78
356T, 357T (Ch. RE-273) 78—2
358-T (Ch. RE-233) (See Model 152-T) 33
360TFM, 361TFM (Ch. RE-260) ..... 70—2
440T, 441T (Ch. RE-278) 96—3
442 (Ch. RE-91) ..... 34—2
444, 444A (Ch. RE-200).. 1—3
444AM, 444M (Ch. RE-200M) ..... 23—3
446P (Ch. RE-280) ..... 106—2

ARVIN—Cont.
450T, 451T (Ch. RE-281).. 110—3
460T, 461T (Ch. RE-284).. 107—3
462-CB, 462-CM (Ch. RE-287-1) ..... 116—3
480TFM, 481TFM (Ch. RE-277, RE-277-1) 107—4
482CFB, 482CFM (Ch. RE-288-1) ..... 117—4
540T (Ch. RE-278) ..... 143—4
544, 544A, 544AR, 544R (Ch. RE-201) ..... 1—7
547A (Ch. RE-242) ..... 42—3
552AN, 552N (Ch. RE-231); 555, 555A (Ch. RE-202) ..... 13—9
558 (Ch. RE-204) ..... 3—16
664, 664A (Ch. RE-206).. 3—23
664, 664A (Ch. RE-206-1), 6640 (Ch. RE-206-2)... 29—2
665 (Ch. RE-229) ..... 18—10
2120CM (Ch. TE289-2, TE289-3) Tel. Rec. ..... 120—3
2120CM (Ch. TE-289-3) Tel. Rec. Prod. Chge. Bul. 20 ..... 134—1
2121TM (Ch. TE289-2, TE289-3) Tel. Rec. (See Model 2120CM).. 120
2121TM (Ch. TE-289-3) Tel. Rec. Prod. Chge. Bul. 20 ..... 134—1
2122TM (Ch. TE-289) Tel. Rec. 97A-1
2123TM (Ch. TE-289-2), TE289-3) Tel. Rec. (See Model 2120CM)... 120
2123TM (Ch. TE-289-3), Tel. Rec. Prod. Chge. Bul. 20 ..... 134—1
2124CCM (Ch. TE289-2, TE289-3) Tel. Rec. (See Model 2120CM)... 120
2124CCM (Ch. TE-289-3) Tel. Rec. Prod. Chge. Bul. 20 ..... 134—1
2126CM (Ch. TE289-2, TE289-3) Tel. Rec. (See Model 2120CM)... 120
2126CM (Ch. TE-289-3) Tel. Rec. Prod. Chge. Bul. 20 ..... 134—1
2160, 2161, 2162, 2164 (Ch. TE-290) Tel. Rec. . 126—3
3100TB, 3100TM, 3101CM, 3120TM, 3121TM (Ch. TE-272-1, TE-272-2) Tel. Rec. ..... 80—2
3160CM (Ch. TE-276) Tel. Rec. ..... 93—2
4080T (Ch. TE282) Tel. Rec. ..... 104—2
4081T Tel. Rec. (See Model 4080T) ... 104
4162CM (Ch. TE-286) Tel. Rec. ..... 130—3
5170CB, CM, 5171TM, 5172CB, CM (Ch. TE302) Tel. Rec. ..... 142—5
5204, 5206 (Ch. TE300) Tel. Rec. ..... *
5210, 5211, 5212 (Ch. TE315) Tel. Rec. ..... *
Ch. RE-91 (See Model 442) 34
Ch. RE-200 (See Model 444) 1
Ch. RE-200M (See Model 444M) 23
Ch. RE-201 (See Model 544) 1
Ch. RE-202 (See Model 552AN) 13
Ch. RE-204 (See Model 558) 3
Ch. RE-206 (See Model 664) 3
Ch. RE-206-1, 206-2 (See Model 664 Late).. 29
Ch. RE-209 (See Model 140P) 25
Ch. RE-228 (See Model 150TC) 25
Ch. RE-228-1 (See Model 150TC Late).... 39
Ch. RE-229 (See Model 665) 18
Ch. RE-231 (See Model 552AN) 13
Ch. RE-232 (See Model 160T) 49
Ch. RE-233 (See Model 152T) 33
Ch. RE-237 (See Model 182TFM) 32
Ch. RE-242 (See Model 547A) 42
Ch. RE-243 (See Model 240P) 42
Ch. RE-244 (See Model 241P) 47
Ch. RE-248 (See Model 250P) 43
Ch. RE-251 (See Model 242T) 52
Ch. RE-252 (See Model 253T) 53
Ch. RE-253 (See Model 280TFM) 44
Ch. RE-254, 255, 256, 259 (See Model 241P).. 47
Ch. RE-260 (See Model 360TFM) 70
Ch. RE-265 (See Model 264T) 64
Ch. RE-267 (See Model 350P) 69
Ch. RE-267-1, RE-267-2 (See Model 350-PB).... 100
Ch. RE-273 (See Model 356T) 78
Ch. RE-274 (See Model 341T) 84
Ch. RE-277, RE-277-1 (See Model 480TFM)... 107

ARVIN—Cont.
Ch. RE-278 (See Model 540T) 143
Ch. RE-280 (See Model 446P) 106
Ch. RE-281 (See Model 450T) 110
Ch. RE-284 (See Model 460T) 107
Ch. RE-287-1 (See Model 462-CB)... 116
Ch. RE-288-1 (See Model 482CFB)... 117
Ch. TE-272-1, 2 (See Model 3100TB)... 80
Ch. TE-276 (See Model 3160CM) 93
Ch. TE282 (See Model 4080T) 104
Ch. TE-286 (See Model 4162CM)... 130
Ch. TE-289 (See Model 2122TM) 97A-1
Ch. TE-289-2, TE-289-3 (See Model 2120CM)... 120
Ch. TE-290 (See Model 2160) 126
Ch. TE300 ..... *
Ch. TE302 (See Model 5170CB)... 142
Ch. TE315 ..... *

ASTRASONIC
T-3 ..... 121—4
748 ..... 53—6

ATLAS
AB-45 ..... 14—5

AUDAR
MAS-4 "Bingo Amp." ..... 26—6
P-1A ..... 5—10
P-4A ..... 19—3
P-5 ..... 5—11
P-7 ..... 44—3
PR-6 ..... 13—10
PR-6A ..... 19—4
RE-8A ..... 25—8
Telvar BM-25, BMP-25 .. 62—5
Telvar FMC-12 ..... 35—2
Telvar RER-9 ..... 65—2

AUDIO DEVELOPMENT (ADC)
71-F ..... 128—3

AUTOMATIC
Tom Boy ..... 27—4
Tom Thumb Buddy ..... 53—7
Tom Thumb Camera-Radio 49—6
Tom Thumb Jr. ..... 26—7
Tom Thumb Personal ATTP 23—4
B-44 ..... 60—5
C60 ..... 5—20
C-60X ..... 24—10
C-65X (See Model C-60X). 24
C300 ..... 102—1
D200 ..... 104—3
F-100 ..... 103—6
F-790 ..... 23—5
M-86 ..... 34—3
M-90 ..... 67—4
S-551 ..... 146—3
TV-P490 Tel. Rec. ..... 81—3
TV-707, TV-709, TV-710 Tel. Rec. ..... 60—6
TV-712 Tel. Rec. (See Model TV-707)... 60
TV-1205 Tel. Rec. (See Model TV-1249) .. 103
TV-1205 Tel. Rec. Prod. Chge. Bul. 5.... 106—1
TV-1249, TV1250 Tel. Rec. ..... 103—5
TV-1294 Tel. Rec. (See Model TV-1249) .. 103
TV-1294 Tel. Rec. Prod. Chge. Bul. 5.... 106—1
TV-1605 Tel. Rec. (See Model TV-1249) 103
TV-1615 Tel. Rec. (See Model TV-1249) 103
TV-1649, TV-1650, TV-1651 Tel. Rec. ..... 143—5
TV-1694 Tel. Rec. (See Model TV-1249) 103
TV-5006 Tel. Rec. ..... 145—4
TV-5020 Tel. Rec. ..... 134—4
TV-5061 Tel. Rec. (See Model TV-5006).. 145
TV-5077 Tel. Rec. (See Model TV-5006).. 145
TV-5116R Tel. Rec. (See Model TV-5020).. 134
TV-5160 Tel. Rec. (See Model TV-5020).. 134
TVX313 Tel. Rec. (See Model TV-707)... 60
TVX404 Tel. Rec. (See Model TV-707)... 60
601, 602 (Series A) ..... 13—11
601, 602 (Series B) ..... 22—5
612X ..... 1—34
613X (See Model 612X)... 1
614X, 616X ..... 8—2
620 ..... 12—3
640, Series B ..... 10—4
660, 662, 666 ..... 22—6
677 ..... 22—7
720 ..... 21—4

AVIOLA
509 ..... 7—3
511 ..... *
601 ..... 15—3
608 ..... 16—6
612 (See Model 601) 15
618 (See Model 608) 16

BELL SOUND SYSTEMS
B-23 ..... 75—4
RC-47 (RE-CORD-O-FONE) 30—3
RT-65 ..... 130—4
440L, 440S "Belfone" ... 25—9
2075 ..... 10—5
2122 ..... 77—3
2122R ..... 76—7

BELL SOUND SYSTEMS—Cont.
2159 .... *
3715 .... 22—8
3725 .... 22—9
3728M .... 24—11
3750 .... 31—5

BELLTONE
500 .... 5—33

BELMONT (Also See Raytheon)
A-6D110 .... 17—7
3AW7 .... 10—7
4B115 .... *
4B17 .... 2—27
4B112, 4B113 (Series A) .. 10—6
5D110 .... 22—10
5D128 (Series A) .... 9—4
5P19 (Series A) .... 9—5
5P113 "Boulevard" .... 28—2
6D111 .... 2—33
6D120 .... 24—12
8A59 .... 6—4
21A21 Tel. Rec. 93A-4
22A21, 22AX21, 22AX22 Television Receiver .... 55—5

BENDIX
C172 Tel. Rec. .... 134—5
C174 Tel. Rec. (See Model 2051) 111
C176, B Tel. Rec. (See Model 2051) 111
C182 Tel. Rec. (See Model C172) 134
C200 Tel. Rec. (See Model C172) 134
T170 Tel. Rec. (See Model 2051) 111
T171 Tel. Rec. (See Model C172) 134
T173 Tel. Rec. (See Model 2051) 111
T190 Tel. Rec. (See Model 2051) 111
0526A, 0526B, 0526C, 0526D, 0526E, 0526F .. 1—22
PAR 80 .... 39—3
55L2, 55L3, 55P2, 55P3 .. 51—4
55X4 .... 58—6
65P4 .... 52—4
69B8, 69M8, 69M9 .... 63—3
75B5, 75M5, 75M8, 75P6, 75W5 .... 59—5
79M7 .... 66—3
95B3, 95M3, 95M9 .... 60—7
110, 110W, 111, 111W, 112, 114, 115 .... 41—3
235B1, 235M1 (Ch. Codes MA, MB, MC, MD) Tel. Rec. .... 69—4
300, 300W, 301, 302 .... 40—2
416A .... 43—5
526MA, 526MB, 526MC .. 29—3
613 .... 40—3
626-A (0626A) .... 12—4
636A, 636C .... 15—4
636D (See Model 636A) .. 15
646A .... 2—28
656A .... 2—31
676B, 676C, 676D .... 5—23
687A .... 61—3
697A .... 26—8
736B .... 10—8
847-B .... 27—5
847-S "Facto Meter" .... 28—3
951, 951W .... 136—6
1217, 1217B, 1217D .... 29—4
1217D (Late) .... 46—5
1518, 1519, 1524, 1525 .. 37—3
1521 .... 42—4
1531, 1533 .... 43—6
2001, 2002 Tel. Rec. .... 84—4
2020, 2021 Tel. Rec. (See Model 2001) 84
2025 Tel. Rec. .... 99—5
2051 Tel. Rec. .... 111—3
2051 Tel. Rec. Prod. Chge. Bul. 16 ... 126—1
2060 Tel. Rec. (See Model 2051) 111
2060 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
2070 Tel. Rec. (See Model 2051) 111
2071 Tel. Rec. (See Model 2051) 111
2071 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
3001, 3002 Tel. Rec. (See Model 2001) 84
3030, 3031 Tel. Rec. (See Model 2001) 84
3033 Tel. Rec. (See Model 2025) 99
3051 Tel. Rec. (See Model 2051) 111
3051 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
6001 Tel. Rec. (See Model 2051) 111
6001 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
6002 Tel. Rec. (See Model 2025) 99
6003 Tel. Rec. (See Model 2051) 111
6003 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
6100 Tel. Rec. (See Model 2051) 111
6100 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126
7001 Tel. Rec. (See Model 2051) 111
7001 Tel. Rec. (See Model 2051) Prod. Chge. Bul. 16 ... 126

BOGEN (See David Bogen)

BREWSTER
9-1084, 9-1085, 9-1086 .. 2—13

BROOK
10C .... 41—4
10C2-A .... 43—7
10C3 .... 72—5
10D (See Model 10C) 41
12A .... 89—3

BROWNING
PF-12, RJ-12 .... 47—4
RJ-12A .... 56—6
RJ-12B .... 146—4
RJ-14A (See Model RJ-12A) ... 56
RJ-20 .... 67—5
RJ-20A .... 132—3
RJ-22 (See Model RJ20) .. 67
RV-10 .... 46—6
RV-10A .... 131—3
RV-11 (See Model RV-10) . 46

BRUNSWICK
BJ-6836 "Tuscany," C-3300 "Darby" .... 28—4
D-1000, D-1100 .... 56—7
D-6876 "Buckingham" (See Model T-4000) 29
T-4000, T-4000½ "Buckingham" .... 29—5
T-4400, T-4400½ .... 61—4
T-6000, T-6000½, T-6000S, T-6000SS, T-6000SX, "Glascow" (See Model T-4000) ... 29
T-9000 (See Model D-1000) 56
512, 513 Tel. Rec. .... *
812 Tel. Rec. .... *
816 Tel. Rec. .... *
911 Tel. Rec. .... *
922B, M Tel. Rec. .... *
5000 .... 42—5
5125 Tel. Rec. .... *
6165 Tel. Rec. .... *
8125 Tel. Rec. .... *
8165 Tel. Rec. .... *

BUICK
980690, 980733 .... 18—9
980744, 980745 .... 19—5
980782 .... 62—6
980797, 980798 .... 59—6
980868 .... 104—4
980979 (See Model 980868) 104

BUTLER BROS. (See Air Knight or Sky Rover)

CADILLAC
7241938 .... *
7253207 .... *
7256609 .... 60—8
7258155 .... *
7258755 .... 109—2
7260205 (See Model 7258755) 109

CALLMASTER (See Lyman)

CAPEHART
B-504-P16 Tel. Rec. (See Model 461P Set 87 and 35P7 Set 135)
P9, P10 .... *
TC-20 (Ch. C-297) .... 132—4
T-30 .... 141—3
19N4, 21P4, 24N4, 24P4, 26N4, 29P4, 30P4, 31N4, 31P4 .... 65—3
32P9, 33P9 .... 64—3
34P10 (See Model 32P9) .. 64
35P7 (Ch. P7) .... 135—4
114N4, 116N4, 116P4, 118P4 (See Model 19N4) 65
115P2 .... 67—6
320-B, 320-M (Ch. CX-33L) Tel. Rec. (See Model 323M) 112
320-B, 320-M (Ch. CX-33L) Tel. Rec. Prod. Chge. Bul. 13 ... 122—1
321-B, 321-M, 322-B, 322-M (Ch. CX-33) Tel. Rec. (See Model 323M) 112
321-B, 321-M, 322-B, 322-M (Ch. CX-33) Tel. Rec. Prod. Chge. Bul. 13 .... 122—1
323M (Ch. CX-33F), 324M, 325F (Ch. CX-33) Tel. Rec. .... 112—3
324-M, 325-F, 325-M (Ch. CX-33) Tel. Rec. Prod. Chge. Bul. 13 ... 122—1
326-M (Ch. CX-33L) Tel. Rec. (See Model 323M) 112
326-M (Ch. CX-33L) Tel. Rec. Prod. Chge Bul. 13 122—1
332-B, 332-M, 334-M (Ch. CX-33F) Tel. Rec. (See Model 323M) 112
332-B, 332-M, 334-M (Ch. CX-33F) Tel. Rec. Prod. Chge. Bul. 13 ... 122—1
413P, 414P (See Model 115P2) 67
461P, 462P12 Tel. Rec. .... 87—2
501P, 502P, 504P Tel. Rec. (See Model 461P Set 87 and 35P7 Set 135)
610P, 651P, 661P Tel. Rec. 95A-1
1002F, 1003M, 1004B (Ch. P-8) (See Model 35P7) 135
1005B, M, W (Ch. C-296), 1006 B, M, W (Ch. C-287) .... 132—5
3001, 3002 (Ch. CX-30, A, Prod. C-272) Tel. Rec. .. 99A-1
3001, 3002 (Ch. CX-30A-2, Prod. C-272) Tel. Rec. .. 99A-2
3004-M (Ch. CX-31, Prod. C-268) Tel. Rec. 93A-5
3005 (Ch. CX32, Prod. C-279) Tel. Rec. 93A-5

CAPEHART—Cont.
3006-M (Ch. CX-31, Prod. C-274) Tel. Rec. (See Model 3004-M) 93A
3007 (Ch. CX-30, Prod. C-276) 99A-2
3008 (Ch. CX-32, Prod. C-278 Tel. Rec. (See Model 3005) 93A
3011B, M, 3012B, M (Ch. CX-33) Tel. Rec. (See Model 323M) 112
4001-M (Ch. CX-31, Prod. C-268) Tel. Rec. (See Model 3004-M) 93A
4002-M (Ch. CX-31, Prod. C-274) Tel. Rec. (See Model 3004-M) 93A
Ch. CX-33, CX-33F (See Model 323M) 112
Ch. CX-33 Series Tel. Rec. Prod. Chge. Bul. 24 ... 142—1

CAPITOL
D-17 .... 30—4
T-13 .... 28—5
U-24 .... 29—6

CARDWELL, ALLEN D.
CE-26 .... 14—6

CENTURY (Also See Industrial Television)
226, 326 (Ch. IT-26R, IT-35R, IT-39R, IT-46R) Tel. Rec. 99A-7
721, 821, 921, 1021 (Ch. IT-21R) Tel. Rec. 97A-8

CENTURY (20th)
100X, 101, 104 .... 12—5
200 .... 21—5
300 .... 21—6

CHALLENGER
CC8 .... 63—4
CC18 .... 67—7
CC30 .... 68—6
CC60 .... 70—3
CC618 .... 66—4
CD6 .... 65—4
20R .... 69—5
60R .... 62—7
200 (See Model 20R) 69
600 (See Model 60R) 62

CHANCELLOR (See Radionic)
35P .... 30—25

CHEVROLET
985792 .... 6—5
985793 .... 19—6
985986 .... *
986067 .... 90—2
986146 .... 28—6
986240 .... 75—5
986241 .... 58—7
986388 .... 104—5

CHRYSLER (See Mopar)

CISCO
1A5 .... 37—4
9A5 .... 20—3

CLARION
C100 .... 1—5
C101 .... 5—9
C102 .... 9—6
C103 .... 6—6
C104 .... 1—4
C105 (See Model C104) ... 1
C105A .... 6—7
C108 (Ch. 101) .... 5—8
150 .... *
155 .... *
11011 .... 17—8
11305 .... 18—11
11411-N .... 30—5
11801 .... 23—6
11802V-M (See Model 11801) 23
12110M .... 54—5
12310-W .... 31—6
12708 .... 41—5
12801 .... 61—5
13101 .... 46—7
13201, 13203 .... 62—8
14601 .... 60—9
14965 .... 66—5
16703 Tel. Rec. .... 102—2

CLARK
PA-10 .... 12—6
PA-10A .... 18—12
PA-20 .... 13—12
PA-20A .... 18—13
PA-30 .... 19—7

CLEARSONIC (See U. S. Television)

COLLINS AUDIO PRODUCTS
FMA-6 .... 99—6
45-D .... 72—6

COLLINS RADIO
75A-1 .... 34—4

COMMANDER INDUSTRIES
Commander 3 Tube Record Player .... 17—10
CD61P .... 19—9

CONCORD
IN434, IN435, IN436 (Similar to Chassis) .... 98—5
IN437 (Similar to Chassis) 121—2
IN549 (Similar to Chassis) 38—5
IN551 (Similar to Chassis) 38—6
IN554, IN555 (Similar to Chassis) .... 55—10
IN556, IN557 (Similar to Chassis) .... 109—7
IN559 (Similar to Chassis) 90—7
IN560 (Similar to Chassis) 109—7
IN561, IN562 (Similar to Chassis) .... 97—8
IN563 (Similar to Chassis) 136—10
IN819 (Similar to Chassis) 69—7
6C51B .... 19—8

CONCORD—Cont.
6C51W (See Model 6C51B) 19
6E51B .... 20—4
6F26W .... 19—10
6R3ARC .... 21—7
7R3APW (See Model 6R3ARC) 21
6T61W .... 22—11
7G26C .... 20—5
1-402, 1-403 .... 45—6
1-411 .... 48—5
1-501 (See 6E51B) 20
1-504 .... 55—6
1-509, 1-510 (See 6C51B) 19
1-516, 1-517 .... 49—7
1-601, 1-602, 1-603 (See 7G26C) 20
1-606 .... 45—7
1-608 (See 6F26W) 19
1-609 (See 6T61W) 22
1-611 .... 46—8
1-1201 .... 55—7
2-105 (See 315WL) 53
2-106 .... 54—6
2-200, 2-201, 2-218, 2-219, 2-232, 2-235, 2-236, 2-237, 2-238, 2-239, 2-240 .... 62—9
315WL, 315WM .... 53—8
325WL, 325WM (See 2-106) 54

CONRAC
10-M-36, 10-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
11-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
12-M-36, 12-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
13-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
14-M-36, 14-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
15-P-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
16-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
17-P-39 (Ch. 39) Tel. Rec. (See Ch. 36) 110
18-M-39, 18-W-39 (Ch. 39) Tel. Rec. (See Ch. 36) .. 110
20-M-39, 20-W-39 (Ch. 39) Tel. Rec. (See Ch. 36) .. 110
21-B-39 (Ch. 39) Tel. Rec. (See Ch. 36) 110
22-P-39 (Ch. 39) Tel. Rec. (See Ch. 36) 110
23-M-390, 23-W-390 (Ch. 39) Tel. Rec. (See Ch. 36) 110
24-M-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
25-W-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
26-B-36 (Ch. 36) Tel. Rec. (See Ch. 36) 110
27-M-40, 27-W-40 (Ch. 40) Tel. Rec. (See Ch. 40) . 140
28-B-40 (Ch. 40) Tel. Rec. (See Ch. 40) 140
29-P-40 (Ch. 40) Tel. Rec. (See Ch. 40) 140
30-M-40, 30-W-40 (Ch. 40) Tel. Rec. (See Ch. 40) . 140
31-P-40 (Ch. 40) Tel. Rec. (See Ch. 40) 140
32-M-44, 32-W-44 (Ch. 44) Tel. Rec. (See Ch. 40) . 140
33-B-44 (Ch. 44) Tel. Rec. (See Ch. 40) 140
34-P-44 (Ch. 44) Tel. Rec. (See Ch. 40) 140
36, 39, Tel. Rec. .... 110—4
40 Series Tel. Rec. .... 140—4
Ch. 44 Tel. Rec. (See Ch. 40) 140

CONTINENTAL ELECTRONICS (See Skyweight)

CONVERSA-FONE
MS-5 (Master Station) SS-5 (Sub-Station) .... 16—7

CO-OP
6AWC2, 6AWC3, 6A47WCR, 6A47WT, 6A47WTR .... 56—8

CORONADO
FA43-8965 (See Model 43-8965) Tel. Rec. ... 86
FA43-8966 Tel. Rec. .... *
TV43-8908 Tel. Rec. .... *
TV43-8960 Tel. Rec. .... *
05RA1-43-7755A, 05RA1-43-7755B .... 101—2
05RA1-43-7901A .... 115—2
05RA2-43-8515A .... 110—5
05RA4-43-8935A Tel. Rec. *
05RA4-43-9876A .... 103—7
05RA33-43-8120A .... 110—6
05RA37-43-8360A .... 102—3
05TV1-43-8945A Tel. Rec. 145—5
05TV1-43-9005A, 05TV1-43-9006A Tel. Rec. (See Model 05TV1-43-8945A) 145
05TV1-43-9014A Tel. Rec. 128—4
05TV2-43-8950A Tel. Rec. 141—4
05TV2-43-9010A Tel. Rec. 146—5
05TV6-43-8935A Tel. Rec. *
15RA1-43-7902A .... 134—6
15TV1-43-9008A Tel. Rec. *
15TV2-43-9012A, 15TV2-43-9013A Tel. Rec. .... *
15TV2-43-9025A, B, 15TV2-43-9026A, B Tel. Rec. .... 144—3
15TV2-43-9101A, 15TV2-43-9102A Tel. Rec. .... *

CORONADO—Cont.
15TV4-43-8948A, 15TV4-43-8949A Tel. Rec. .... *
43-2027 .... 11—3
43-5005 .... 28—36
43-6301 .... 7—4
43-6451 .... 10—10
43-6485 .... 46—9
43-6730 (See Model 43-8685) 11
43-7601, 43-7602 (See Model 43-7601B) 10
43-7601B .... 10—11
43-7651 .... 9—7
43-7652 (See Model 43-7651) 9
43-7851 .... 47—5
43-8101 (See Model 94RA31-43-8115A) ... 81
43-8130C, 43-8131C (See Model 94RA33-43-8130C) 82
43-8160 .... 12—7
43-8177 (See Model 43-8178) 21
43-8178 .... 21—8
43-8180 .... 10—12
43-8190 .... 19—11
43-8201 (See 43-8178) 21
43-8213 .... 7—5
43-8240, 43-8241 .... 12—8
43-8305 .... 8—3
43-8312A .... 8—4
43-8330 .... 19—12
43-8351, 43-8352 .... 12—9
43-8353, 43-8354 .... 28—7
43-8420 .... 24—13
43-8470 (See Model 43-8305) 8
43-8471 (See Model 43-8312A) 8
43-8576B .... 9—8
43-8685 .... 11—4
43-8965 Tel. Rec. .... 86—3
43-9196 .... 14—35
43-9201 .... 24—14
94RA1-43-6945A .... 69—6
94RA1-43-7605A .... 65—5
94RA1-43-7656A, 94RA1-43-7657A .... 73—2
94RA1-43-7751A .... 87—3
94RA1-43-8510A, 94RA1-43-8511A .... 71—7
94RA1-43-8510B, 94RA1-43-8511B .... 75—6
94RA4-43-8129A, 94RA4-43-8130A, 94RA4-43-8130B, 94RA4-43-8131A, 94RA4-43-8131B .... 62—10
94RA31-43-8115A, B, 94RA31-43-8116A .... 81—5
94RA31-43-9841A .... 79—3
94RA33-43-8130C, 94RA33-43-8131C .... 82—3
94TV1-43-8940A Tel. Rec. *
94TV1-43-9002A Tel. Rec. *
94TV2-43-8970A, 94TV2-43-8971A, 94TV2-43-8972A, 94TV2-43-8973A, 94TV2-43-8985A, 94TV2-43-8986A, 94TV2-43-8987A, 94TV2-43-8993A, 94TV2-43-8994A, 94TV2-43-8995A Tel. Rec. .... 78—4
94TV6-43-8953A Tel. Rec. 106—3
165 (See Model 94RA31-43-8115A) ... 81
197, 197U (See Model 94RA31-43-8115A) ... 81

CORONET
C2 .... 6—8

CRESCENT
H-16A1 .... 76—8

CROMWELL (Mercantile Stores)
1010 .... 88—2
1020 .... 89—5

CROSLEY
S11-442M1U (Ch. 331-4) Tel. Rec. .... *
S11-444MU (Ch. 331-4) Tel. Rec. .... *
S11-453MU (Ch. 331-4) Tel. Rec. .... *
S11-472B1U (Ch. 331-4) Tel. Rec. .... *
S11-474BU (Ch. 331-4) Tel. Rec. .... *
S17CDC1, S17CDC2, S17CDC3, C17CDC4 (Ch. 331-4) Tel. Rec.) .. *
S17OC1, S17COC2, S17COC3 (Ch. 331-4) Tel. Rec. .... *
S20CDC1, S20CDC2, S20CDC3 (Ch. 323-6) Tel. Rec. .... *
9-101 .... 58—8
9-102 .... 50—4
9-103, 9-104W .... 60—10
9-105, 9-105W .... 59—70
9-113, 9-114W .... 53—9
9-117 .... 51—5
9-118W (See Model 9-102) 50
9-119, 9-120W .... 50—5
9-121, 9-122W .... 54—8
9-201, 9-202M, 9-203B .. 52—5
9-204, 9-205M .... 63—5
9-207M .... 57—6
9-209, 9-212M .... 53—10
9-213B (See Model 9-209) 53
9-214M, 9-214ML .... 65—6
9-302 .... 47—6
9-403M, 9-403M-2 Tel. Rec. .... 79—4
9-404M Tel. Rec. (See Model 9-403M) 79

CROSLEY—Cont.

9-407, 9-407M-1, 9-407M-2 Tel. Rec. .... 66—6
9-409M3 Tel. Rec. .... 94—3
9-413B, 9-413B-2, 9-414B Tel. Rec. (See Model 9-403M) 79
9-419M1, 9-419M1-LD, 9-419M2, 9-419M3, 9-419M3-LD Tel. Rec. (See Model 9-409M3) .. 94
9-420M Tel. Rec. (See Model 9-403M) ... 79
9-422M, 9-422MA Tel. Rec. 81—6
9-423M Tel. Rec. 91A-4
9-424B Tel. Rec. (See Model 9-403M) ... 79
9-425 Tel. Rec. 95A-2
10-135, 10-136E, 10-137, 10-138, 10-139, 10-140 93—3
10-307M, 10-308, 10-309 80—4
10-401 Tel. Rec. .... 95—2
10-404MU, 10-404M1U Tel. Rec. .... 114—3
10-412MU Tel. Rec. (See Model 10-404MU) . 114
10-414MU Tel. Rec. .... 116—4
10-416MU Tel. Rec. (See Model 10-414MU) 116
10-418MU Tel. Rec. (See Model 10-404MU) . 114
10-419MU Tel. Rec. .... 104—6
10-420MU Tel. Rec. (See Model 10-404MU) . 114
10-421MU Tel. Rec. .... 106—4
10-427MU Tel. Rec. .... 125—1A
10-428MU Tel. Rec. .... 129—5
10-429MU Tel. Rec. (See Model 10-414MU) 116
11-100U, 11-101U, 11-102U, 11-103U, 11-104U, 11-105U (Ch. 301) .... 127—5
11-114U, 11-115U, 11-116U, 11-117U, 11-118U, 11-119U (Ch. 330) .... 135—5
11-126U, 11-127U, 11-128U, 11-129U (Ch. 312) .... 125—5
11-207MU, 11-208BU (Ch. 333) .... 142—6
11-301U, 11-302U, 11-303U, 11-304U 11-305U .... 124—3
11-441MU Tel. Rec. .... *
11-442MU Tel. Rec. .... 126—4
11-443MU Tel. Rec. (See Model 11-442) 126
11-443MU Tel. Rec. Prod. Chge. Bul. 22 ... 138—1
11-445MU, 11-446MU, 11-447MU Tel. Rec. (See Model 11-442MU) 126
11-453MU Tel. Rec. (See Model 11-442MU) 126
11-459MIU, MU, 11-460MU Tel. Rec. (See Model 11-442MU) 126—4
11-461WU Tel. Rec. .... *
11-465WU Tel. Rec. (See Model 11-442MU) 126
11-470BU Tel. Rec. (See Model 11-442MU) 126
11-471BU Tel. Rec. .... *
11-472BU Tel. Rec. (See Model 11-442MU) 126
11-473BU Tel. Rec. (See Model 11-442) 126
11-473BU Tel. Rec. Prod. Chge. Bul. 22 ... 138—1
11-475BU, 11-476BU, 11-477BU Tel. Rec. (See Model 11-442MU) 126
11-483BU Tel. Rec. (See Model 11-442MU) 126
11-550MU (Ch. 337) .... 139—5
11-560BU (Ch. 337) (See Model 11-550MU) . 139
17CDC1, 17CDC2, 17CDC3, 17CDC4 (Ch. 331, 331-1, 331-2) Tel. Rec. (See Model 11-442) ... 126
17COC1, 17COC2, 17COC3 (Ch. 331, 331-1, 331-2) Tel. Rec. (See Model 11-442) ... 126
20CDC1, 20CDC2, 20CDC3 (Ch. 323-3, 323-4) Tel. Rec. .... *
46FA, 46FB .... 15—5
56FA, 56FB, 56FC .... 31—7
56PA, 56PB .... 10—9
56TA-L, 56TC-L .... 4—9
56TD .... 21—9
56TG .... 4—3
56TJ .... 5—14
56TN-L, 56TW-L (See Models 56TA-L, 56TC-L) 4
56TP .... 8—5
56TQ, 56TZ .... 33—2
56TR, 56TS .... 17—11
56TU .... 10—13
58TA .... 36—4
58TC (See Model 58TW) .. 38
58TK .... 34—5
58TL (See Model 58TA) 36
58TW .... 38—2
66CA, 66CP, 66CQ (See Model 66CS) 18
66CS, 66CSM .... 18—14
66TA, 66TC, 66TW .... 5—15
68CP, 68CR .... 37—5
68TA, 68TW .... 40—4
86CR, 86CS .... 12—10
87CQ (Revised Models 86CR, 86CS) .... 36—5
88CR (See Model 87CQ) .. 36
88TA, 88TC .... 38—3
88TA, 88TC (Revised) .... 43—8
106CP, 106CS .... 7—6
146CS .... 25—10
148CP, 148CQ, 148CR .... 42—6
307TA Tel. Rec. .... *

CROSLEY—Cont.

348CP-TR1, 348CP-TR2, 348CP-TR3 Tel. Rec. .... *

CROSLEY CAR

5MX080 .... *

CRYSTAL PRODUCTS (See Coronet)

DALBAR

Barcombo Jr., Barcombo Sr. .... 10—14
M8 "Tonomatic" .... 8—34
100-1000 Series .... 10—15
400 .... 9—9

DAVID BOGEN

DB-10 .... 102—4
E66 .... 85—4
E75 .... 83—2
E1620 .... *
EX35 .... *
EX-326 .... 76—9
G-50 .... 30—6
GO-50 .... 26—9
GO-125 .... 22—12
GX50 .... 25—11
H15 .... 80—6
H30 .... 79—5
H50, HL50, H2L50 .... 78—6
H623 .... 71—8
HOH, HOL .... 80—5
HO50 .... 84—5
HO125 .... 87—4
HX30 .... 82—4
HX50 .... 75—7
LOH, LOL (See Model HOH) 80
LP16 .... 86—4
PH10 .... 73—3
PX10 .... 68—5
PX15 .... 72—7
R501 .... 33—3
R602 .... 67—8
UP16 (See Model LP16) .. 86
2AR, 2RS .... 28—8
11D .... 77—5
11U .... 76—10
11X .... 74—2
21D (See Model 11D) 77
21U (See Model 11U) 76
21X (See Model 11X) 74

DEARBORN

100 .... 22—13

DECCA

DP-11 .... 24—15
DP-29 .... 19—13
PT-10 .... 25—12

DELCO

R-705 .... 42—7
R-1227, R-1228, R-1229 .. 15—6
R-1230-A, R-1231-A, R-1232-A .... 14—33
R-1233 .... 42—8
R-1234, R-1235 .... 7—7
R-1236, R-1237 .... 29—7
R-1238 .... 38—4
R-1241 .... 62—11
R-1242 .... 31—8
R-1243 .... 32—4
R-1244, R-1245, R-1246 .. 52—6
R-1248, R-1249, R-1250 .. 66—7
R-1251, R-1252 .... 21—10
R-1253, R-1254, R-1255 .. 47—7
R-1408, R-1409 .... 15—7
R1410 .... *
TV-71, TV-71A Tel. Rec. ... 99A-3
TV-101, TV-102 Tel. Rec. .. 88—3
TV-160 Tel. Rec. .... 85—5
TV-201 (Television Receiver) 59—8

DeSOTO (See Mopar)

DETROLA

554-1-61A (See Aria Model 554-1-61A) 7
558-1-49A .... 7—8
568-13-221D .... 9—10
571, 571A, 571B, 571L, 571AL, 571BL .... 10—16
571X, 571AX, 571BX .... 9—11
572-220-226A .... 8—6
576-1-6A .... 8—7
579 .... 7—9
579-2-58B (See Model 579) 7
582 .... 19—14
610-A .... 55—8
611-A .... 50—6
626 Series .... 11—5
7156 .... 48—6
7270 .... 16—8

DEWALD

A500, A500I, A500W, A501, A502, A503 .... 4—22
A504, A505 .... 16—9
A-507 .... 26—10
A-509 .... 31—9
A-514 .... 27—6
A602, A605 .... 16—10
A608 (See Model A602) .. 16
B-400 .... 35—3
B-401 .... 34—6
B-402 .... 45—8
B-403 .... 52—7
B-504 .... 43—9
B-506 .... 38—5
B-510 .... 34—7
B-512 .... 35—4
B-515 .... 63—6
B-612 .... 42—9
B-614 .... 56—9
BT-100, BT-101 Tel. Rec. .. 79—6
C-516 .... 64—4
C-800 .... 69—7
CT-101 Tel. Rec. (See Model BT-100) 79
CT-102, CT-103, CT-104 Tel. Rec. .... 82—5
D-508 .... 106—5
D-517 .... 131—4
D-518 .... 100—5
D519 (See Model B-506) .. 38
D-616 .... 102—5

DEWALD—Cont.

DT-120, DT-122 Tel. Rec. .. 100—6
DT-160 Tel. Rec. (See Model CT-102) 82
DT-161 Tel. Rec. (See Model DT-120) 100
DT-162, DT-163 Tel. Rec. .. 118—5
DT-162R, DT-163A, DT-163R Tel. Rec. .... 136—7
DT-190 Tel. Rec. (See Model DT-162) ... 118
DT-190D Tel. Rec. (See Model DT-162R) .. 136
DT-1020, DT-1020A Tel. Rec. (See Model DT-120) 100
DT-1030, DT-1030A Tel. Rec. (See Model DT-120) 100
DT-X-160 Tel. Rec. (See Model DT-120) 100
E-520 .... 128—5
E-522 .... 141—5
ET-140, ET-141 Tel. Rec. (See Model DT-162) ... 118
ET-140R, ET-141R Tel. Rec. (See Model DT-162R) .. 136
ET-170, ET-171, ET-172 Tel. Rec. (See Model DT-162R) .. 136
ET-190D, ET-190R Tel. Rec. (See Model DT-162R) .. 136
511 .... 71—9

DODGE (See Mopar)

DUMONT

RA-101 Tel. Rec. .... *
RA-102B1, RA-102B2, RA-102B3 Tel. Rec. .... *
RA-103 Tel. Rec. .... 90—3
RA-103, RA-103C Tel. Rec. Prod. Chge. Bul. 6 .... 108—1
RA-103D Tel. Rec. .... 93—4
RA-103D Tel. Rec. Prod. Chge. Bul. 9 . 114—1
RA-104A Tel. Rec. (See Model RA-103D) .. 93
RA-104A Tel. Rec. Prod. Chge. Bul. 9 .... 114—1
RA-105 Tel. Rec. .... 72—8
RA-105 Tel. Rec. Prod. Chge. Bul. 6 .... 108—1
RA-105B Tel. Rec. .... 95—3
RA-106 Tel. Rec. (Supp. to RA-105, Set 72) 99A-4
RA-106 Tel. Rec. Prod. Chge. Bul. 6 .... 108—1
RA-108A Tel. Rec. (See Model RA-105B) .. 95
RA-109-A1, -A2, -A3, -A5, -A6, -A7 Tel. Rec. .... 110—7
RA-109A Tel. Rec. Prod. Chge. Bul. 14 ... 124—1
RA-110A Tel. Rec. (See Model RA-103D) .. 93
RA-110A Tel. Rec. Prod. Chge. Bul. 9 .... 114—1
RA-111A Tel. Rec. .... 106—6
RA-112A Tel. Rec. .... 119—5
RA-113 Tel. Rec. (See Model RA-112A) .. 119
RA-117A Tel. Rec. .... 131—5

DUOSONIC

K1, K2 .... 19—15
K3, K4 .... 19—16

DYNAVOX

AP-514 (Ch. AT) .... 28—9
M-510 .... 15—8
Swingmaster .... 27—7
3-P-801 .... 36—3

ECA

101 (Ch. AA) .... 1—25
102 .... 14—7
104 .... 13—14
105 .... 16—11
106 .... 7—10
108 .... 3—6
121 .... 13—15
131 .... 16—12
132 .... 45—9
201 .... 15—9
204 .... 32—5

ECHOPHONE (Also See Hallicrafters)

EC-1A .... *
EC113 .... 3—13
EC-306 .... 14—8
EC-403, EC-404 .... 22—14
EC-600 .... 4—18
EX-102, EX-103 .... 64—5
EX-306 (See Model EC-306) 14

EDWARDS

Fidelotuner .... 33—4

EICOR

15 .... 135—6

ELCAR

602 .... 5—19

ELECTONE

T5TS3 .... 12—34

ELECTRO

B20 .... 14—9

ELECTROMATIC

APH301-A, APH301-C ... 7—11
606A, 607A .... 5—32

ELECTRO-TONE

555 .... 13—16
706, 712 (See Model 555) 13

ELECTRONIC CORP. OF AMERICA (See ECA)

ELECTRONIC SPECIALTY CO. (See Ranger)

E/L (ELECTRONIC LABS.)

7S (Sub-Station) (See Model 76RU) 20

E/L (ELECTRONIC LABS.)—Cont.

76E, 76K, 76M, 76W (See Model 2701) 4
76RU ("Radio-Utiliphone") 20—6
710B, 710M, 710T, 710W, Orthosonic (Ch. 2875) .. 20—7
710PB, 710PC Orthosonic (Ch. 2887) .... 24—16
2660 "Master Utiliphone" 8—8
2701 .... 4—28
3000 Orthosonic .... 31—10

EMERSON

501, 502 (Ch. 120000, 120029) .... 2—1
503 (Ch. 120000, 120029) 1—18
504 (Ch. 120000, 120029) (See Models 501, 502). 2
505 (Ch. 120002) .... 8—9
505 (Ch. 120041) (See Model 523) 5
506 .... 6—9
507 .... 8—10
508 (Ch. 120008) .... 7—12
509 (See Model 507) 8
510, 510A (Ch. 120000, 120029) .. 5—36
511 (See Model 507) 8
511 (Ch. 120010) (See Model 541) 16
512 (Ch. 120006) .... 9—12
512 (Ch. 120056) .... 26—11
514 (Ch. 120007) .... 27—8
515, 516 .... 12—11
515, 516 (Ch. 120056) (See Model 512 Ch. 120056) 26
517 (Ch. 120010) (See Model 541) 16
518 (See Model 507) 8
519 (Ch. 120030) .... 30—7
520 (Ch. 120000, 120029) (See Models 501, 502). 2
521 (Ch. 120013, 120031) 7—13
522 (See Model 507) 8
523 .... 5—37
524 .... 17—12
525 .... 20—8
527 (Ch. 120019) Tel. Rec. *
528 (Ch. 120038) .... 21—13
529, 529-9 (Ch. 12002B). 18—15
530 (Ch. 120006, Ch. 120056) .... 32—6
531, 532, 533 .... 11—6
534 (Ch. 120007) (See Models 514 Ch. 120007) 27
535 .... 20—9
536 (Ch. 120036) .... 21—14
536A .... 24—17
537 .... 23—7
538 (Ch. 120051) (See Model 549 Ch. 120051) 26
539 .... 9—13
540A (Ch. 120042) .... 20—10
541 .... 16—13
542 (See Model 521) 7
543, 544 (Ch. 120046) .. 19—30
545 (Ch. 120047) Tel. Rec. Photofact Servicer 82
546 (Ch. 120049) .... 21—15
547A (Ch. 120050) .... 25—13
548 (Ch. 120051) .... 30—8
549 (Ch. 120051) .... 26—12
550 (Ch. 120006) (See Model 512 Ch. 120006) 9
550 (Ch. 120056) (See Model 512 Ch. 120056) 26
551A (See Model 536A) .. 24
552 (See Model 525) 20
553A (See Model 536A) .. 24
556, 557 (Ch. 120018B) .. 70—4
557B (Ch. 120048B) .... 43—10
558 (Ch. 120058) .... 31—11
559A (Ch. 120059) .... 31—12
560 (Ch. 120016) .... 25—14
561 (Ch. 120001B) .... 63—7
563 (Ch. 120063B) .... 73—4
564 (Ch. 120027) (See Model 540A Ch. 120042) 20
565 (Ch. 120018B) (See Model 556) 70
566 (Ch. 120051) (See Model 549 Ch. 120051) 26
567 (Ch. 120016) (See Model 560 Ch. 120016) 25
567 (Ch. 120042) (See Model 540A) 20
568A (Ch. 120070A) .... 58—9
569A (Ch. 120062A) .... 42—10
570 (Ch. 120064) .... 97—3
571 (Ch. 120066) Television Receiver .... 46—25
571 (Ch. 120066B) Tel. Rec. .... *
571 (Ch. 120086B) Tel. Rec. .... 76—11
572 (Ch. 120065) (See Model 540A Ch. 120042) 20
573B (Ch. 120039B) .... 42—11
574 (Ch. 120064) (See Model 570) 97
575 (Ch. 120068A, 120068B) .... 85—6
576A (Ch. 120069A) .... 40—5
577B (Ch. 120012B) .... 41—6
578 (Ch. 120050) (See Model 547A Ch. 120050) 25
579A (Ch. 120034A) .... 61—6
580 (Ch. 120064) (See Model 570) 97
581 (Ch. 120014A, B) .... 68—7
582 (See Model 548) 30
583 (See Model 573B) 42
584 (See Model 558) 31
585 (Ch. 120025B) Tel. Rec. .... 61—7
585 (Ch. 120088B, 120090B, 120090D) Tel. Rec. .... *
586 (Ch. 120023B, 120083B) .... 72—9
587 (Ch. 120033A, B) .... 71—10
588 (See Model 547A) 25
590 (Ch. 120101A, B) .... 87—5
591 (Ch. 120055A) .... 67—9

EMERSON—Cont.

593 (Chassis 120063B) (See Models 563) 73
594, 595 (Ch. 120071A) (See Model 581) 68
596 (See Model 579A) 61
597 (Ch. 120073B) .... 90—5
599 (Ch. 120075B) .... 69—8
600 (Chassis 120103-B) Tel. Rec. .... 87—6
600 (Ch. 120103-B) Tel. Rec. Prod. Chge. Bul. 9. 114—1
601 (Chassis 120075B) (See Model 599) 69
602 (Ch. 120072A, 120082A) .... 56—10
603 (Chassis 120063B) (See Model 563) 73
604A (See Model 576A) .. 40
605 (Ch. 120076B) .... 66—8
606 (Ch. 120066) Tel. Rec. (See Model 571) 46
606 (Ch. 120066B) Tel. Rec. .... *
606 (Ch. 120087B-D) Tel. Rec. (See Model 571 Ch. 120086B) 76
606 (Ch. 120086B) Tel. Rec. (See Model 571 Ch. 120086B) 76
607 (Ch. 120074A) (See Model 597) 90
608A (Ch. 120089B) Tel. Rec. .... 84—6
609 (Chassis 120084-B) Tel. Rec. .... 90—6
610 (Chassis 120100A, B) (See Model 587) 71
611, 612 (Ch. 120087B-D) (See Model 571 Ch. 120086B) 76
613A (Ch. 120085A, B) .. 79—7
614, B, BC, C (Ch. 120110, B, BC, C) Tel. Rec. .... 97—4
614D (Ch. 120095-B) Tel. Rec. 95A-3
615 (Ch. 120001B) (See Model 561) 63
616 (Chassis 120100A, B) (See Model 587) 71
618 (Ch. 120090B,D) Tel. Rec. .... *
619 (Ch. 120092D) Tel. Rec. (See Model 571 Ch 120086B) 76
620 (Ch. 120091D-QD) Tel. Rec. (See Model 571 Ch. 120086B) 76
621 (Ch. 120098B) Tel. Rec. .... 108—5
622 (Ch. 120098P) Tel. Rec. (See Model 621) 108
623 (Ch. 120101A, B) (See Model 590) 87
624 (Ch. 120087B-D) Tel. Rec. (See Model 571 Ch. 120086B) 76
625 (Ch. 120105B) .... 103—8
626 (Ch. 120104B, 120104BJ) Tel. Rec. (See Model 608A) 84
627 (Ch. 120107B) Tel. Rec. (See Model 571 Ch. 120086B) 76
628 (Ch. 120098B) Tel. Rec. (See Model 621) 108
629 (Ch. 120114B) Tel. Rec. (See Model 631) .. 93A—6
629B, 629C (Ch. 120120) Tel. Rec. .... 119—6
629D (Ch. 120124B) Tel. Rec. .... 116—5
630 (Ch. 120099B) Tel. Rec. (See Model 621) 108
631 (Ch. 120109) Tel. Rec. 93A-6
632 (Ch. 120096B) Tel. Rec. 93A-7
633 (Ch. 120114) Tel. Rec. (See Model 631). 93A
634B (Ch. 120097B) .... 111—4
635 (Ch. 120108) .... 92—1
636A (Ch. 120106A) .... 99—7
637, B, BC, C (Ch. 120110, B, BC, C) Tel. Rec. (See Model 614) 97
637A (Ch. 120095-B) Tel. Rec. (See Model 614D). 95A
638 (Ch. 120087D) Tel. Rec. (See Model 571) .. 76
639 (Ch. 120103B) Tel. Rec. (See Model 600) .. 87
639 (Ch. 120103-B) Tel. Rec. Prod. Chge. Bul. 9. 114—1
640 (Ch. 120112) .... 93—5
641B (Ch. 120125B) .... 120—5
642 (Ch. 120117A) .... 98—3
643A (Ch. 120111A) .... 91—4
644, B, BC, C (Ch. 120113, B, BC, C) Tel. Rec. (See Model 614) 97
645 (Ch. 120115) .... 94—4
646A (Ch. 120121A), 646B (Ch. 120121B) ... 102—6
647, B, BC, C (Ch. 120113, B, BC, C) Tel. Rec. (See Model 614) 97
648B (Ch. 120110E) Tel. Rec. (See Model 614) . 97
649A (Ch. 120094A) Tel. Rec. .... 106—7
650 (Ch. 120113C) Tel. Rec. (See Model 614) (Ch. 120110) 97
650, 650B (Ch. 120118B) Tel. Rec. .... 113—2
650D (Ch. 120123-B) Tel. Rec. .... 109—3
650F (Ch. 120138-B) Tel. Rec. 133-1A
651B (Ch. 120120) Tel. Rec. (See Model 629B) 119

EMERSON—Cont.
651C (Ch. 120109) Tel. Rec. (See Model 631).. 93A
651C (Ch. 120124) Tel. Rec. (See Model 629D) 116
651D (Ch. 120124, B) Tel. Rec. (See Model 629D) 116
652 (Ch. 120032B) (See Model 642)........ 98
653 (Ch. 120080B) (See Model 642)........ 98
654, 654B (Ch. 120118B) Tel. Rec. (See Model 650)......113
654D (Ch. 120123-B) Tel. Rec. (See Model 650D) 109
654F (Ch. 120138-B) Tel. Rec. (See Model 650F).133–1A
655B (Ch. 120123-B) Tel. Rec. (See Model 650D) 109
655F (Ch. 120138-B) Tel. Rec. (See Model 650F).133–1A
656B, 657B (Ch. 120122B) 111—5
658B (Ch. 120124, B) Tel. Rec. (See Model 629D) 116
658C (Ch. 120124) Tel. Rec. (See Model 629D) 116
658D (Ch. 120124B) Tel. Rec. .... *
660B (Ch. 120133B) Tel. Rec. ....131—6
661B (Ch. 120134B, G, H) Tel. Rec. ....137—4
662B, 663B (Ch. 120127-B, 120128-B) Tel. Rec. ...125—6
662B, 663B (Ch. 120127-B, 120128-B) Tel. Rec. Prod. Chge. Bul. 18...130—1
664B (Ch. 120133-B) Tel. Rec. (See Model 660B). 131
665-B (Ch. 120131-B and Radio Ch. 120130-B) Tel. Rec. ....146—6
666B (Ch. 120135B and Radio Ch. 120132B) Tel. Rec. ....133—5
667B, 668B (Ch. 120134B, G, H) Tel. Rec. (See Model 661B).....137
668B (Ch. 120134-B) Tel. Rec. (See Model 661B).....137
669B (Ch. 120129-B) Tel. Rec. ....126—5
669B (Ch. 120129D) Tel. Rec. Prod. Chge. Bul. 24 ....124—1
671B (Ch. 120137-B).....118—6
671D (Ch. 120137D) Tel. Rec. (See Model 671B) 118
672B (Ch. 120097-B)....131—7
673B (Ch. 120133-B) Tel. Rec. (See Model 660B). 131
674B (Ch. 120134B) Tel. Rec. (See Model 661B).....137
675B (Ch. 120129-B) Tel. Rec. (See Model 669B) 126
676B (Ch. 120140B) Tel. Rec. ....128—6
676D (Ch. 120144-B) Tel. Rec. ....138—4
677B, 678B (Ch. 120134B, G, H) Tel. Rec. (See Model 661B).....137
679B (Ch. 130116-B)....142—7
680B (Ch. 120144-B) Tel. Rec. (See Model 676D) 138
680B (Ch. 120144G, H) Tel. Rec. (See Model 676D).....138
680D (Ch. 120140B) Tel. Rec. (See Model 676B) 128
681B (Ch. 120140B) Tel. Rec. (See Model 676B) 128
681D (Ch. 120144-B) Tel. Rec. (See Model 676D) 138
681F (Ch. 120143B, H) Tel. Rec. .... *
683B (Ch. 120141-B) Tel. Rec. .... *
684B, 685B (Ch. 120134B, G, H) Tel. Rec. (See Model 661B).....137
686B, 687B (Ch. 120144-B) Tel. Rec. (See Model 676D).....138
686D (Ch. 120140B) Tel. Rec. (See Model 676B). 128
686F (Ch. 120143B, H) Tel. Rec. .... *
686L (Ch. 120142-B) Tel. Rec. .... *
687B (Ch. 120144-B) Tel. Rec. (See Model 676D). 131–1A
687D (Ch. 120134B) Tel. Rec. (See Model 676B). 128
687F (Ch. 120143B, H) Tel. Rec. .... *
687L (Ch. 120142-B) Tel. Rec. .... *
688B, 689B, 690B (Ch. 120129-B) Tel. Rec. (See Model 669B) 126
688B, 689B, 690B (Ch. 120129D) Tel. Rec. Prod. Chge. Bul. 24...142—1
692B, 693B, 694B (Ch. 120129B) Tel. Rec. (See Model 669B).....126
692B, 693B, 694B (Ch. 120129B) Tel. Rec. Prod. Chge. Bul. 24...142—1
696B (Ch. 120144G, H) Tel. Rec. (See Model 676D).....138
696F (Ch. 120143B, H) Tel. Rec. .... *
696L (Ch. 120142-B) Tel. Rec. .... *

EMERSON—Cont.
697B (Ch. 120129B) Tel. Rec. (See Model 669B). 126
697B (Ch. 120129B) Tel. Rec. Prod. Chge. Bul. 24 ....142—1
698B (Ch. 120127B) Tel. Rec. (See Model 662B). 125
1002 .... 16—14
1003 (See Model 1002)... 16
Ch. 120002B (See Model 529) 18
Ch. 120003 (See Model 506) 6
Chassis 120023B (See Model 586)........... 72
Ch. 120043 (See Model 537) 23
Chassis 120083B (See Model 586)........... 72

EMPRESS
55, 56 .... 7—14

ESPEY (Also see Philharmonic)
RR13, RR13L .... 13—17
7B .... 47—8
18B .... 90—7
31 ....103—9
512 .... 68—8
513, 514 .... 63—8
524 (See Model 18B).... 90
581 .... 14—10
621 .... 10—17
641, 642 .... 8—11
651 .... 9—14
652, 653 (See Model 651) 9
751 (See Model 18B).... 90
6511, 6511-2, 6511-S, 6514, 6516, 6517, 6520, 6520-2, 6521, 6533, (Ch. FJ97) See model 651 9
6540, 6541 .... 8—12
6542 (Ch. FJ97) (See Model 651)...... 9
6545 (Ch. FJ97)......... 5—16
6546 (Ch. FJ97) (See Model 651)...... 9
6547 (See Models 6540, 6541) 8
6560 (Ch. FJ97) (See Model 651)...... 9
6611, 6612, 6613, 6614, 6615, 6630, 6631, 6632, 6634, 6635 (Ch. 97A). 18—16
7541 (Ch. FJ97) (See Model 651)...... 9
7552 (See Model 18B)... 90

ESQUIRE
60-10, 65-4 .... 14—11

FADA
G-925 Tel. Rec......... 89—6
P80 .... 27—9
P82 .... 21—16
P100 .... 27—10
P-130 ....135—7
R-1025 Tel. Rec.........114—4
R-1050 Tel. Rec. (See Model R-1025)....114
S4C20 Tel. Rec..........142—8
S4C40 Tel. Rec. (See Model S4C20)....142
S4T15 Tel. Rec. (See Model S4C20)....142
S4T30 Tel. Rec. (See Model S4C20)....142
S6C55 Tel. Rec..........134—7
S6C70 Tel. Rec. (See Model S6C55)....134
S6T65 Tel. Rec. (See Model S6C55)....134
S7C20, S7C30 Tel. Rec. (See Model S6C55)....134
S7C70 Tel. Rec. (See Model S6C55)....134
S7T65 Tel. Rec. (See Model S6C55)....134
S9C10 Tel. Rec. (See Model S6C55)....134
S1015 Tel. Rec..........109—4
S1020 Tel. Rec. (See Model S1015) 109
S1030 Tel. Rec. (See Model S1015) 109
S1055, S1055X Tel. Rec. (See Model S6C55)....134
S1060 Tel. Rec. (See Model S6C55)....134
S1065 Tel. Rec. (See Model S6C55)....134
TV30 Tel. Rec........... 74—3
602 .... 14—12
605, 606 Series......... 1—13
609, 610 Series......... 1—15
633 .... 17—13
637 .... 17—14
652 Series .... 1—23
700 .... 32—7
711, 740 .... 28—10
790 .... 64—6
795 .... 36—6
799 Tel. Rec. (See Model TV30) 74
830 .... 97—5
845 .... 97—6
855 .... 92—2
880 Tel. Rec............ 95A-5
899 Tel. Rec. (See Model TV30) 74
925 (See Model G-925).. 89
930, 940 Tel. Rec. (See Model TV30)..... 74
965 (See Model G-925).. 89
1000 Series .... 1—17
1001 .... 17—15

FAIRMONT
30T14A-056 Tel. Rec. (Similar to Chassis)....119—3
38T12A-058 Tel. Rec. (Similar to Chassis)....109—1
317T3 Tel. Rec. (Similar to Chassis).... 72—4

FAIRMONT—Cont.
318T4 Tel. Rec. (Similar to Chassis).... 85—3
318T45 Tel. Rec. (Similar to Chassis).... 85—3
318T4-872 Tel Rec. (Similar to Chassis).... 85—3
318T6A Tel. Rec. (Similar to Chassis).... 85—3
318T6A-950 Tel. Rec. (Similar to Chassis).... 85—3
318T9A-900 Tel. Rec. (Similar to Chassis).... 78—4
518T6A Tel. Rec. (Similar to Chassis).... 85—3
518T9A-918 Tel. Rec. (Similar to Chassis).... 78—4
518T10A-916 Tel. Rec. (Similar to Chassis).... 78—4
2318T6A-954 Tel. Rec. (Similar to Chassis).... 85—3
2318T9A-912 Tel. Rec. (Similar to Chassis).... 78—4

FARNSWORTH
EC-260 .... 7—15
EK-081, EK-082, EK-083.. 26—13
EK-262, EK-263BL, E-263WL, E-264BL, EK-264WL, EK-265 (See Model EC-260) 7
EK-681 (See Model EK-081) 26
ET-060, ET-061, ET-063.. 6—11
ET-064, ET-065, ET-066.. 4—2
GK-100, GK-102, GK-103, GK-104 ..... 23—8
GK-111, GK-112, GK-114, GK-115 ...... 60—11
GK-140, GK-141, GK-142, GK-143, GK-144 ..... 24—18
GT-050, GT-051, GT-052. 35—5
GT-060, GT-061, GT-064, GT-065 .... 35—6
GV220, GV240, GV260 Tel. Rec............. *
K-267, K-669 (See Model EC-260) 7
Ch. 150 (See Model ET-060) 6
Ch. 152, 153 (See Model EC-260) 7
Ch. 156, 157 (See Model EK-081) 26
Ch. 158, 159 (See Model ET-064) 4
Ch. 162 (See Model EC-260) 7
Ch. 170 (See Model GK-100) 23
Ch. 193 (See Model EK-081) 26
Ch. 194, 201, 216 (See Model GK-100)... 23

FEDERAL MFG. CO.
104 (Select-A-Call) ...... 18—17
135 (Select-A-Call) ...... 11—7

FEDERAL TEL. & RADIO CORP.
1021 (See Model 1030T).. 8
1030T .... 8—13
1031, 1032 (See Model 1030T) 8
1040T, 1040TB .... 23—9
1540T (See Model 1030T). 8

FERRAR
C-81-B .... 17—16
T-61B .... 39—4
WR-11 .... 15—10

FIRESTONE (AIR CHIEF)
4-A-2 (Code No. 297-6-LMMU-143) . 14—4
4-A-3 (Code No. 297-6-LMFU-134) ..... 31—13
4-A-10 (Code No. 297-7-RN228) .... 28—11
4-A-11 (Code No. 188-8-4A11) ..... 41—7
4-A-12 (Code No. 213-8-8370) .... 49—8
4-A-15 (Code 177-7-4A15) 36—7
4-A-17 (Code No. 213-7-7270) .... 35—7
4-A-20 (Code 5-5-9000-A) 15—11
4-A-21 (Code No. 5-5-9001A); 4-A-22X (Code No. 5-5-9001B) . 11—19
4-A-23 (5-5-9003-A) .... 2—29
4-A-24 (Code 291-6-566) . 13—5
4-A-25 (Code 291-6-572) . 13—6
4-A-26 (Code 307-6-9030-A) .... 33—5
4-A-27 .... 28—12
4-A-30 .... *
4-A-31 (Code No. 177-5-4A31) ..... 11—20
4-A-37 (Code 177-5-4A37) 13—7
4-A-40 .... *
4-A-41 (Code 291-7-576). 52—8
4-A-42 (Code No. 177-7-4A42) ..... 30—9
4-A-60 (Code No. 307-8-9047A) .... 38—6
4-A-61 (Code No. 332-8-137J2T) .... 48—7
4-A-62, 4-A-63 .... 67—10
4-A-64, 4-A-65 .... 68—9
4-A-66 (Code No. 177-8-4A66) .... 74—4
4-A-68 (Code No. 332-8-143653) .... 53—11
4-A-69 (Code No. 155-8-B5) .... 61—8
4-A-70 ....136—8
4-A-71 (Code 291-8-628). 59—9
4-A-78, 4-A-79 ....117—5
4-A-85 ....118—7
4-A-86 ....129—6
4-A-86 (Late) ....144—4
4-A-87 ....119—7
4-A-88 ....132—6
4-A-89 (See Model 4-A-85)...118

FIRESTONE—Cont.
4-A-95 (See Model 4-A-86 Late) 144
4-A-96 (See Model 4-A-87) 119
4-B-1 (Code 7-6-PM15) .. 7—1
4-B-2 (Code 7-6-PM14) .. 18—18
4-B-6 (Code No. 177-7-PM18) ..... 29—8
4-B-31 .... *
4-B-56 ....133—6
4-B-57 ....124—4
4-B-58 ....135—8
4-C-1 .... *
4-C-3 .... 19—17
4-C-5 (Code 291-7-574) . 33—6
4-C-6 (See Model 4C3)... 19
4-C-13 (Code 332-8-140623) .... 66—9
4-C-16, 4-C-17 ....120—6
4-C-18 ....110—8
13-G-3 Tel. Rec........ 86—5
13-G-4 (Code 347-9-249B) Tel. Rec............. 73—5
13-G-5 (Code 291-9-651) Tel. Rec. .... 83—3
13-G-33 Tel. Rec........108—6
13-G-44, 13-G-45 Tel. Rec. *
13-G-46, 13-G-47 Tel. Rec. ....140—5
13-G-48 Tel. Rec........143—6
13-G-49, 13-G-50 Tel. Rec. *
13-G-53, 13-G-54, 13-G-55 Tel. Rec...... *
13-G-57 Tel. Rec........ *
13-G-58, 13-G-59 Tel. Rec. .... *
13-G-79 Tel. Rec........ *

FLUSH WALL
5P .... 26—14

FORD
GF890, E (OA-18805-B)..109—5
M-1 (8A-18805A) .... 46—4
M-1A-1 (OA-18805-A1) ..106—8
M-2 (1A-18805-A1) .....132—7
OBF (OA-18805-A1) (See Model M-1A-1) 106
OMF (OA-18805-A2) ....135—9
OZF (OA-18805-B) (See Model GF890).........109
1CF743 (1A-18805-B)....133—7
1MF (1A-18805-A2) .....131—8
6MF080 (51A-18805-A1 Ch. 6CA1) .... 10—18
6MF780 (51A-18805-A1) . 62—12
8MF880 (8A-18805B) .... 42—12
8MF881 (8C-18805B) .... 47—9
8MF980 (8A-18805B) ... 61—9
8MF983 (8A-18805B-1), 8MF983-E (8A-18805) . 83—4
8ZT (8A-18805-B) (See Model 8MF881)... 47
9BF (8A-18805-A1) (See Model M-1)...... 46
9OF (8A-18805-A2) (See Model 8072)..... 44
9MF (8A-18805-A3) (See Model 8072)..... 44
9ZF (8A-18805-B1) (See Model 8MF983)... 83
7070 (51A-18805-B2) .... 45—10
8072 (8A-18805-A) ..... 44—4

FREED EISEMAN
46 .... 11—8
54, 55, 56, 58 (Ch. 1620C) Tel. Rec. 113–1A

GALVIN (See Motorola)

GAMBLE-SKOGMO (See Coronado)

GAROD (Also See MAJESTIC)
4A-1, 4A-2 .... 29—9
4B-1 .... 51—6
5A-1 .... 22—15
5A-2 .... 5—28
5A-3 .... 44—5
5A-4 .... 40—6
5AP1-Y "The Companion" 15—12
5D, 5D-2 .... 12—12
5D-3, 5D-3A .... 22—16
5D-4, 5D-5 .... 33—7
5RC-1 .... 36—8
6A-2 .... 28—13
6AU-1 .... 5—29
6BU-1A "The Senator" .. 13—18
6DPS, 6DPS-A .... 12—13
10TZ1, 10TZ2, 10TZ3, 10TZ4, 10TZ5 Tel. Rec. 60—12
10TZ20, 10TZ21, 10TZ22, 10TZ23 Tel. Rec......... 95A-4
11FMP .... 38—7
12TZ1, 12TZ2, 12TZ3, 12TZ4, 12TZ5, 12TZ6A, 12TZ7A, 15TZ6, 15TZ7 Tel. Rec. (See Model 10TZ1) 60
12TZ20, 12TZ21, 12TZ22, 12TZ23 Tel. Rec. (See Model 10TZ20)... 95A
15TZ24, 15TZ25, 15TZ26, 15TZ27 Tel. Rec....... 95A-4
62B .... 29—10
306 .... 48—8
900, 1000 Series Television Receiver ... 50—7
1100 Series Tel. Rec. (See Model 900)...... 50
1142, 1143 Tel. Rec..... *
1200 Series Tel. Rec. (See Model 900)...... 50
3912 TVFMP, 3915 TVFMP Tel. Rec. 95A-6

GENERAL ELECTRIC
YRB-60-1, YRB-60-2, YRB-60-12 .... 33—8
10C101, 10C102 Tel. Rec. 96—4
10T1 Tel. Rec. (See Model 10C101).... 96
10T4, 10T5, 10T6 Tel. Rec. (See Model 10C101).... 96
12C101, 12C102, 12C105 Tel. Rec. (See Model 10C101) 96

GENERAL ELECTRIC—Cont.
12C107, 12C107B, 12C108, 12C108B, 12C109, 12C109B Tel. Rec. ....125—7
12K1 Tel. Rec........... 95A-6
12T1 Tel. Rec. (See Model 10C101)... 96
12T3, 12T3B, 12T4, 12T4B Tel. Rec. (See Model 12C107) 125
12T7 Tel. Rec........... 99A-5
14 .... 35—8
14C102, 14C103 Tel. Rec. 123—4
14T2, 14T3 Tel. Rec. (See Model 14C102) ..123
16C103 Tel. Rec. (See Model 14C102) ..123
16C110, 16C111 Tel. Rec. (See Model 14C102) ..123
16C113 Tel. Rec. (See Model 14C102) 123
16C115, 16C116, 16C117 Tel. Rec. (See Model 14C102) 123
16T1, 16T2, 16T3, 16T4, 16T5, Tel. Rec. (See Model 14C102) ..123
17C101, 17C102 Tel. Rec. (See Model 14C102) ..123
17C103, 17C104, 17C105 Tel. Rec.......141—6
17C107, 17C108, 17C109 Tel. Rec. (See Model 17C103)...141
17C110, 17C111 Tel. Rec. 139–1A
17C113 Tel. Rec......... *
17C115 Tel. Rec......... *
17C120 Tel. Rec......... *
17T1, 17T2, 17T3 Tel. Rec. (See Model 17C103)...141
19C101 Tel. Rec......... 99A-6
20C150, 20C151 Tel. Rec. 143–1A
24C101 Tel. Rec........137–1A
41, 42, 43, 44, 45 ...... 32—8
50 .... 7—16
60, 62 .... 36—9
64, 65 .... 98—4
66, 67 .... 76—12
100, 101 .... 6—13
102, 102W .... 41—8
103, 105 (See Models 100, 101) 6
106 .... 8—14
107, 107W (See Models 102, 102W) .... 41—8
113 .... 51—7
114, 114W, 115, 115W (See Models 102, 102W) 41
118, 119M, 119W .... 39—5
123, 124 .... 97—7
135, 136 .... 81—8
140 .... 30—10
143 .... 75—9
145 .... 60—13
150 .... 56—11
160 .... 56—12
165 .... 89—7
180 .... 20—11
186-4 .... 57—7
200, 201, 202, 203, 205, 205M .... 8—15
210, 211, 212.......... 51—8
218, 218 "H" ....121—5
219, 220, 221 .... 4—1
226 .... 91—5
230 (See Kaiser-Frazer 200001) 35
250 .... 4—13
254 .... 32—9
260 .... 15—13
280 .... 23—10
303 .... 18—19
304 .... 32—10
321 .... 3—26
324 .... 64—7
326, 327 .... 30—11
328 (See Model 324)..... 64
329, 330 (See Model 324) 64
354, 355 .... 33—9
356, 357, 358 .... 37—6
376, 377, 378 .... 45—11
400, 401 ....118—8
404, 405 ....121—6
408 ....116—6
410 (See Model 404) 121
411 (See Model 400)....118
417 .... 16—15
500, 501 (See Model 64).. 98
502 .... 35—9
505, 506, 507, 508, 509 (See Model 64)......... 98
510, 511 ....120—7
510F, 511F, 512F, 513F..143—7
515F, 516F, 517F, 518F (See Model 510F).....143
521, 522 ....114—5
521F, 522F (See Model 510F).....143
530 (See Model 64)...... 98
600 ....109—6
601, 603, 604..........115—3
605, 606 ....145—6
650 ....101—3
752, 753 ....123—5
755 ....130—6
757 (See Model 755)....130
800A, B, C, D Tel. Rec. (See Model 805)...... 78
801 Tel. Rec. (Photofact Servicer) .. 78
802 Tel. Rec............ 91A-7
803 Tel. Rec............ 97A-4
805, 806, 807, 809 Series Tel. Rec........ 78—7
810 Tel. Receiver........ 53—12
811 Tel. Receiver........ 63—9
814 Tel. Rec............ 69—9
815 Tel. Rec............ 97A-5
817 Tel. Rec. (See Model 805)...... 78
818 Tel. Rec............ 95A-7
820 Tel. Rec............ *
821 Tel. Rec. (See Model 805)...... 78

GENERAL ELECTRIC—Cont.
830 Early, Tel. Rec. .... 81—9
835 Early, Tel. Rec. (See Model 830 Early) .. 81
840 Tel. Rec. (See Model 830 Early) .. 81
901 Tel. Rec. 97A-5
910 Tel. Rec. (See Model 901) 97A

GENERAL IMPLEMENT
9A5 .... 37—7

GENERAL MOTORS CORP. (GMC)
2233029 .... 93—6

GENERAL TELEVISION
1A5, 2A5, 3A5, 5A5 (Ch. 1-1) .... 1—21
4B5 .... 27—11
5B5G, 5B5Y .... 27—12
9A5 .... 39—6
9B6P .... 36—10
14A4F .... 3—21
15A5 (Ch. 1-1) (See Models 1A5, 2A5, 3A5, 5A5) 1
17A5 .... 5—22
19A5 (Ch. 1-1) (See Models 1A5, 2A5, 3A5, 5A5) 1
21A4 .... 12—14
22A5C .... 13—19
23A6 .... 14—14
24B6 .... 37—8
25B5 .... 26—15
26B5 .... 29—11
27C5 .... 36—11

GILFILLAN
56A, 56B .... 1—27
56BC1, 56BCR, 56C, 56D, 56E (See Model 56A) .. 1
58M, 58W .... 45—12
66A, 66AM .... 8—16
66B "The Overland" ... 8—17
66D, 66DM (See Model 66A) 8
66P, 66PM "The El Dorado" .... 9—15
68B-D .... 46—10
68F .... 46—11
68-48 .... 61—10
86C, 86P, 86U (86 Series) 26—16
108-48 .... 59—10

GLOBE
5BP1 .... 18—20
6AP1 (See Model 6P1) ... 20
6D1 .... 20—13
6P1 .... 20—12
6U1 (See Model 6D1) 20
7CP-1 .... 28—14
51 .... 19—18
62C .... 19—19
85 .... 49—9
454 .... 41—9
456 .... 40—7
457 .... 39—7
500 .... 21—18
517 .... 21—17
551 .... 16—16
552 .... 27—13
553 .... 28—15
559 .... 50—8

GODFREY
6AD .... 28—16
6SM .... 28—17

GON-SET
3-30 Meter Converter .... 61—11
10-11 Meter Converter ... 37—9

B. F. GOODRICH (See Mantola)

GOODELL
ATB-3 .... 70—5
NSA-20 .... 73—6

W. T. GRANT (See Grantline)

GRANTLINE
300 (Series B) .... 9—16
500, 501 (Series A) ..... 9—17
501-7 .... 35—10
504-7 .... 21—19
508-7 .... 34—8
510-A .... 24—19
605, 606 .... 2—17
641 .... 12—15
651 .... 11—9
5610 .... 35—11
6547 .... 11—10

HALLICRAFTERS (Also See Echophone)
CA-2, CA-2A .... 30—12
CA-4 .... 36—13
S-38 .... 3—7
S-38B .... 121—7
S-40 .... 2—19
S-40A .... 33—10
S-40B .... 122—4
S-41G, S-41W .... 10—19
S-47 .... 46—12
S-51 .... 40—8
S-52 .... 48—9
S-53 .... 39—8
S-55, S-56 .... 55—9
S-58 .... 57—8
S-59 .... 58—10
S-72 .... 82—6
S-76, S-76U .... 143—9
S-77 .... 146—7
S78 .... 124—5
ST-74 .... 125—8
SX-42 .... 44—6
SX-43 .... 45—13
SX-62 .... 61—12
SX-71 .... 111—6
T-54 Tel. Receiver ...... 48—10
T-54 (Late) Tel. Rec. ..... 91—6
T-60 Tel. Receiver ...... 63—10
T-61, T-64, T-67 Tel. Rec. 65—7
T-68 (Tel. Rec.) (See Model T-60) 63

HALLICRAFTERS—Cont.
T-69 Tel. Rec. .... *
5R10 .... 130—7
5R11, 5R12, 5R13, 5R14 .. 129—7
400, 406, 409, 410, 411, 412 .... 52—9
505, 506 Tel. Rec. (See Model T-54) 48
505, 506 (Late) (See Model T-54 Late) 91
509, 510 Tel. Rec. (See Model T61) ...... 65—7
511 Tel. Rec. .... 96—5
512C, 513 Tel. Rec. ...... 80—7
514 Tel. Rec. (See Model T-54 Late) 91
515 Tel. Rec. (See Model 512C) 80
518, 519, 520 Tel. Rec. ... 92—3
520E Tel. Rec. (See Model 512C) 80
521 Tel. Rec. (See Model 518) 92
521E Tel. Rec. (See Model 512C) 80
524 Tel. Rec. (See Model 512C) 80
600, 601, 602, 603, 604 Tel. Rec. (See Model 518) 92
605, 606 Tel. Rec. .... 107—5
680, 681 Tel. Rec. .... 113—3
690 Tel. Rec. (See Model 680) 113
715 Tel. Rec. (See Model 680) 113
730, 731 (Run 1) Tel. Rec. (See Model 680) ...... 113—3
732, 733 Tel. Rec. .... *
740, 741 (Run 1) Tel. Rec. (See Model 680) ...... 113—3
745 Tel. Rec. .... 105—4
750, 751, Tel. Rec. (See Model 745) 105
760, 761 Tel. Rec. (See Model 745) 105
805, 806 Tel. Rec. .... 136—9
810 Tel. Rec. (See Model 805) 136
810A, 811 Tel. Rec. ...... 124—6
810C Tel. Rec. (See Model 805) ..... 125—1A
815 Tel. Rec. (See Model 810A) 124
818, 820, 822 Tel. Rec. (See Model 810A) 124
832, 833 Tel. Rec. ...... 121—1A
860, 861 Tel. Rec. (See Model 810A) 124
870, 871 Tel. Rec. (See Model 810A) 124
880 Tel. Rec. (See Model 810A) 124
17804C Tel. Rec. .... *
17810C Tel. Rec. .... *
17811-H Tel. Rec. .... *
17812 Tel. Rec. .... *
17813 Tel. Rec. .... *
17814 Tel. Rec. .... *
17815-H Tel. Rec. .... *
17816 Tel. Rec. .... *
17817 Tel. Rec. .... *
17819 Tel. Rec. .... *
17824 Tel. Rec. .... *
17838 Tel. Rec. .... *
17848, 17849, 17850 Tel. Rec. .... *
17860-H, 17861-H Tel. Rec. .... *
20872 Tel. Rec. .... *
20882 Tel. Rec. .... *
20990, S Tel. Rec. .... *
20994 Tel. Rec. .... *

HAMILTON ELECTRONICS
H-15-S .... 16—17
H-50-2S .... 16—18

HAMILTON RADIO CORP. (See Olympic)

HAMMARLUND
HQ-129-X .... 8—18
SP-400-X .... 10—20

HARVEY-WELLS
AT-3B-6, AT-3B-12 ...... 32—11
ATR-3-6, ATR-3-12 ...... 36—14

HEATH
HBR-5 .... 24—20

HOFFMAN
A-200 (Ch. 103) .... 4—23
A-202 (Ch. 119) .... 11—11
A-300 .... 4—41
A-309 (Ch. 119) (See Model A-202) 11
A-401 (Ch. 102) .... 11—12
A-500 (Ch. 107) .... 4—34
A-501 (Ch. 108ST) ...... 3—35
A-700 (Ch. 110S) .... 12—16
B-400 .... 17—17
B-1000 .... 20—14
C-501 .... 48—11
C-502 .... 51—9
C-503 .... 50—9
C-504 (Ch. 123) .... 47—10
C-506, C-507 .... 49—10
C509, C510 .... *
C-511 (See Model C-501) 48
C-512 (See Model C-502) 51
C-513 (See Model C-503) 50
C-514 (See Model C-504) 47
C-518 .... 61—13
C710 (Ch. 133) .... *
C1006, C1007 .... 54—9
CT-800, CT-801, CT-900, CT-901 (Tel. Rec.) .... 63—11
522, 524 (Ch. 138) ...... *
600, 601 (Ch. 154, 155) Tel. Rec. 95A-8
610 (Ch. 140) Tel. Rec. ... 97A-6
612 (Ch. 142) Tel. Rec. (See Model 610) 97A
613 (Ch. 149) Tel. Rec. (See Model 610) 97A

HOFFMAN—Cont.
630, 631 (Ch. 159) Tel. Rec. .... *
630, 631 (Ch. 170) Tel. Rec. .... 117—1A
632, 633 (Ch. 160) Tel. Rec. .... *
632, 633 (Ch. 171) Tel. Rec. .... 117—1A
636, 637 (Ch. 183) Tel. Rec. .... 141—7
638, 639 (Ch. 180) Tel. Rec. .... 144—5
820, 821, 822 (Ch. 146) Tel. Rec. .... *
826, 827, 828 (Ch. 143) Tel. Rec. 95A-8
830, 831 (Ch. 151) Tel. Rec. 97A-6
832 (Ch. 151) Tel. Rec. (See Model 830) 97A
836, 837 (Ch. 153) Tel. Rec. 93A-8
840 (Ch. 153) Tel. Rec. (See Model 836) 93A
846 (Ch. 151) Tel. Rec. (See Model 830) 97A
847, 848, 849 (Ch. 156) Tel. Rec. 97A-7
860, 861, 862 (Ch. 157) Tel. Rec. (See Model 847) 97A
866, 867, 868 (Ch. 173) Tel. Rec. .... 117—1A
870, 871, 872 (Ch. 170) Tel. Rec. .... 117—1A
876, 877, 878 (Ch. 171) Tel. Rec. .... 117—1A
880, 881, 882, 883, 884, 885, 886, 887 (Ch. 183) Tel. Rec. (See Model 636) 141
890, 891, 892 (Ch. 175) Tel. Rec. .... 117—1A
893, 894, 895, 896, 897 (Ch. 185) Tel. Rec. (See Model 636) 141
912, 913 (Ch. 147) Tel. Rec. (See Model 826) .. 95A
914, 915 (Ch. 150) Tel. Rec. (See Model 610) ... 97A
917, 918 (Ch. 152) Tel. Rec. (See Model 830) ... 97A
920 (Ch. 152) Tel. Rec. (See Model 830) 97A
946, 947, 948 (Ch. 164) Tel. Rec. (See Model 847) 97A
950, 951, 952 (Ch. 172), 950A, 951A, 952A (Ch. 174) Tel. Rec. ... 127—6
953, 954, 955 (Ch. 184) Tel. Rec. (See Model 636) 141
960, 961, 962, (Ch. 176) Tel. Rec. (See Model 950) 127
963, 964, 965 (Ch. 186) Tel. Rec. (See Model 636) 141
Chassis 102 (See Model A401) 11
Chassis 103 (See Model A200) 4
Chassis 107 (See Model A500) 4
Chassis 108ST (See Model A501) 3
Chassis 110S (See Model A700) 12
Chassis 114 (See Model B1000) 20
Chassis 119 (See Model A202) 11
Chassis 123 (See Model C504) 47
Ch. 138 (See Models 912, 913) .... *
Ch. 140 (See Model 610) 97A
Ch. 142 (See Model 612) 97A
Ch. 143 (See Model 826) 95A
Ch. 146 (See Model 820) *
Ch. 147 (See Model 826) 95A
Ch. 149 (See Model 613) 97A
Ch. 150 (See Model 914) 97A
Ch. 151 (See Model 830) 97A
Ch. 152 (See Model 917) 97A
Ch. 153 (See Model 836) 93A
Ch. 154 (See Model 600) 95A
Ch. 155 (See Model 600) 95A
Ch. 156 (See Model 847) .. 97A
Ch. 157 (See Model 860) .. 97A
Ch. 164 (See Model 946) .. 97A
Ch. 170, 171 (See Model 630) ...... 117—1A
Ch. 172 (See Model 950) . 127
Ch. 173 (See Model 630) . 117—1A
Ch. 174 (See Model 950) . 127
Ch. 175 (See Model 630) . 117—1A
Ch. 176 (See Model 950) . 127

HOWARD
472AC, 472AF, 472C, 472F .... 31—14
474 .... 32—12
475TV Tel. Rec. Photofact Servicer 84
481B, 481C, 481M .... 67—11
482, 482A .... 48—12
901A-E, 901A-H, 901A-I, 901A-M, 901A-W (See 901A Series) 1
901A Series .... 1—8
901AP .... 10—21
902 .... *
906, 906C .... 17—18
909M .... 25—15
920 .... 5—7

HUDSON
DB47 (Fact. No. 6MH089) 25—16
DB48 (Fact. No. 6MH889) 39—9

HUDSON ELECTRONICS
30T14A-056 Tel. Rec. (Similar to Chassis) .... 119—3

HUDSON ELECTRONICS—Cont.
38T12A-058 Tel. Rec. (Similar to Chassis) .... 109—1
317T3 Tel. Rec. (Similar to Chassis) .... 72—4
318T4 Tel. Rec. (Similar to Chassis) .... 85—3
318T4S Tel. Rec. (Similar to Chassis) .... 85—3
318T4-872 Tel. Rec. (Similar to Chassis) .... 85—3
318T6A Tel. Rec. (Similar to Chassis) .... 85—3
318T6A-950 Tel. Rec. (Similar to Chassis) .... 85—3
318T9A-900 Tel. Rec. (Similar to Chassis) .... 78—4
332-H .... 123—6
347BL .... 121—8
350 .... 126—6
518T6A Tel. Rec. (Similar to Chassis) .... 85—3
518T9A-918 Tel. Rec. (Similar to Chassis) .... 78—4
518T10A-916 Tel. Rec. (Similar to Chassis) .... 78—4
2318T6A-954 Tel. Rec. (Similar to Chassis) .... 85—3
2318T9A-912 Tel. Rec. (Similar to Chassis) .... 78—4

INDUSTRIAL ELECTRONIC CORP. (See Simplon)

INDUSTRIAL TELEVISION (Also See Century)
IT-40R, IT-42R (Ch. IT-26R, IT-35R, IT-39R, IT-46R) Tel. Rec. 99A-7
IT-48R Tel. Rec. .... *

JACKSON
10C, 10T Tel. Rec. .... 132—8
12C, 12T Tel. Rec. (See Model 10C) 132
14C, 14T Tel. Rec. (See Model 10C) 132
16C, 16T Tel. Rec. (See Model 10C) 132
17XC, 17XT Tel. Rec. (See Model 10C) 132
20XC, 20XT Tel. Rec. (See Model 10C) 132
29C Tel. Rec. .... *
150 .... 130—8
153 (See Model 150) 130
312 Tel. Rec. (See Model 10C) 132
316 Tel. Rec. (See Model 10C) 132
350 .... 131—9
412 Tel. Rec. (See Model 10C) 132
416 Tel. Rec. (See Model 10C) 132
1400T Tel. Rec. (See Model 10C) 132
1700C, T Tel. Rec. (See Model 10C) 132
2000C Tel. Rec. (See Model 10C) 132
5000, 5050 Tel. Rec. ..... 88—5
5200, 5250 (See Model 5000) Tel. Rec. 88
5600, 5650 (See Model 5000) Tel. Rec. 88

JEFFERSON-TRAVIS
MR-2B .... 10—22
MR3 .... 17—19

JEWEL
300 .... 23—11
304 .... 35—12
500A, B, C; 501A, B, C; 502A, B, C; 503A, B, C; 504A, B, C; 505A, B, C 15—14
505 "Pin-Up" .... 18—21
801 (Trixie) .... 45—14
814 .... 51—10
910 .... 99—8
915 (See Model 910) 99
920 .... 55—10
935 (See Model 920) 55
949 .... 105—5
955 .... 98—5
956 .... 144—6
960 .... 97—8
985 (See Model 910) 99
5010 .... 111—7
5020 .... 136—10
5050 .... 128—7
5057U .... 109—7

KAISER-FRAZER
100170 .... 128—8
100205 .... 139—6
200001 .... 35—13
200002 .... 56—13

KAPPLER
102T .... 54—10

KARADIO
80-C .... 66—10
1275, 1275A .... 85—7
1276 .... 115—4

KAYE-HALBERT
014 (Ch. 253) Tel. Rec. ... 146—8
024 (Ch. 253) Tel. Rec. (See Model 014) 146
033, 034, 035, 036, 037 (Ch. 242) Tel. Rec. .... 139—7
044, 045, 046 (Ch. 253) Tel. Rec. (See Model 014) 146
074, 076, 077 (Ch. 253) Tel. Rec. (See Model 014) 146
231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241 (Ch. 231 or 242) Tel. Rec. (See Model 033) 139
424 (Ch. 253) Tel. Rec. (See Model 014) 146

KAYE-HALBERT—Cont.
714, 724 (Ch. 253) Tel. Rec. (See Model 014) .. 146
731, 733 (Ch. 231 or 242) Tel. Rec. (See Model 033) 139
734, 735, 736, 737 (Ch. 242) Tel. Rec. (See Model 033) 139
744, 745, 746 (Ch. 253) Tel. Rec. (See Model 014) 146
777 (Ch. 253) Tel. Rec. (See Model 014) 146
821-C, 821-T Tel. Rec. .... *
914 (Ch. 253) Tel. Rec. (See Model 014) 146
921-C, 921-T Tel. Rec. .... *
1621-C, 1621-T Tel. Rec. .. *
Ch. 231 (See Model 033) . 139
Ch. 242 (See Model 033) . 139
Ch. 253 (See Model 014) . 146

KAY MUSICAL INSTRUMENT CO.
77 .... 42—13

KITCHENAIRE
5 Tube Radio .... 6—14

KNIGHT
4D-450 .... 40—9
4G420 .... 88—6
5A150, 5A152, 5A154 ... 12—17
5A-190 .... 14—15
5B-160 .... 20—15
5B-175, 5B-176 .... 20—16
5B-185 .... 22—17
5C-290 .... 30—13
5D-250, 5D-251 .... 55—11
5D-455 .... 34—9
5E-250, 5E-251 (Similar to Chassis) .... 36—25
5E-457 (Similar to Chassis) 53—23
5F-525, 5F-526 .... 53—13
5F-565 .... 55—12
5G-563 (Similar to Chassis) 97—1
5H-570 .... 143—10
5H-571 (See Model 5H-570) 143
5H605 .... 131—10
5H-607, 5H-608 (Similar to Chassis) .... 97—15
5H-678, 5H-679 (Similar to Chassis) .... 109—7
5H-700 .... 123—7
6A-122 .... 9—18
6A-127 .... 9—19
6A-195 .... 16—19
6B-122 (See Model 6A-122) 9
6B-127 (See Model 6A-127) 9
6C-225, 6D-225, 6D-226 . 30—14
6D-235 .... 54—11
6D-360 .... 39—10
6G-400 (See Model 449). 83
6H580 .... 126—7
7B-220 .... 27—14
7D-405 .... 39—11
8B-210 .... 20—17
8D-340 .... 46—13
8G-200, 8G-201 .... 128—9
9V-101 Tel. Rec. .... 78—8
10B-249 .... 42—14
11C-300 .... 29—12
11D302 .... 57—9
14F490, 14F495, 14F496 . 63—12
15H609 (See Model 511B) 125
19F492, 19F497, 19F498. 58—11
93-017 .... 31—15
93-024 .... 32—13
93-103 .... 31—16
93-146 .... 36—15
93-155 .... 37—10
93-191 .... 38—8
93-320 .... 74—5
93-330 .... 99—9
93-350 .... 76—13
93-360 .... 79—9
93-370 .... 75—10
93-380 .... 90—8
96-326 .... 137—5
97-870 .... 78—9
449 .... 83—5
511B .... 125—9

LAFAYETTE
FA15W, FA15Y .... 15—15
J62, J62C .... 16—21
MC10B, MC10Y .... 14—16
MC11 .... 28—18
MC12 .... 27—15
MC13 .... 15—16
MC16 .... 27—16
IN434, IN435, IN436 (Similar to Chassis) .... 98—5
IN437 (Similar to Chassis) 121—2
IN549 (Similar to Chassis) 38—5
IN551 (Similar to Chassis) 38—6
IN554, IN555 (Similar to Chassis) .... 55—10
IN556, IN557 (Similar to Chassis) .... 109—7
IN559 (Similar to Chassis) 90—7
IN560 (Similar to Chassis) 109—7
IN561, IN562 (Similar to Chassis) .... 97—8
IN819 (Similar to Chassis) 69—7

LAMCO
1000 .... 16—20

LEARADIO
Chassis R-971 .... 51—11
RM-402C (Learavian) .... 42—15
561, 562, 563 .... 1—26
565, 565BL, 566, 567, 568 9—20
1281-PC (Ch. 78) .... 49—11
6610PC, 6611PC, 6612PC . 9—21
6614, 6615, 6616, 6619 .. 3—18
6617PC .... 16—22

LEE TONE
AP-100 .... 16—23

LEWYT
605 *
615A 11—13
711 42—16

LEXINGTON
6545 13—20

LIBERTY
A6K, A6P, 6K 20—18
507A 20—19

LINCOLN (Auto Radio)
7ML080 (5EH-18805-A), 7ML081 (5EH-18805-B). 66—11
8ML882 (8L-18805-A), 8ML882Z (8H-18805-A) (Ch. 8E82) 44—7
8ML985 (8L-18805-A), 8ML985E (8L-18805-B), 8ML985Z (8H-18805-A), 8ML985ZE (8H-18805) . 83—4

LINCOLN
S13L-B 2—10

LINCOLN (ALLIED RADIO CORP.)
5A-110 5—34

LINDEX CORP. (See Swank)

LIPAN (See Supreme)

LULLABY (See Mitchell)

LYMAN
CM10, CM20 44—8

LYRIC (Also See Rauland)
546T, 546TY, 546TW 7—17

MAGIC TONE
500, 501 5—40
504 (Bottle Receiver) 22—18
508 (Keg Radio) 38—9
510 52—10
900 (See Model 508) 38

MAGNAVOX
Chassis AMP-101A, AMP-101B 43—12
Chassis AMP-108A, AMP-108B 41—10
Chassis AMP-109 *
Chassis AMP-110 *
AMP-111A, B, C 68—10
Chassis AMP-116 *
Chassis CR-188 (155B Regency Symphony) 18—22
Chassis CR190A, CR190B. 46—14
Chassis CR-192A, CR-192B 41—11
Chassis CR-197C 37—11
Chassis CR-198A, B, C (Hepplewhite, Modern Symphony) 17—20
Chassis CR-199 63—13
Chassis CR-200A, B, C, D, E, F 44—9
Chassis CR-202 *
Chassis CR-203 *
Chassis CR-204 *
Chassis CR-206 *
Chassis CR-207A, B, C, D . 41—12
Chassis CR-208A, CR-208B 43—13
Chassis CR-209 *
Chassis Models CR-210A, CR-210B 52—11
Chassis CR-211A, B (See Ch. AMP-111A) 68
Chassis CR-213 *
Chassis CR-215 *
Chassis CR-216 *
Chassis CR-217 *
Chassis CR-223 *
Chassis CR-229 *
Chassis CT-214, CT-218, Tel. Rec. 62—13
Chassis CT-219, CT-220 Tel. Rec. 82—7
Chassis CT-221 Tel. Rec. (See Ch. CT-214) 62
Chassis CT-222 Tel. Rec. (See Ch. CT-219) 82
Chassis CT-224 Tel. Rec. 97A-8
Chassis CT-232 Tel. Rec. 93A-9
Chassis CT-235 Tel. Rec. (See Ch. CT-224) 97A
Chassis CT-236 Tel. Rec. (See Model CT-232) 93A
Chassis CT237, CT238 Tel. Rec. (Supp. to CT219 Set 82) 95A-9
Chassis CT239 Tel. Rec. (See Ch. CT232) 93A
Chassis CT244, CT245, CT246 Tel. Rec. (See Ch. CT232) 93A
Chassis CT247, CT248, CT249 Tel. Rec. *
Chassis CT250, CT251 Tel. Rec. 135-1A
Chassis CT252, CT253 Tel. Rec. 95A-9
Chassis CT255 Tel. Rec. *
Chassis CT257, CT258, CT259, CT260 Tel. Rec. 119-1A
Chassis CT262, CT263, CT264, CT265, CT266, CT267, CT269 Tel. Rec. 131-1A
Chassis CT270, CT271, CT272, CT273, CT274, CT275 Tel. Rec. *
Chassis CT283, CT284, CT285, CT286, CT287, CT288, CT289, CT290, CT291 Tel. Rec. (See Ch. CT262) 131-1A
Chassis CT293, CT294 Tel. Rec. (See Ch. CT262) 131-1A
Chassis CT295, CT296 Tel. Rec. *
Chassis CT297 Tel. Rec. (See Ch. CT262) 131-1A
Chassis CT301, CT303, CT305, CT307, CT309, CT311, CT313 Tel. Rec. *
Chassis MCT228 Tel. Rec. 95A-9

MAGUIRE
500BI, 500BW, 500DI, 500DW 6—15
561BI, 561BW, 561DI, 561DW 6—16
571 44—10
661, 661A 12—18
700A 7—18
700E 15—17

MAJESTIC
G-414 Tel. Rec. 133—8
G-614 Tel. Rec. (See Model G-414) 133
G-624 Tel. Rec. (See Model G-414) 133
G-914 Tel. Rec. (See Model G-414) 133
5A410 (Ch. 4501), 5A430 (Ch. 4504) 1—30
5A445, 5A445R 23—12
5AK711 27—17
5AK731, 5AK780, (Ch. 5B05A) 28—19
5LA5, 5LA6 130—9
5LA7, 5LA8 132—9
6FM714 (Ch. 6B02D) 50—10
6FM773 (Ch. 6B11D) 57—10
7BK758 (See Model 7JK777R) 27
7C432 (Ch. 4706), 7C447 (Ch. 4707) 14—17
7FM877, 7FM888 (Ch. 7C11D) 56—14
7JK777R (Ch. 4708R) 27—18
7JL866 (Ch. 7C25A) 60—14
7P420 (Ch. 4705) 26—17
7S433, 7S450, 7S470 (Ch. 4702, 4703) 22—19
7TV850, 7TV852 (Ch. 18C90, 18C91) Tel. Rec. *
7YR752 (Ch. 7B04A) 29—13
7YR753 (Ch. 7B09A-1), 7YR772 (Ch. 7B09A) 42—17
8FM744 (Ch. 8B06D) 30—15
8FM775 (Ch. 8B08D), 8FM776 (Ch. 8B07D) 29—14
8FM889 (Ch. 8C07D) 54—12
8JL885 (Ch. 4810B) 47—11
8S452, 8S473 (Ch. 4810) 8—19
10FM891 (See Model 10FM981) 65
10FM981 (Ch. 10C23E) 65—8
12C4, 12C5 Tel. Rec. 108—7
12FM475, 12FM778, 12FM779 (Ch. 41201) 28—20
12FM895 (Ch. 12C22E) 59—11
12T2, 12T3 Tel. Rec. (See Model 12C4) 108
14C4 Tel. Rec. (See Model 12T2) 108
14CT4 Tel. Rec. (See Model G-414) 133
14T2 Tel. Rec. (See Model 12T2) 108
16C4, 16C5 Tel. Rec. (See Model 12C4) 108
16CT4, 16CT5 Tel. Rec. (See Model G-414) 133
16K1 (94 Series) Tel. Rec. (See Model 12C4) 97A
16T2, 16T3 Tel. Rec. (See Model 12C4) 108
17DA (Ch. 101) Tel. Rec. 127—7
17FA Tel. Rec. 135—1A
17GA, 17HA (Ch. 101) Tel. Rec. (See Model 17DA) 127
17JA, 17X Tel. Rec. (See Model 17FA) 135—1A
19C6, 19C7 Tel. Rec. (See Model G-414) 133
20KA, 20LA Tel. Rec. (See Model 17FA) 135—1A
70, 72, 73 Tel. Rec. (See Model 17FA) 135—1A
80FMP2 137—6
120, 121, 121B (Ch. 99) Tel. Rec. (See Model 17DA) 127
141, 141B (Ch. 100), 141C (Ch. 101), 142, 142B (Ch. 100) Tel. Rec. (See Model 17DA) 127
160, 160B, 162, 163 (Ch. 101) Tel. Rec. (See Model 17DA) 127
170 (Ch. 101) Tel. Rec. (See Model 17DA) 127
700, 701 Tel. Rec. (See Model 17FA) 135—1A
712, 715 Tel. Rec. (See Model 17FA) 135—1A
800, 801, 802, 803, 804 Tel. Rec. (See Model 17FA) 135—1A
902, 903 (Ch. 103) Tel. Rec. (See Model 17DA) 127
910, 911 (Ch. 103) Tel. Rec. (See Model 17DA) 127
1042, G, GU, T, 1043, G, GU, T Tel. Rec. (See Model 12C4) 108
1142, 1143 Tel. Rec. (See Model 12C4) 108
1244, G, GU, T, TX, 1245, G, GU, T, TX Tel. Rec. (See Model 12C4) 108
1348 Tel. Rec. (See Model 12C4) 108
1400, 1400B (Ch. 100), 1401 (Ch. 105) Tel. Rec. (See Model 17DA) 127
1546, G, GU, T, 1547, G, GU, T, 1548, G, GU, T, 1549, G, GU, T Tel. Rec. (See Model 12C4). 108
1600, 1600B (Ch. 101) Tel. Rec. (See Model 17DA) 127

MAJESTIC—Cont.
1605, 1605B (Ch. 102) Tel. Rec. (See Model 17DA) 127
1610, 1610B (Ch. 102) Tel. Rec. (See Model 17DA) 127
1646, 1647, 1648, 1649 Tel. Rec. (See Model 12C4) 108
1671, 1672, 1673, 1674, 1675 Tel. Rec. (See Model G-414) 133
1710 (Ch. 101) Tel. Rec. (See Model 17DA) 127
1900 Tel. Rec. 95A-10
1974, 1975 Tel. Rec. (See Model G-414) 133
2042T, 2043T Tel. Rec. (See Model 12C4) 108
2546T, 2547T, 2548T, 2549T Tel. Rec. (See Model 12C4) 108
Ch. 5B01A (See Model 5AK711) 27
Ch. 5B05A (See Model 5AK731) 28
Ch. 6B02D (See Model 6FM714) 50
Ch. 6B11D (See Model 6FM773) 57
Ch. 7B04A (See Model 7YR752) 29
Ch. 7B09A (See Model 7YR772) 42
Ch. 7B09A1 (See Model 7YR753) 42
Ch. 7C11D (See Model 7FM887) 56
Ch. 7C25A (See Model 7JL866) 60
Ch. 8B06D (See Model 8FM744) 30
Ch. 8B07D (See Model 8FM776) 29
Ch. 8B08D (See Model 8FM775) 29
Ch. 8C07D (See Model 8FM889) 54
Ch. 10C23E (See Model 10FM981) 65
Ch. 12B26E (See Model 12FM475) 28
Ch. 12C22E (See Model 12FM895) 59
Ch. 18C90, 18C91 (See Model 7TV850) *
Ch. 4501 (See Model 5A410) 1
Ch. 4504 (See Model 5A430) 1
Ch. 4506 (See Model 5A445) 23
Ch. 4702, 4703 (See Model 7S433) 22
Ch. 4705 (See Model 7P420) 26
Ch. 4706 (See Model 7C432) 14
Ch. 4707 (See Model 7C447) 14
Ch. 4708R (See Model 7JK777R) 27
Ch. 4810 (See Model 8S452) 8
Ch. 4810B (See Model 8JL885) 47
Ch. 41201 (See Model 12FM475) 28

MANTOLA (B. F. Goodrich Co.)
R630-RP 3—22
R643-PM (See Model R643W) 4
R463W 4—29
R643-PM, R643W 4—29
R652, R652N 9—22
R654-PM, R654-PV 3—5
R655W (Ch. No. 501APH) 8—20
R662, R662N 3—33
R664-PM, R664-PV, R664-W 23—13
R-743-W (See Model R-643-W) 4
R-7543 18—23
R-75143 39—12
R-75152 38—10
R-75343 (See Model 75143) 39
R-76143 (See Model 24B6) 25
R-76162 40—10
R-76262 (Fact. No. 7160-17) 51—12
R-78162 43—11
11-701 *
24B6 25—17
92-520, 92-521, 92-522 68—11
92502 (See Model R643W) 4
92503, 92504 (See Models R654PM, PV) 3
92505, 92506 (See Models R664PM, PV, PW) 23
92516, 92517 *
92752 *

MARK SIMPSON (See Masco)

MASCO
IM-5 41—13
JMR 31—17
JM-5 (Master Station), JR (Sub-Station) 42—18
MA-5NO 45—15
MA-8N 119—8
MA-10HF 112—4
MA-10EX 113—4
MA-12HF 51—13
MA-17 14—32
MA-17N 50—11
MA-17P (See Model MA-17) 14
MA-17PN (See Model MA-17N) 50
MA-20HF 28—21
MA-25 16—24
MA-25EX 60—15

MASCO—Cont.
MA-25HF 54—13
MA-25N 43—14
MA-25NR 49—12
MA-25P (See Model MA-25) 16
MA-25PN (See Model MA-25N) 43
MA-35 21—20
MA-35N 44—11
MA-35RC (See Model MA-35) 21
MA-50 30—16
MA-50N (See Model MA-5N0) 45
MA-50NR 53—14
MA-60 119—9
MA-75 28—22
MA-75N 52—27
MA-121 24—21
MA-808 26—18
MAP-15 26—19
MAP-18 59—12
MAP-105 25—18
MAP-105N 52—12
MAP-120 21—21
MAP-120N 46—15
MB-50N 58—12
MB-60 127—8
MB-75 61—15
MC-10 47—12
MC-25, MC-25P 17—21
MC-25N, MC-25PC, MC-25PN, MC-25RC 57—11
MC-126, MC-126P 111—8
MHP-110 114—6
MHP-110X 115—5
Midgetalk 116—7
MPA-3, MPT-4 16—25
MCR-5 15—18
MU-5 117—6
RK-5 33—11
T-16 123—8
TD-16 120—8
TP-16A 30—17
76, 711 20—20
86, 811 20—21

MASON
45-1A 14—18
45-1B, 45-1P, 45-3, 45-4, 45-5 (See Model 45-1A) 14

MAYFAIR
510, 510W, 520, 520W, 530, 530W 25—20
550, 550W 24—22

McGRADE
M-100 16—27

MECK (Trail Blazer-Plymouth)
CD-500 (PX-5C5-EW-19) . 33—12
CE-500 (5C5-P12) 34—10
CM-500 (5D7-W18) 34—11
CR-500 38—11
CW-500 40—11
CX-500 48—13
DA601, DB6021 81—10
EC720 85—8
EF-730, EG-731 (Ch. 10003) 89—8
EV-760 104—7
MM510T, MM512T, MM516C, MM516T Tel. Rec. 110—9
MM614C, T (Ch. 9018) Tel. Rec. 117—8
MM614C, T Tel. Rec. Prod. Chge. Bul. 12 120—1
MM616C, T (Ch. 9018) Tel. Rec. (See Model MM614C) 117
MM616C, T Tel. Rec. Prod. Chge. Bul. 12 120—1
MM619C (Ch. 9018) Tel. Rec. (See Model MM614C) 117
MM619C Tel. Rec. Prod. Chge. Bul. 12 120—1
PM-5C5-DW10 2—4
PM-5C5-PW10 12—19
RC-5C5-P 1—9
RC-6A7-P6 31—19
SA-10, SA-20 101—4
XA-701 Tel. Rec. 61—16
XE-705 (See Model XA-701) 61
XF-777 Tel. Rec. 101—5
XL750 Tel. Rec. 76—14
XN-752 Tel. Rec. (See Model XF-777) 101
XOB Tel. Rec. (See Model MM510T) 110
XP-775, XQ-776, XQA-776 Tel. Rec. (See Model XF-777) 101
XQA, XQR Tel. Rec. (See Model MM510T) 110
XRA, XRPT Tel. Rec. (See Model MM510T) 110
XR-778, XS-786, XT-785 Tel. Rec. (See Model XF-777) 101
XSA Tel. Rec. (See Model MM510T) 110
XSB (Ch. 9018) Tel. Rec. (See Model MM614C) 117
XSB Tel. Rec. Prod. Chge. Bul. 12 120—1
XSC (Ch. 9018) Tel. Rec. (See Model MM614C) 117
XSD (Ch. 9018) Tel. Rec. (See Model MM614C) 117
XSPT Tel. Rec. (See Model MM510T) 110
XTA, XTR Tel. Rec. (See Model MM510T) 110
XX900 Tel. Rec. (See Model MM510T) 110
4B7 *
4C7 35—14
5A7-P11, 5A7-PB11 31—18
5D7/WL18 21—22
6A6-W4 16—26
514C, T (Ch. 9018) Tel. Rec. *

MECK—Cont.
616C, T (Ch. 9018) Tel. Rec. *
619C (Ch. 9018) Tel. Rec. *

MEDCO (See Telesonic)

MEISSNER
TV-1 (Ch. 24TV) Tel. Rec. 56—15
5A (See Maguire Model 571) 44
6H (See Maguire Model 661, 661A) 12
8C 37—12
9AJ 123—9
9-1065 3—15
9-1091A, 9-1091B 35—15
9-1091C 116—8
9-1093 55—13
16A 105—6
24TV Tel. Rec. (See Model TV1) 56
25TV Tel. Rec. *
574 (See Maguire Model 571) 44
661 (See Maguire Model 661) 12
2961 Series 27—19

MERCURY
6MM790 (See Ford Model 6MF780) 62
8MM890 (Ch. 8E90) (8M-18805-B) 49—13
8MM990 (8M-18805-B) 69—10
8MM991 (8M-18805-B), 8MM991-E (8M-18805) 83—4

MIDLAND
M6B 2—30

MIDWEST
P-6, PB-6 14—19
R-12, RG-12, RT-12 (Ch. RGL-12) 44—12
R-12, RG-12, RT-12 (Ch. RGT-12) 44—13
R-16, RG-16, RT-16 (Ch. RGT-16) 45—16
S8, ST-8, TM-8 (Ch. STM-8) 15—19
S-12, SG-12, ST-12 (Ch. SGT-12) 21—23
S-16, SG-16, ST-16 (Ch. SGT-16) 21—24
716, 716A (See Model S-16) 21

MINERVA
L-702 (See W-702B) 12
L-728, W-728 11—15
W-117, Tropic Master 6—17
W-117-3 11—14
W-702B 12—20
W710, W710A (W119) 5—25
W-728 (See Model L-728) 11
410, 411 41—14
702H, 702H-1 30—18
729 (Portapal) 23—14

MIRRORTONE (Also See Meck)
14MC, 14MT Tel. Rec. (Similar to Chassis) 117—8
16MC, 16MT, 16MXC, 16MXCS, 16MXT, 16MXTS Tel. Rec. (Similar to Chassis) 117—8
17MC, 17MT, 17MXC, 17MXCS, 17MXT, 17MXTS Tel. Rec. (Similar to Chassis) 117—8

MITCHELL
1250, 1251 55—14
1267 (See Model 1268R) 127
1268R 127—9

MOLDED INSULATION CO. (Also see Viz)
MR-6 (Wiretone) 41—15

MONITOR
M-403 (Fact. No. 470-2) . 22—20
M-500 (Fact. No. 475) 28—23
M-510 (Fact. No. 472) 23—15
M-3070 29—15
RA-50 24—23
TA56M, TW56M 6—18

MONTGOMERY WARD (See Airline)

MOPAR
602 (Colonial Model 671A) 19—20
603 65—9
604 106—9
606 133—9
802 (Philco C-4608) 18—24
802 (Philco C-4608) (Revised) 42—19
803 (Philco PD-4908) 66—12
804 67—12
805 71—11
806, 807 (See Model 803) 66
808 107—6
809 (See Model 805) 71
812, 813 139—8
814 137—7
815, 816, 817 (See Model 812) 139

MOTOROLA
AR-96-23 (M-5) 11—16
BKO-A (See Ch. 10A) 106
BK-6 (Buick) 10—23
BK8, BK8X (See Ch. 8A) 46
CR-6 (Chrysler) 20—24
CR-76 25—21
CT0 (See Model CT9) 82
CT1 (See Ch. 1A) 134
CT1M 143—11
CT-6 (Chevrolet) 8—21
CT8 (See Ch. 8A) 46
CT8-A (See Ch. 10A) 106
CT9 82—8
FD-6 (Ford) 7—20
FD7 (Ford) (See Model FD6) 7

MOTOROLA—Cont.
FD8 (See Ch. 8A) 46
GMOT (See Ch. 10A) 106
GM9T (See Ch. 8A) 46
GM9T-A (See Ch. 10A) 106
HNO (See Ch. 10A) 106
HN8, HN9 (See Ch. 8A) 46
1LOTC (See Ch. 10A) 106
KR1 (See Ch. 1A) 134
KR8, KR9 (See Ch. 8A) 46
KR9A (See Ch. 10A) 106
NH1C 139—9
NH6 (Nash) 9—24
NH8 (See Ch. 8A) 46
OEO (See Ch. 10A) 106
OE2 (See Ch. 8A) 46
OE6 (Oldsmobile) (See Model CT6) 8
OE8, OE9 (See Ch. 8A) 46
PCO (See Ch. 10A) 106
PC2 (See Ch. 8A) 46
PC6 (Pontiac) (See Model CT6) 8
PC8, PC9 (See Ch. 8A) 46
PC9-A (See Ch. 10A) 106
SROB (Ch. OB) 105—7
SR1B (See Ch. 1B) 136
SR6, SR8, SR9 (See Ch. 8A) 46
SR9A (See Ch. 10A) 106
VF102, A, C Tel. Rec. (See Model VK101) 51
VF103, VF103M (Ch. TS-8) Tel. Rec. 73—8
VK101, M Tel. Rec. 51—14
VK106 (Ch. TS-9D) Tel. Rec. Photofact Servicer. 82
VK106, VK106B, VK106M Tel. Rec. (See Model VT105) 67
VK106, VK107 (Ch. TS-9E, TS-9E1) Tel. Rec. 77—6
VT71 (Ch. TS-4B Thru J) Tel. Rec. 55—16
VT-73, VT-73A (Chassis TS-4J Late) Tel. Rec. 71—12
VT101 Television Receiver 51—14
VT105 (Ch. TS-9D) Tel. Rec. Photofact Servicer. 82
VT105, VT105M (Ch. TS-9, TS-9A, TS-9B, TS-9C) Tel. Rec. 67—13
VT107 (Ch. TS-9D) Tel. Rec. Photofact Servicer. 82
VT107, VT107M Tel. Rec. (See Model VT105) 67
VT121 (Ch. TS-15) Tel. Rec. 91A-9
WR6 (Ch. HS-18) 5—2
WR7, WR8 (See Model WR6) 5
5A1 (Ch. HS-6) 2—11
5A5 (Ch. HS-15) 3—11
5A7 (Ch. HS-62), 5A7A (Ch. HS-62A) 29—16
5C1 (Ch. HS-228) 116—9
5C2 (Ch. HS-258) (See Model 5C1) 116
5C3 (Ch. HS-262) (See Model 5C1) 116
5C4 (Ch. HS-270) (See Model 5C1) 116
5C5 (Ch. HS-271) (See Model 5C1) 116
5C6 (Ch. HS-272) (See Model 5C1) 116
5H11U, 5H12U, 5H13U (Ch. HS-244) 117—9
5J1 (Ch. HS-250), 5J1U (Ch. HS-224) 100—7
5J2 (Ch. HS-250), a 5J2U (Ch. HS-224) (See Model 5J1) 100
5L1 (Ch. HS-250), 5L1U (Ch. HS-224) (See Model 5J1) 100
5L2 (Ch. HS-250), 5L2U (Ch. HS-224) (See Model 5J1) 100
5M1, 5M1U, 5M2, 5M2U (Ch. HS-249, HS-223) 101—7
5R11A, 5R12A, 5R13A, 5R14A, 5R15A, 5R16A (Ch. HS-280) (See Model 5R11U) 115
5R11U, 5R12U, 5R13U, 5R14U, 5R15U, 5R16U (Ch. HS-242) 115—6
5X11U, 5X12U, 5X13U (Ch. HS-243) 114—7
5X21U, 5X22U, 5X23U (Ch. HS-259) 120—9
6F11, 6F11B (Ch. HS-264) 117—10
6L1, 6L2 (Ch. HS-226) 102—7
6X11U, 6X12U (Ch. HS-245) 112—5
7F11, 7F11B (Ch. HS-265) 113—5
7VT1, 7VT2, 7VT5 (Ch. TS-18) Tel. Rec. 83—6
8FDT, 8GMT (See Ch. 8A) 46
8FM21, 8FM21B (Ch. HS-247) 121—9
9FM21, 9FM21B (Ch. HS-246) 114—8
9T1 (Ch. TS-18, A) Tel. Rec. (See Model 7VT1) 83
9VT1, 9VT5 (Ch. TS-18) Tel. Rec. (See Model 7VT1) 83
10T2 (Ch. TS14, A, B) Tel. Rec. 92—4
10VK9 (Ch. TS-9E, TS-9E1) Tel. Rec. (See Models VK106 Ch. TS-9E) 77
10VK12 (Ch. TS14, A, B) Tel Rec. (See Model 10T2) 92
10VK22 (Ch. TS14, A, B) Tel. Rec. (See Model 10T2) 92
10VT3 (Ch. TS-9E, TS-9E1) Tel. Rec. (See Model VK106) 77

MOTOROLA—Cont.
10VT10 (Ch. TS14, A, B) Tel. Rec. (See Model 10T2) 92
10VT24 (Ch. TS14, A, B) Tel. Rec. (See Model 10T2) 92
12K1 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12K2 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12K2 (Ch. TS-53) Tel. Rec. 115—7
12T1 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12T3 (Ch. TS-53) Tel. Rec. (See Model 12K2) 115
12VF4R, 12VF26 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12VK11 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12VK15 (Ch. TS-30, A) Tel. Rec. 93—7
12VK15 (Ch. TS-30, A) Tel. Rec. Prod. Chge. Bul. 5 106—1
12VK18B, 12VK18R (Ch. TS-15C, TS-15C1) Tel. Rec. (See Model VK106 Ch. TS-9E) 77
12VT13 (Ch. TS-23, A, B) Tel. Rec. (See Model 10T2) 92
12VT16 12VT16B, 12VT16R (Ch. TS-15C, TS-15C1) (See Model VK106 Ch. TS-9E) Tel. Rec. 77
14K1, B (Ch. TS-88) Tel. Rec. 112—6
14K1BH, 14K1H (Ch. TS-115) Tel. Rec. 121—10
14T1, B (Ch. TS-88) Tel. Rec. (See Model 14K1) 112
14T3 (Ch. TS-114) Tel. Rec. (See Model 14K1BH) 121
16F1 (Ch. TS-60 & Radio Ch. HS-234) Tel. Rec. 102—3
16F1BH, 16F1H (Ch. TS-89 & Radio Ch. HS-234) Tel. Rec. (See Model 14K1BH) 121
16K2 (Ch. TS-52) Tel. Rec. 93A-10
16K2 (Ch. TS-74) Tel. Rec. (See Model 16F1) 102
16K2BH, 16K2H (Ch. TS-94) Tel. Rec. (See Model 14K1BH) 121
16T1 (Ch. TS-60) Tel. Rec. (See Model 16F1) 102
16T1BH, 16T1H (Ch. TS-89) Tel. Rec. (See Model 14K1BH) 121
16VF8 (Ch. TS-16, A) Tel. Rec. (See Model 12VK15) 93
16VF8, 16VK7 (Ch. TS-16, A) Tel. Rec. Prod. Chge. Bul. 5 106—1
16VK1 (Ch. TS-52) Tel. Rec. (See Model 16K2) 93A
16VK7 (Ch. TS-16, A) Tel. Rec. (See Model 12VK15) 93
17F1 (Ch. TS-118 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F1A (Ch. TS-89 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F1B (Ch. TS-118 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F1BA (Ch. TS-89 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F2W (Ch. TS-118 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F2WA (Ch. TS-89 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F3B (Ch. TS-118 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F3BA (Ch. TS-89 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F4 (Ch. TS-118 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F4A (Ch. TS-89 & Radio Ch. HS-253) Tel. Rec. (See Model 14K1BH) 121
17F5, 17F5B (Ch. TS-118 & Radio Ch. HS-261) Tel. Rec. (See Model 14K1BH) 121
17F5A, 17F5BA (Ch. TS-89 & Radio Ch. HS-261) Tel. Rec. (See Model 14K1BH) 121
17F6,B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17F6BC, C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17F7B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17F7BC (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121

MOTOROLA—Cont.
17F8 (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17F8C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17F9,B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17F9BC,C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17K1A, 17K1BA (Ch. TS-95) Tel. Rec. (See Model 14K1BH) 121
17K1BE, 17K1E (Ch. TS-172) Tel. Rec. (See Model 14K1BH) 121
17K2BE, 17K2E (Ch. TS-172) Tel. Rec. (See Model 14K1BH) 121
17K3, 17K3B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17K3A, 17K3BA (Ch. TS-89) Tel. Rec. (See Model 14K1BH) 121
17K4A (Ch. TS-95) Tel. Rec. (See Model 14K1BH) 121
17K4E (Ch. TS-172) Tel. Rec. (See Model 14K1BH) 121
17K5 (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17K5C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17K5E (Ch. TS-221) Tel. Rec. *
17K6 (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17K6C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17K7,B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17K7BC,C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17T1, 17T1B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17T1A, 17T1BA (Ch. TS-89) Tel. Rec. (See Model 14K1BH) 121
17T2A, 17T2BA (Ch. TS-89) Tel. Rec. (See Model 14K1BH) 121
17T2, 17T2B (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17T3 (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17T3A (Ch. TS-89) Tel. Rec. (See Model 14K1BH) 121
17T3G (Ch. TS-221) Tel. Rec. *
17T4 (Ch. TS-118) Tel. Rec. (See Model 14K1BH) 121
17T4C (Ch. TS-174) Tel. Rec. (See Model 14K1BH) 121
17T4E (Ch. TS-221) Tel. Rec. *
19F1, 19K1 (Ch. TS-67 and Radio Ch. HS-230) Tel. Rec. 111—9
19K2, 19K2B (Ch. TS-101) Tel. Rec. 122—5
19K2BE, 19K2E (Ch. TS-119) Tel. Rec. (See Model 19K2) 122
19K3, 19K4, 19K4B (Ch. TS-101) Tel. Rec. (See Model 19K2) 122
20F1, 20F1B (Ch. TS-119 & Radio Ch. HS-230) Tel. Rec. (See Model 19K2) 122
20F2,B (Ch. TS-119) Tel. Rec. (See Model 19K2) 122
20K1,B, 20K2 (Ch. TS-119) Tel. Rec. (See Model 19K2) 122
20T1,B (Ch. TS-119) Tel. Rec. (See Model 19K2) 122
45B12 (Ch. HS-8) 9—23
47B11 (Ch. HS-72) 29—17
48L11 (Ch. HS-113) 47—13
49L11Q, 49L13Q (Ch. HS-183) 77—7
51C1, 51C2, 51C3, 51C4 (Ch. HS-288) (See Model 5C1) 116
51L1U, 51L2U (Ch. HS-224) (See Model 5J1) 100
55F11 (Ch. HS-30) 4—14
55X11A, 55X12A, 55X13A 2—22
56X11 (Ch. HS-94) 28—24
57X11, 57X12 (Ch. HS-60) 28—25
58A11, 58A12 (Ch. HS-158) 52—13
58G11, 58G12 (Ch. HS-160) 64—8
58L11 (Ch. HS-114) 45—17
58R11, 58R12, 58R13, 58R14, 58R15, 58R16 (Ch. HS-116) 49—14
58R11A, 58R12A, 58R13A, 58R14A, 58R15A, 58R16A (Ch. HS-184) 69—11
58X11, 58X12 (Ch. HS-125) 53—15
59F11 (Ch. HS-188) 68—12

MOTOROLA—Cont.
59H11U, 59H12IU (Ch. HS-210) 97—9
59L11Q, 59L12Q, 59L14Q (Ch. HS-187) 78—10
59R11, 59R12I, 59R13M, 59R14E, 59R15G, 59R16Y (Ch. HS-167) 79—10
59X11, 59X12I (Ch. HS-180) 81—11
59X21U, 59X22IU (Ch. HS-192) 98—6
61L1, 61L2 (Ch. HS-226) (See Model 6L1) 102
65F11 (Ch. HS-31) 6—19
65F12 (See Model 65F11) 6
65F21 (Ch. HS-26) 4—12
65L11, 65L12 (Ch. HS-7) 8—22
65T21, 65T21B (Ch. HS-32) 1—1
65X11A, 65X12A, 65X13A, 65X14A, 65X14B (Ch. HS-2) 4—8
67F11, 67F12, 67F12B, (Ch. HS-63) 31—20
67F14 (Ch. HS-122) 55—15
67F61BN (Ch. HS-69) 44—14
67L11 (Ch. HS-59) 31—21
67X11, 67X12, 67X13 (Ch. HS-58) 30—20
67XM21 (Ch. HS-64) 32—14
68F11, 68F12, 68F14, 68F14B, 68F14M 58—13
68L11 (Ch. HS-119) 45—18
68T11 (Ch. HS-144) 54—14
68X11, 68X12 (Ch. HS-127), 68X11A, 68X12A (Ch. HS-127A) 56—16
69L11 (Ch. HS-175) 76—15
69X11, 69X12I (Ch. HS-181) 82—9
75F21 (Ch. HS-91) 19—21
75F31 (Ch. HS-36), 75F31A, B (Ch. HS-36A), 76F31 (Ch. HS-98) 29—18
77FM21 (Ch. HS-89) 77FM22, 77FM22M, 77FM22WM, 77FM23 (Ch. HS-97) 33—13
77XM21, 77XM22, 77XM22B (Ch. HS-102) 34—12
78F11, 78F11M (Ch. HS-150), 78F12M (Ch. HS-155) 56—17
78FM21, 78FM21M (Ch. HS-132), 78FM22M (Ch. HS-128) 59—13
79FM21, 79FM21B, 79FM21R (Ch. HS-178) 88—7
79XM21, 79XM22 (Ch. HS-168) 85—9
85F21 (Ch. HS-22) 6—20
85K21 (Ch. HS-52) 5—3
88FM21 (Ch. HS-133) 54—15
91FM21 (Ch. HS-230A) (See Model 19F1) 111
95F31, 95F31B (Ch. HS-39) 95F33 (Ch. HS-38) 19—22
99FM21R (Ch. HS-170) 80—10
107F31, 107F31B, (Ch. HS-87) 33—14
309 63—14
400 99—10
401 131—12
405 (Ch. AS-13) 3—8
405M 21—25
408 38—12
409 (See Model 408) 38
500 98—7
501 133—10
505 (Ch. AS-14) 4—37
508 39—13
509 (See Model 508) 39
600 97—10
605 (Ch. AS-15) 5—1
608 39—14
609 (See Model 608) 39
700 100—8
701 137—8
705 (Ch. AS-16) 7—19
708 40—12
709 (See Model 708) 40
800 103—10
801 138—6
Ch. AS-13 (See Model 405) 3
Ch. AS-14 (See Model 505) 4
Ch. AS-15 (See Model 605) 5
Ch. AS-16 (See Model 705) 7
Ch. AS-22 (See Model BK-6) 10
Ch. HS-2 (See Model 65X11A) 4
Ch. HS-6 (See Model 5A1) 2
Ch. HS-7 (See Model 65L11) 8
Ch. HS-8 (See Model 45B12) 9
Ch. HS-15 (See Model 5A5) 3
Ch. HS-18 (See Model WR6) 5
Ch. HS-22 (See Model 85F21) 6
Ch. HS-26 (See Model 65F21) 4
Ch. HS-30 (See Model 55F11) 4
Ch. HS-31 (See Model 65F11) 6
Ch. HS-32 (See Model 65T21) 1
Ch. HS-36 (See Model 75F31) 29
Ch. HS-36A (See Model 75F31A) 29
Ch. HS-38 (See Model 95F33) 19
Ch. HS-39 (See Model 95F31) 19
Ch. HS-50 (See Model 55X11A) 2
Ch. HS-52 (See Model 85K21) 5
Ch. HS-58 (See Model 67X11) 30

MOTOROLA—Cont.
Ch. HS-59 (See Model 67L11) 31
Ch. HS-60 (See Model 57X11) 28
Ch. HS-62 (See Model 5A7) 29
Ch. HS-62A (See Model 5A7A) 29
Ch. HS-63 (See Model 67F11) 31
Ch. HS-64 (See Model 67XM21) 33
Ch. HS-69 (See Model 67F61BN) 44
Ch. HS-72 (See Model 47B11) 29
Ch. HS-87 (See Model 107F31) 33
Ch. HS-89 (See Model 77FM21) 33
Ch. HS-91 (See Model 75F21) 19
Ch. HS-94 (See Model 56X11) 28
Ch. HS-97 (See Model 77FM22) 33
Ch. HS-98 (See Model 76F31) 29
Ch. HS-102 (See Model 77XM21) 34
Ch. HS-108 (See Model VK-101) 51
Ch. HS-113 (See Model 48L11) 47
Ch. HS-114 (See Model 58L11) 45
Ch. HS-116 (See Model 58R11) 49
Ch. HS-119 (See Model 68L11) 45
Ch. HS-122 (See Model 67F14) 55
Ch. HS-124 (See Model 68F11) 58
Ch. HS-125 (See Model 58X11) 53
Ch. HS-127 (See Model 68X11) 56
Ch. HS-127A (See Model 68X11A) 56
Ch. HS-128 (See Model 78FM22M) 59
Ch. HS-132 (See Model 78FM21) 59
Ch. HS-133 (See Model 88FM21) 54
Ch. HS-137 (See Model VK101) 51
Ch. HS-144 (See Model 68T11) 54
Ch. HS-150 (See Model 78F11) 56
Ch. HS-155 (See Model 78F12M) 56
Ch. HS-158 (See Model 58A11) 52
Ch. HS-160 (See Model 58G11) 64
Ch. HS-167 (See Model 59R11) 79
Ch. HS-168 (See Model 79XM21) 85
Ch. HS-170 (See Model 99FM21R) 80
Ch. HS-175 (See Model 69L11) 76
Ch. HS-178 (See Model 79FM21) 88
Ch. HS-180 (See Model 59X11) 81
Ch. HS-181 (See Model 69X11) 82
Ch. HS-183 (See Model 49L11Q) 77
Ch. HS-184 (See Model 58R11A) 69
Ch. HS-187 (See Model 59L11Q) 78
Ch. HS-188 (See Model 59F11) 68
Ch. HS-192 (See Model 59X21U) 98
Ch. HS-210 (See Model 59H11U) 97
Ch. HS-223 (See Model 5M1) 101
Ch. HS-224 (See Model 5J1) 100
Ch. HS-226 (See Model 6L1) 102
Ch. HS-228 (See Model 5C1) 116
HS-230 (See Model 19F1) 111
Ch. HS-234 (See Model 16F1) 102
Ch. HS-242 (See Model 5R11U) 115
Ch. HS-243 (See Model 5X11U) 114
Ch. HS-244 (See Model 5H11U) 117
Ch. HS-245 (See Model 6X11U) 112
Ch. HS-246 (See Model 9FM21) 114
Ch. HS-247 (See Model 8FM21) 121
Ch. HS-249 (See Model 5M1) 101
Ch. HS-250 (See Model 5J1) 100
Ch. HS-253 (See Model 17F1) 121
Ch. HS-258 (See Model 5C1) 116
Ch. HS-259 (See Model 5X21U) 120
Ch. HS-261 (See Model 17F5) 121
Ch. HS-262 (See Model 5C1) 116
Ch. HS-264 (See Model 6F11) 117
Ch. HS-265 (See Model 7F11) 113

MOTOROLA—Cont.
Ch. HS-270 (See Model 5C1) 116
Ch. HS-271, HS-272 (See Model 5C1) 116
Ch. M-5 (See Model AR96-23) 11
Ch. OB (See Model SROB) 105
Ch. TS-3 (See Model VK-101) 51
Ch. TS-4B Thru J (See Model VT-71) 55
Chassis TS-4J Late (See Model VT-73) 71
Ch. TS-5 (See Model VK101) 51
Ch. TS-7 (See Model VK101) 51
Chassis TS-8 (See Model VF103) 73
Ch. TS-9, TS-9A, TS-9B, TS-9C (See Model VT105) 67
Ch. TS-9D (See Model VT105) Photofact Servicer 82
Ch. TS-9D1 *
Ch. TS-9E, TS-9E1 (See Model VK106) 77
Ch. TS-14, A, B (See Model 10T2) 92
Ch. TS-15 (See Model VT121) 91A
Ch. TS-15A *
Ch. TS-15B *
Ch. TS-15C, TS-15C1 (See Model 12VK18B) 77
Ch. TS-16, A (See Model 12VK15) 93
Ch. TS-18, A (See Model 7VT1) 83
Ch. TS-23, A, B (See Model 10T2) 92
Ch. TS-30, A (See Model 12VK15) 93
Ch. TS-52 (See Model 16K2) 93A
Ch. TS-53 (See Model 12K2) 115
Ch. TS-60 (See Model 16F1) 102
Ch. TS-67 (See Model 19F1) 111
Ch. TS-74 (See Model 16F1) 102
Ch. TS-88 (See Model 14K1) 112
Ch. TS-89 (See Model 16F1BH) 121
Ch. TS-94 (See Model 16K2BH) 121
Ch. TS-95 (See Model 17K1A) 121
Ch. TS-101 (See Model 19K2) 122
Ch. TS-114 (See Model 14T3) 121
Ch. TS-115 (See Model 14K1BH) 121
Ch. TS-118 (See Model 14K1BH) 121
Ch. TS-119 (See Model 19K2) 122
Ch. TS-172 (See Model 14K1BH) 121
Ch. TS-174 (See Model 14K1BH) 121
Ch. 1A 134—8
Ch. 1B 136—11
Ch. 8A 46—16
Ch. 10A 106—10

MUNTZ
M30 (Ch. TV-16A1) Tel. Rec. 108—8
M31 (Ch. TV-16A2) Tel. Rec. (See Model M30) 108
M31 (Ch. TV17A2) Tel. Rec. 116—10
M31R (Ch. TV17A3) Tel. Rec. (See Model M31) 116
M31R, M32 (Ch. TV-16A3) Tel. Rec. (See Model M30) 108
M32 (Ch. TV17A2) Tel. Rec. (See Model M31) 116
M32, M32R (Ch. TV17A3) Tel. Rec. (See Model M31) 116
M33 (Ch. TV17A4) Tel. Rec. (See Model M31) 116
M34 (Ch. TV-17A4) Tel. Rec. (For Tel. Rec. Chassis See Model M31) 116
M41, M42 (Ch. TV17A3A) Tel. Rec. (See Model M31) 116
M46 (Ch. TV17A7) Tel. Rec. (See Model M31) 116
M49 (Ch. TV17A7) Tel. Rec. (See Model M31) 116
M-158 Tel. Rec. 97A-10
M-159 Tel. Rec. 97A-10
M-159A, B Tel. Rec. 97A-10
M-169 Tel. Rec. 96—6

MURPHY
112 2—15
113 2—2
122 (See Model 112) 2

MUSITRON
PT-10 15—20
PX 16—28
SRC-3 (See Model 101) 13
101 "Piccolo" 13—21
103 "Piccolo" 15—21
105 21—26
202 21—27

NASH
6MN082 9—25
Ch. 6C82 (See Model 6MN082) 9

NATIONAL CO.
HFS 62—14
HRO-7R, HRO-7T 50—12
HRO-50 112—7
NC-TV7, NC-TV7M, NC-TV7W Tel. Rec. 67—14
NC-TV-10C, T, W Tel. Rec. 94—5
NC-TV-10C, T, W Tel. Rec. Prod Chge. Bul. 1 103—19
NC-TV-12C, W Tel. Rec. (See Model NC-TV-10C) 94
NC-TV-12C, W Tel. Rec. Prod. Chge. Bul. 1 103—19
NC-TV-1001 Tel. Rec. (See Model NC-TV-10C) 94
NC-TV-1001 Tel. Rec. Prod. Chge. Bul. 1 103—19
NC-TV-1025 Tel. Rec. (See Model NC-TV-10C) 94
NC-TV-1025 Tel. Rec. Prod. Chge. Bul. 1 103—19
NC-TV-1201, NC-TV-1202 Tel. Rec. (See Model NC-TV-10C) 94
NC-TV-1201 Tel. Rec. Prod. Chge. Bul. 1 103—19
NC-TV-1225, NC-TV-1226 Tel. Rec. (See Model NC-TV-10C) 94
NC-TV-1225, NC-TV-1226 Tel. Rec. Prod. Chge. Bul. 1 103—19
NC-2-40DR, NC-2-40DT 41—16
NC-33 47—14
NC-46 9—26
NC-57 48—14
NC-108R, NC-108T 47—15
NC-125 139—10
NC-173R, NC-173T 40—13
NC-183R, NC-183T 49—15
SW-54 141—9
TV-1201 Tel. Rec. 119—10
TV-1226 Tel. Rec. (See Model TV-1201) 119
TV-1601 Tel. Rec. (See Model TV-1201) 119
TV-1625 Tel. Rec. (See Model TV-1201) 119
TV-1701, TV-1702 Tel. Rec. 145—7
TV-1725, TV-1727 Tel. Rec. (See Model TV-1701) 145
TV-1729, TV-1730, TV-1731, TV-1732 Tel. Rec. (See Model TV-1701) 145
TV-2029, TV-2030 Tel. Rec. (See Model TV-1701) 145

NATIONAL UNION
G-613 "Commuter" 19—23
G-619 11—35
571, 571A, 571B 17—22

NEWCOMB
H-10 14—20
H-14 15—22
KX-30 15—23

NIELSON
1018 Tel. Rec. *
1618 Tel. Rec. *

NOBLITT SPARKS (See Arvin)

NORELCO
PT200, PT300 Tel. Rec. *

OLDSMOBILE
982375 20—25
982376 *
982399 59—14
982420 57—12
982421 87—7
982454 60—16
982455 *
982544, 982573 96—7
982697, 982698 (See Model 982544) 96

OLYMPIC
DX-214, DX-215, DX-216 Tel. Rec. 106—11
DX-619, DX-620, DX-621, DX-622 Tel. Rec. (See Model DX-214) 106
DX-931, DX-932 Tel. Rec. (See Model DX-214) 106
DX-950 Tel. Rec. (See Model DX-214) 106
RTU-3H (Duplicator) 62—15
TV-104, TV-105 Tel. Rec. 67—15
TV-106, TV-107, TV-108 Tel. Rec. (See Model TV-104) 67
TV-922 Television Receiver 58—14
TV-922L Tel. Rec. (See Model TV-104) 67
TV928 Tel. Rec. (See Model TV922) 58
TV-944, TV-945, TV-946 Tel. Rec. (See Model TV-104) 67
TV-947 Tel. Rec. 85—10
TV-948 Tel. Rec. (See Model TV-104) 67
TV-949, TV-950 Tel. Rec. (See Model TV-947) 85
XL-210, XL-211 Tel. Rec. 109—8
XL-612, XL-613 Tel. Rec. (See Model XL-210) 109
6-501, 6-502, 6-502-P, 6-503 4—10
6-501V-U (See Model 6-501W-U) 3
6-501W-U, 6-502-U 3—20
6-504, 6-504L 3—25
6-601W, 6-601V, 6-602 8—24
6-604 Series 22—21

OLYMPIC—Cont.
6-604V-110, 6-604V-220, 6-604W-110, 6-604W-150, 6-604W-220 (See Model 6-604 Series) 22
6-606 4—36
6-606-A 11—17
6-606-U 11—18
6-617 4—7
6-617U (See Model 6-617) 4
7-421V, 7-421W, 7-421X 57—13
7-435V, 7-435W 34—13
7-526 30—21
7-532W, 7-532V 32—15
7-537 37—13
7-622, 7-638 34—14
7-724 29—19
7-728 (See Model 7-724) 29
7-925, 7-934, 7-936, 7-939 31—22
8-451 48—15
8-533V, 8-533W 57—14
8-618 35—16
8-925, 8-934, 8-936 45—19
752, 752U, 753, 753U, Tel. Rec. 126—8
754 Tel. Rec. (See Model 752) 126
755, 755U Tel. Rec. (See Model 752) 126
762 Tel. Rec. 139—11
764, 764U Tel. Rec. (See Model 752) 126
765 Tel. Rec. (See Model 752) 126
766 Tel. Rec. (See Model 752) 113
767 Tel. Rec. (See Model 752) 126
773 Tel. Rec. (See Model 752) 126
783 Tel. Rec. (See Model 762) 139
785 Tel. Rec. (See Model 762) 139
967, 968, 970 Tel. Rec. (See Model 762) 139

OPERADIO
1A30 34—15
1A35 33—15
1A45 48—16
1A65 52—14
1A70-A 47—16
1A140 46—17
4A25-E 101—8
4A30-A 102—9
4A35, 4A55 100—9
4A50-A, 4A51-A (See Model 4A30-A) 102
4M25C 99—11
11A55 113—6
530, 531, 1335 "Soundcaster" 37—14

ORTHOSONIC (See Electronic Labs.)

PACKARD
PA-382042 20—26
PA-393607 57—15
416394 145—8

PACKARD-BELL
C1362 12—21
C1461 12—22
5DA 16—29
5D8 44—15
5FP 1—29
100 53—16
261 21—28
471 30—22
551 2—7
551-D (See Model 551) 2
561 2—35
563 (See Model 561) 2
566 (See Model 551) 2
568 19—24
571 (See Model 572) 22
572 22—22
581 (See Model 5D8) 44
651 4—42
661 8—25
662 13—22
673A, 673B 46—18
682 54—16
771 44—16
861 17—23
872 31—23
880, 880A (See Model 673A) 46
881-A, 881-B 47—17
882 *
884, 892 74—6
1052, 1052A 8—26
1054B 13—23
1063 18—25
1091 Tel. Rec. *
1181, 1181A 75—12
1272 *
1273 46—19
1291TV Tel. Rec. *
1472 48—17
1751 *
2001TV, 2002TV Tel. Rec. 98—8
2091, 2092 Tel. Rec. *
2101, 2102 Tel. Rec. 123—10
2105, 2105A Tel. Rec. (See Model 2101) 123
2202, 2204 Tel. Rec. (See Model 2101) 123
2291TV, 2292TV, 2293TV, 2294TV, 2295TV, 2296TV Tel. Rec. 82—10
2297-TV De Luxe, 2297-TV Standard Tel. Rec. (See Model 2291-TV) 82
2298-TV Tel. Rec. (See Model 2291-TV) 82
2301-TV Tel. Rec. 126—9
2601-TV Tel. Rec. 122—6
2602 Tel. Rec. (See Model 2101) 123
2692-TV Tel. Rec. (See Model 2601-TV) 122

PACKARD-BELL—Cont.
2801-TV, 2801A-TV Tel. Rec. (See Model 2301-TV) 126
2803TV Tel. Rec. 129—8
2991TV Tel. Rec. 94—6
3191, 3192 Tel. Rec. *
3381 Tel. Rec. *
4580 Tel. Rec. *
4691TV Tel. Rec. *

PHILCO
C-4608 (See Mopar Model 802) 18
C-4608 (Revised) (See Mopar Model 802 Revised) 42
C-4908 (See Mopar Model 805) 71
CR-2 35—17
CR-4, CR-6 33—17
CR-8 38—13
CR-9 44—17
CR-12 39—16
CR-501 142—9
CR-503 128—10
CR-505 130—10
P-4635 (See Packard Model PA-382042) 20
P-4735 (See Packard Model PA-393607) 57
PD-4908 (See Mopar Model 803) 66
S-4624, S-4625 (See Studebaker Model S-4624) 21
S-4626, S-4627 (See Studebaker Model S-4626) 19
UN6-100 19—26
UN6-400 30—23
UN6-450 18—26
UN6-500 17—24
UN6-550 31—24
46-131 5—13
46-131 (Revised) 32—16
46-132 4—20
46-142 36—16
46-200 Series 1—24
46-200-I, 46-201, 46-202, 46-203 (See Model 46-200 Series) 1
46-250, 46-250-I, 46-251 2—12
46-350 10—24
46-420, 46-420-1 6—22
46-421, 46-421-I 5—12
46-427 2—25
46-480 19—25
46-1201 4—35
46-1201 (Revised) 29—21
46-1203 6—23
46-1209 13—24
46-1213 12—33
46-1226 15—24
47-204, 47-205 33—18
47-1227 25—22
47-1230 22—23
48-141, 48-145 25—23
48-150 34—16
48-200, 48-200-1 33—19
48-206 37—16
48-214 (See Model 48-200) 33
48-225, 48-230 37—15
48-250, 48-250-I 32—17
48-300 37—17
48-360 38—14
48-460, 48-460-I 34—17
48-461 38—15
48-464 26—20
48-472, 48-472-I 43—15
48-472 (Revised) 48—18
48-475 40—14
48-482 30—24
48-485 47—19
48-700 Tel. Rec. 68—13
48-1000 (Code 121) Tel. Rec. *
48-1000, 48-1000-5 (Code 122) Tel. Rec. 53—17
48-1000 (Code 125) Tel. Rec. *
48-1001, 48-1001-5 (Code 121 & 122) Tel. Rec. (See Model 48-1000 Code 122) 53
48-1050, 48-1050-5 (Code 122) Tel. Rec. (See Model 48-1000 Code 122) 53
48-1200 29—20
48-1201 31—25
48-1253 36—17
48-1256 34—18
48-1260 (See Model 48-1201) 31
48-1262 35—18
48-1263 32—18
48-1264 36—18
48-1266 39—15
48-1270 42—20
48-1274, 48-1276 41—17
48-1282, 48-1283 (See Model 48-1262) 35
48-1284 45—20
48-1286 51—15
48-1290 47—18
48-2500, 48-2500-5 Tel. Rec. (Codes 121 and 122) 89—10
49-101 87—8
49-500, 49-500-I 48—19
49-501, 49-501-I 56—18
49-503 52—15
49-504, 49-504-I 54—17
49-505 53—18
49-506 (See Model 49-500) 48
49-601 42—21
49-602 41—18
49-603 59—15
49-605, 49-607 58—15
49-900-E, 49-900-I 49—16
49-901 56—19
49-902 51—16
49-904 58—16
49-905 52—16
49-906 57—16
49-909 55—17
49-1002 (Code 121) Tel. Rec. 91A-10

PHILCO—Cont.
49-1040 (Code 121) Tel. Rec. (See Model 49-1002) 91A
49-1040 (Code 123) Tel. Rec. 92—5
49-1075 (Codes 121 and 122) Tel. Rec. 93A-11
49-1076 (Code 122) Tel. Rec. (See Model 49-1075) 93A
49-1076 (Code 123), 49-1077 (Code 122) Tel. Rec. (See Model 49-1040) 92
49-1100 (See Model 48-485) 47
49-1101 (See Model 49-909) 55
49-1150 (Codes 121 & 123) Tel. Rec. 70—6
49-1150 (Codes 122, 124) Tel. Rec. (See Model 49-1040) 92
49-1175 (Codes 121 & 123) Tel. Rec. (See Model 49-1150 Code 121) 70
49-1175 (Codes 122, 124) Tel. Rec. (See Model 49-1040) 92
49-1240 (Codes 121, 123) Tel. Rec. (See Model 49-1075) 93A
49-1240 (Code 124) Tel. Rec. (See Model 49-1040) 92
49-1275 (Code 121) Tel. Rec. (See Model 49-1075) 93A
49-1278 (Code 122) Tel. Rec. (See Model 49-1075) 93A
49-1278 (Code 123), 49-1279 (Code 122), 49-1280 (Code 121) Tel. Rec. (See Model 49-1040) 92
49-1401 45—21
49-1404 (See Model 49-1405) 54
49-1405 54—24
49-1450 (Codes 121A or B, 123A or B, 123T A or B) Tel. Rec. 77—8
49-1475 (Codes 121A or B, 123A or B, 123T A or B) (See Model 49-1450) 77
49-1480 (Codes 121A or B, 123A or B, 123T A or B) (See Model 49-1450) 77
49-1600 50—13
49-1601 (See Model 49-1600) 50
49-1602, 49-1603, 49-1604, 49-1605 55—18
49-1606, 49-1607 53—19
49-1609, 49-1611 (See Model 49-1606) 53
49-1613 91—9
49-1615 64—9
50-520, 50-520I 73—9
50-522, 50-522-I, 50-524 78—11
50-526 96—8
50-527, 50-527-I 80—11
50-620 85—11
50-621 89—11
50-920, 50-921, 50-922 88—8
50-925 (Code 123) 50-926 99—12
50-1420, 50-1421, 50-1422, 50-1423 97—11
50-1720 93—8
50-1721, 50-1723, 50-1724 98—9
50-1725 (See Model 50-1720) 93
50-1726 (See Model 49-1613) 91
50-1727 86—7
50-T701, 50-T702 (Code 122) Tel. Rec. 140—7
50-T1104 (Code 123) Tel. Rec. 114—9
50-T1105, 50-T1106 Tel. Rec. *
50-T1400, 50-T1401, 50-T1402 (Code 121) Tel. Rec. (See Model 50-T1104) 114
50-T1400 (Code 123) Tel. Rec. *
50-T1402 (Code 123) Tel. Rec. *
50-T1403 (Code 125), 50-T1404, 50-T1406 (Codes 123, 124, 125) Tel. Rec. 115—8
50-T1430 (Code 121) Tel. Rec. (See Model 50-T1104) 114
50-T1432 (Code 124) Tel. Rec. (See Model 50-T1403) 115
50-T1443 (Codes 122, 123) Tel. Rec. 94—7
50-T1476, 50-T1477, 50-T1478, 50-T1479 Tel. Rec. 128—11
50-T1481, 50-T1482 Tel. Rec. (See Model 50-T1476) 128
50T-1483 Tel. Rec. 93A—12
50-T1484 Tel. Rec. (See Model 50-T1476) 128
50-T1600 Tel. Rec. 91A-10
50-T1600 (Code 122) Tel. Rec. 110—10
50-T1606 (Code 131) Tel. Rec. (See 50-T1600 Code 121) 91A
50-T1630 Tel. Rec. 99A-8
50-T1632, 50-T1633 Tel. Rec. (See 50-T1600) 91A

PHILCO—Cont.

50-T1632, 50-T1633 (Code 122) Tel. Rec. (See Model 50T1600) 110
51-PT1207, 51-PT1208 Tel. Rec. ....136—12
51-PT1234 Tel. Rec. (See Model 51-PT1207) 136
51-PT1282 Tel. Rec. (See Model 51-PT1207) 136
51-T1443B,L,M,X,XL, (Code 121) Tel. Rec. ..125—10
51-TL443PL, 51-T1443PM, 51-T1443PW Tel. Rec. .123—11
51-T1601, T, 51-T1602 (Codes 121, 122) Tel. Rec. ....138—7
51-T1604 (Codes 121, 122) Tel. Rec. (See Model 50-T1600 Code 122)...110
51-T1604 (Codes 121, 125) Tel. Rec. Prod. Chge. Bul. 20 ....134—1
51-T1606 (Codes 121, 125) Tel. Rec. (See Model 50-T1600 Code 122)...110
51-T1606 (Codes 121, 122) Tel. Rec. Prod. Chge. Bul. 20 ....134—1
51-T1606 (Code 131) Tel. Rec. (See Model 50-T1600) 91A
51-T1606 (Code 132) Tel. Rec. .... *
51-T1607 (Codes 121, 122) Tel. Rec. (See Model 51-T1601) 138
51-T1634 (Codes 121, 122) Tel. Rec. (See Model 50-T1600 Code 122)...110
51-T1634 (Codes 121, 125) Tel. Rec. Prod. Chge. Bul. 20 ....134—1
51-T1634 (Codes 123, 124) Tel. Rec. (See Model 51-T1601) 138
51-T1800 (Code 121) Tel. Rec. .... *
51-T1800 (Code 122) Tel. Rec. .... *
51-T1830 (Code 121) Tel. Rec. .... *
51-T1832 (Code 121) Tel. Rec. .... *
51-T1833 (Code 121) Tel. Rec. ....135—10
51-T1834 (Code 121) Tel. Rec. .... *
51-T1835 (Code 121) Tel. Rec. (See Model 51-T1833)..135
51-T1836 (Code 123) Tel. Rec. .... *
51-T1838 (Code 124) Tel. Rec. (See Model 51-T1833)..135
51-T1870 (Code 121) Tel. Rec. (See Model 51-T1833)..135
51-T1871, 51-1872 (Codes 121, 122) Tel. Rec. (See Model 51-T1833)..135
51-T1872 (Code 121) Tel. Rec. .... *
51-T1872 (Code 122) Tel. Rec. .... *
51-T1874, (L), 51-T1875, 51-T1876 (Code 121) Tel. Rec. (See Model 51-T1833) 135
51-T1874 (Code 121) Tel. Rec. .... *
51-T1875 (Code 121) Tel. Rec. .... *
51-T1876 (Code 121) Tel. Rec. .... *
51-T2102 (Code 122) Tel. Rec. ....132—10
51-T2130 (Code 121) Tel. Rec. (See Model 51-T2102)...........132
51-T2132, 51-T2133 (Code 121) Tel. Rec. (See (Model 51-T2102).....132
51-T2134 (Code 124) Tel. Rec. (See Model 51-T2102)..132
51-T2136 (Code 124) Tel. Rec. (See Model 51-T2102)..132
51-T2138 (Code 124) Tel. Rec. (See Model 51-T2102)..132
51-T2170 (Code 121) Tel. Rec. (See Model 51-T2102)..132
51-T2175, 51-T2176 (Code 124) Tel. Rec. (See Model 51-T2102)..132
51-530 ....122—7
51-532 (See Model 51-530) 122
51-534 (See Model 51-530) 122
51-537, 51-5371 ....126—10
51-629 ....136—13
51-631 ....106—12
51-632 (See Model 51-629) 136
51-934 ....102—10
51-1330 ....130—11
51-1730, 51-1730 (L)....140—8
51-1731, 51-1732 ......124—7
51-1733, 51-1733 (L), 51-1734 ....137—9
52-T1810 (Code 122, 123) Tel. Rec. .... *
52-T1812 (Code 122, 123) Tel. Rec. .... *
52-T1840 (Code 122, 123) Tel. Rec. .... *
52-T1842 (Code 122, 123) Tel. Rec. .... *

PHILCO—Cont.

52-T1844 (Code 122, 123) Tel. Rec. .... *
52-T1882 (Code 122, 123) Tel. Rec. .... *
52-T2110 (Code 122) Tel. Rec. .... *
52-T2142 (Code 122) Tel. Rec. .... *

PHILHARMONIC

100C .... 38—16
100T .... 33—20
149-C, 249-C .... 55—19
349-C .... 58—17
6810, 8701, 8702, 8703, 8710, 8711, 8712 (Ch. RR14) .... 18—27
Ch. RR14 (See Model 6810) 18

PHILLIPS 66 (See Woolaroc)

3-62A (See Woolaroc Model 3-71A) 36
3-81A .... 48—20

PHILMORE

CP-731D Tel. Rec........132—11

PHONOLA

K-92, K-104 .... 51—17
K-105 .... 79—11
K-202, K-263 .... 55—20
TK-134 .... 83—8
TK-234 ....108—9

PILOT

T-411-U .... 15—25
T-500 Series .... 12—23
T510, T511 .... 5—24
T-521 .... 19—27
T-530 Series .... 12—24
T-601 "Pilotuner" ...... 28—26
T-700 .... *
T-741 .... 37—18
TV-37 Tel. Rec.......... 62—16
TV-40 Tel. Rec.......... *
TV125 Tel. Rec.......... *
TV-950 Tel. Rec......... *

PLYMOUTH (See Mopar)

PLYMOUTH (Interstate Stores)

250 Tel. Rec............ *
350 Tel. Rec............ *
750 Tel. Rec............ *
1010 .... 88—2
1020 .... 89—5

POLICALARM

PR-8 ....103—12
PR-31 ....105—8

PONTIAC

984170 .... 20—27
984171 .... 14—22
984172 .... *
984247 .... *
984248, 984249 .... *
984273 .... *
984296, 984570 .... 95—4

PORTO BARADIO (Also See Porto Products)

PA-510 (9008-A), PB-520 (9008-B) .... 33—16
PA-510, PB-520 (Revised). 48—21

PORTO PRODUCTS

SR-600 (Ch. 9040A "Smokerette") (See Porto Baradio Model PA-510) 33

PREMIER

15LW .... 6—24

PURE OIL (See Puritan)

PURITAN

501 (Ch. 5D15WG), 502 (Ch. 5D25WG) .... 4—5
501X (Ch. 5D15WG), 502X (Ch. 5D25WG) ... 4—26
503 .... 10—25
503W (See Model 503)... 10
504 (Ch. 6A35WG)...... 5—39
504W (See Model 504)... 5
506 (6D15SW), 507 (6D25SW) .... 3—10
506X, 507X (See Model 506) 3
508 (Code 7A35SW) ..... 4—31
509 .... 26—21
515 .... 25—24

RADIO APPARATUS CORP.

(See Policalarm)

RCA VICTOR

AAPU-1 .... *
A55 (Ch. RC-1087)......109—10
A-82 (Ch. RC1094)......137—10
A106 (Ch. RC-622)....... 97—12
A-108 (Ch. RC1096)......141—10
B1-A, B1-B, B1-C (Ch. KCS24-1, KRK1-1, KRS20-1, KRS21-1) Tel. Rec. .... *
B2-C, B2-F, B2-G, B2-H (Ch. KCS24-1, KRK1-1, KRS20-1, KRS21-1) Tel. Rec. .... *
B3-A, B3-B .... *
B4-A, B4-B, B4-C........ *
B5-A, B5-B .... *
B-411 (Ch. RC1098)......132—12
BX6 (Ch. RC-1082)......103—13
BX55 (Ch. RC-1088), BX57 (Ch. RC-1088A) ....102—11
MI-12224, MI-12224A ... 81—12
MI-12236, -A, -B, -C, MI-12237, -A, MI-12238, -A, MI-12239, -A .... 78—13
MI-12287, MI-12288 .... 89—12
MI-12289, MI-12290 .... 80—12
MI-12291, MI-12292, MI-12293, MI-12294 .. 86—8

RCA VICTOR—Cont.

MI-12295 (See Model MI-12287). 89
MI-12296, MI-12298 (See Model MI-12289). 80
MI-12299 (See Model MI-12287). 89
MI-13159 .... 10—26
MI-13167 .... 35—19
PPAU-1 .... *
RV151 (Ch. RK121C, RS-123D) .... 61—17
S1000 (Ch. KCS31-1, RC617B) Tel. Rec...... 91A-11
T100 (Ch. KCS-38) Tel. Rec. .... 93—9
T120, T121 (Ch. KCS 34C) Tel. Rec. (See Model T100) 93
T164 (Ch. KCS40) Tel. Rec. ....109—11
TA-128 (Ch. KCS42A), TA-129 (Ch. KCS41-1) Tel. Rec. ....110—11
TA169 (Ch. KCS43 & Radio Ch. RK135D) Tel. Rec. ....108—10
TC124, TC125, TC127 (Ch. KCS34, B) Tel. Rec. (See Model T100)...... 93
TC165, TC166, TC167, TC168 (Ch. KCS40A) Tel. Rec. (See Model T164)..........109
X551, X552 (Ch. 1089B, C) ....129—9
X711 (Ch. RC-1070A).....133—11
2T51 (Ch. KCS45) Tel. Rec. ....111—11
2T51 (Ch. KCS-45) Tel. Rec. Prod. Chge. Bul. 11.........118—1
2T60 (Ch. KCS-45A) Tel. Rec. Prod. Chge. Bul. 11.........118—1
2T60 (Ch. KCS45A) Tel. Rec. (See Model 2T51). 111
2T81 (Ch. KCS46 and Radio Ch. RC1090) Tel. Rec. (See Model 2T51 (Set 111) and Model 4T101 (Set 139)]
4T101 (Ch. KCS 61) Tel. Rec. ....139—12
4T141 (Ch. KCS62 and Radio Ch. RC1090) Tel. Rec. (See Model 4T101) 139
6T53 (Ch. KCS47AT, T) Tel. Rec. (See Model 6T54).....113
6T53 (Ch. KCS47AT, T) Tel. Rec. Prod. Chge. Bul. 12........120—1
6T54 (Ch. KCS47, A) Tel. Rec....113—7
6T54 (Ch. KCS47, A, AT, T) Tel. Rec. Prod. Chge. Bul. 12.........120—1
6T64, 6T65 (Ch. KCS47, A) Tel. Rec. (See Model 6T54).....113
6T64, 6T65 (Ch. KCS47, A, AT, T) Tel. Rec. Prod. Chge. Bul. 12...120—1
6T71 (Ch. KCS47, A) Tel. Rec. (See Model 6T54). 113
6T71 (Ch. KCS47, A, AT, T) Tel. Rec. Prod. Chge. Bul. 12........120—1
6T72 (Ch. KCS 40B) Tel. Rec. (See Model T164)..........109
6T74, 6T75, 6T76 (Ch. KCS47, A) Tel. Rec. (See Model 6T54).....113
6T74, 6T75, 6T76 (Ch. KCS47, A, AT, T) Tel. Rec. Prod. Chge. Bul. 12 ....120—1
6T84 (Ch. KCS48 and Radio Ch. RC1090 or RC1092) Tel. Rec. [See Model 6T54 (Set 113) and Model 4T101 (Set 139) or Model 9T57 (Set 122)]
6T86, 6T87 (Ch. KCS48 and Radio Ch. RC1090 or RC1092) Tel. Rec. [See Model 6T54 (Set 113) and Model 4T101 (Set 139) or Model 9T57 (Set 122)]
7T103, 7T104 (Ch. KCS47B, C) Tel. Rec...134—9
7T103B, 7T104B Tel. Rec. Prod. Chge. Bul. 26...146—1
7T112 (Ch. KCS47B, C) Tel. Rec. (See Model 7T103) 134
7T112B Tel. Rec. Prod. Chge. Bul. 26...146—1
7T122, 7T123, 7T124, 7T125 (Ch. KCS47B, C) Tel. Rec. (See Model 7T103) 134
7T122B, 7T123B, 7T125B Tel. Rec. Prod. Chge. Bul. 26...146—1
7T132 (Ch. KCS47D) Tel. Rec. ....143—12
7T143 (Ch. KCS48A) Tel. Rec. (See Model 7T103)....134
8B41 (Ch. RC-1069), 8B42 (Ch. RC-1069A), 8B43 (Ch. RC-1069B).. 76—16
8B46 (Ch. RC-1069C) (See Model 8B41)...... 76
8BX5 (Ch. RC-1059)...... 46—20
8BX6 (Ch. RC-1040C) .... 44—18
8BX54, 8BX55 (See Model 8BX5) 46
8BX65 (See Model 8BX6). 44

RCA VICTOR—Cont.

8F43 (Ch. RC-1037B)..... 97—13
8PCS41, 8PCS41B, 8PCS41C (Ch. KCS24B-1, KRK1A-1, KRK4, KRS20A-1, KRS20B-1, KRS21A-1, RS-123C) Tel. Rec. .... 90—9
8R71 (Ch. RC-1060), 8R72 (Ch. RC-1060A).. 53—20
8R74, 8R75, 8R76 (Ch. RC-1060, A) (See Model 8R71)..... 53
8T241, 8T243, 8T244 (Ch. KCS28) Tel. Rec... 74—8
8T270 (Ch. KCS29, KCS29A) Tel. Rec...... 85—13
8TC270, 8TC271 (Ch. KCS29, KCS29A) Tel. Rec. (See Model 8T270) 85
8TK29 (Ch. KCS32, KCS32A, KCS32B, KCS32C, RK135, RK135A) Tel. Rec....... 88—9
8TK320 (Ch. KCS33A-1) (Radio Ch. RK-135A-1) Tel. Rec. (See Model 8T270) 85
8TR29 (Ch. KCS32, KCS32A, KCS32B, KCS32C, RK135, RK135A) Tel. Rec. (See Model 8TK29).... 88
8TS30 Tel. Rec. (See Model 630TS) 54
8TV41 (Ch. KCS25D-1, KCS25E-2, RK117A, RS-123A) Tel. Rec...... *
8TV321, 8TV321B, 8TV323, 8TV323B (Ch. KCS30-1) (Radio Ch. RC616B, C, J, K) Tel. Rec. (See Model 8T241) 74
8V7 (Ch. RC-615) (See Model 77V1) 38
8V90 (Ch. RC-618, RC-618A), 8V91 (Ch. RC-616A, RC-616H) ... 56—20
8V111, 8V112 (Ch. RC-616) 58—18
8V151 (See Model RV151) 61
8X53 (Ch. RC-1064) ..... 39—17
8X71, 8X72 (RC-1070)... 63—15
8X521 (RC-1066), 8X522 (RC-1066A) .... 52—17
8X541, 8X542 (Ch. RC-1065, RC-1065A) 59—16
8X544. 8X545, 8X546, 8X547 (See Model 8X541) 59
8X681, 8X682 (Ch. RC-1061) .... 65—10
9BX5 (Ch. RC-1059B, C) (See Model 8BX5)..... 46
9BX56 (Ch. RC-1068).... 79—13
9EY31, 9EY32 .... 98—10
9PC41A, B, C (Ch. KCS24C-1, D, KRK-4, KRS20B-1, KRS21A-1, RS-123C) Tel. Rec. (See Model 8PCS41)... 90
9T57 (Ch. KCS49, A,AT,T) Tel. Rec. ....122—8
9T77 (Ch. KCS49, A, AT,T) Tel. Rec. (See Model 9T57) 122
9T79 (Ch. KCS49,A, AT,T) Tel. Rec. (See Model 9T57) 122
9T89 (Ch. KCS60, T) Tel. Rec. (See Model 9T57).122
9T105 (Ch. KCS49B, C) Tel. Rec. (See Model 7T103)....134
9T126 (Ch. KCS49B, C) Tel. Rec. (See Model 7T103)....134
9T128 (Ch. KCS49B, C) Tel. Rec. (See Model 7T103)....134
9T147 (Ch. KCS60A) Tel. Rec. (See Model 7T103)....134
9T240 (Ch. KCS28, A) Tel. Rec. (See Model 8T241) 74
9T246 (Ch. KCS28C) Tel. Rec. (See Model 8T241) 74
9T246 (Ch. KCS38) Tel. Rec. (See Model T100).. 93
9T256 (Ch. KCS38C) Tel. Rec. (See Model T100).. 93
9T270 (Ch. KCS29, KCS29C) Tel. Rec. (See Model 8T270).... 85
9TC240 (Ch. KCS28B) Tel. Rec. (See Model 8T241) 74
9TC245 (Ch. KCS34B) Tel. Rec. (See Model T100).. 93
9TC247 (Ch. KCS34, B) Tel. Rec. (See Model T100).. 93
9TC249 (Ch. KCS34, B) Tel. Rec. (See Model T100).. 93
9TC272, 9TC275 (Ch. KCS29, KCS29C) Tel. Rec. (See Model 8T270).... 85
9TW309 (Ch. KCS41-1, RK135C) Tel. Rec...... 95A-11
9TW333 (Ch. KCS30-1, Radio Ch. RC616N) Tel. Rec. (See Model 8T241). 74
9TW390 (Ch. KCS31-1, RC617A) Tel. Rec. (See Model S1000).... 91A
9W101, 9W102, 9W103 (Ch. RC-618B), 9W105 (Ch. RC-618C)....... 73—10
9W106 (Ch. RC-622) (See Model A106)...... 97
9X561 (Ch. RC-1079B), 9X562 (Ch. RC-1079C).101—9
9X571 (Ch. RC-1079), 9X572 (Ch. RC-1079A) 107—7
9X641 (Ch. RC-1080), 9X642 (Ch. RC-1080A). 87—9

RCA VICTOR—Cont.

9X651 (Ch. RC-1085), 9X652 (Ch. RC-1085A). 104—9
9Y7 (Ch. RC-1057B)..... 75—13
9Y51 (Ch. RC-1077)...... 98—11
9Y510 (Ch. RC1077A), 9Y511 (Ch. RC1077B)..131—13
45EY1 (Ch. RS-132F)....135—11
45-EY-3 ....126—11
45EY15 (Ch. RS-132H) (See Model 45EY1)....135
45-W-10 (Ch. RC1096A)..138—8
54B1, 54B1-N, 54B2, 54B3 (Ch. RC589) ..... 7—22
54B5 (Ch. RC1047) ..... 17—25
55AU (Ch. RC1017)...... 2—16
55U (See Model 55AU)... 2
55F (Ch. RC-1004E)...... 4—6
55FA (See Model 55F).... 4
56X, 56X2, 56X3 (Ch. RC-1011) .... 1—16
56X5 (See Model 56X10).. 1
56X10 (Ch. RC-1023B).... 1—12
58AV, 58V (Ch. RC-604) . 1—32
59AV1, 59V1 (Ch. RC-605) 6—25
63E (Ch. RS-127) .... 28—28
64F1, 64F2 (Ch. RC1037), 64F3 (Ch. RC1037A) ... 4—16
65BR9 (Ch. RC-1045) .... 23—16
65F (See Model 55F) 4
65AU (Ch. No. RC-1017A) 14—23
65U, 65U-1 (See Model 65AU) 14
65X1, 65X2 (Ch. RC-1034) 4—30
65X1, 65X2 (Ch. RC-1064) 31—26
65X8, 65X9 (See Model 65X1) 4
66BX (Ch. RC-1040, RC-1040A) .... 14—24
66E (Ch. RS-126) .... 17—26
66X1, 66X2, 66X3, 66X4.. 7—23
66X7, 66X8, 66X9 (See Model 66X1)..... 7
66X11 (Ch. RC-1046A), 66X12 (Ch. RC-1046), 66X13, 66X14, 66X15 (Ch. RC-1046B) .... 27—20
67V1, 67AV1 (Ch. RC-606) .... 9—27
68R1, 68R2, 68R3, 68R4 (Ch. RC-608) .... 23—17
75X11, 75X12 (Ch. RC-1050) .... 33—21
75X14, 75X15 (Ch. RC-1050) (See Model 75X11) 33
75X16, 75X17, 75X18, 75X19 (Ch. RC-1050B) (See Model 75X11).. 33
77U (Ch. RC-1057A) ..... 38—17
77V1 (Ch. RC-615) ...... 38—18
77V2 (Ch. RC-606-C) .... 39—18
610V1 (Ch. RC610C) 610V2 (Ch. RC610) .... 31—27
612V1, 612V2, 612V3 (Ch. RK-121, RS-123).. 17—27
612V4 (See Model 612V1) 17
621TS (Ch. KCS21-1) Tel. Rec. (Servicer).... 78
630TCS Tel. Rec. (See Model 630TS).... 54
630TS Tel. Rec.......... 54—18
641TV (Ch. KCS25A1-1, KCS25C-2, RK117A, RS-123A) Tel. Rec.... 91A-11
648PTK (Ch. KCS24-1, KRK1-1, KRS20-1, KRS21A-1, RK-121A, RS-123A) Tel. Rec. (See Model 8PCS41)... 90
648PV (Ch. KCS24A-1, KRK-1A, KRS20-1, KRS21A-1, RK-121A, RS-123B) Tel. Rec. (See Model 8PCS41)... 90
710V2 (Ch. RC-613A) .... 40—15
711V1 (See Model 711V2) 22
711V2, 711V3 (Ch. RK-117 & RS-123) ..... 22—24
721TCS (Ch. KCS26-1, 2) Tel. Rec. (See Model 730TV1) 70
730TV1 (Ch. KCS27, RC610A) Tel. Rec...... 70—7
730TV2 (Ch. KCS27, RC610B) Tel. Rec. (See Model 730TV1)... 70
741PCS (Ch. KCS24B-1, KRK1A-1, KRS20A-1, KRS21A-1, RS-123C) Tel. Rec. (See Model 8PCS41) 90
Ch. KCS-20A-1 (See Model 630TS)..... 54
Ch. KCS-20B-1 (See Model 630TCS:... 54
Ch. KCS-20J-1 (See Model 8TS30)...... 54
Ch. KCS21-1 (See Model 621TS)..... *
Ch. KCS24-1 (See Model 8PCS41)... 90
Ch. KCS24A-1 (See Model 8PCS41)... 90
Ch. KCS24B-1 (See Model 8PCS41)... 90
Ch. KCS24C-1 (See Model 8PCS41)... 90
Ch. KCS24D (See Model 8PCS41)... 90
Ch. KCS25A1-1 (See Model 641TV).... *
Ch. KCS25C-2 (See Model 641TV).... *
Ch. KCS25D-1 (See Model 8TV41).... *
Ch. KCS25E-2 (See Model 8TV41).... *
Ch. KCS26-1, KCS26-2 (See Model 721TCS).... *
Ch. KCS27 (See Model 730TV1)... 70
Ch. KCS28, A, B, C (See Model 8T241).... 74

RCA VICTOR—Cont.
Ch. KCS29, KCS29A (See Model 8T270) 85
Ch. KCS29C (See Model 8T270) 85
Ch. KCS30-1 (See Model 8T241).... 74
Ch. KCS31-1 (See Model S1000) 91A
Ch. KCS32, KCS32A, KCS32B, KCS32C (See Model 8TK29) 88
Ch. KCS33A-1 (See Model 8T270)..... 85
Ch. KCS34, B, C (See Model T100)...... 93
Ch. KCS-38, C (See Model T100)...... 93
Ch. KCS40, A, B (See Model T164)..........109
Ch. KCS41-1 (See Model TA-128)........110
Ch. KCS42A (See Model TA-128)........110
Ch. KCS43 (See Model TA169) 108
Ch. KCS45, A (See Model 2T51).....111
Ch. KCS47, A, AT, T (See Model 6T54).....113
Ch. KCS47B, C (See Model 7T103)....134
Ch. KCS47D (See Model 7T132)....143
Ch. KCS48 (See Model 2T81) .... *
Ch. KCS48A (See Model 7T143)....134
Ch. KCS49, A, AT, T (See Model 9T57) 122
Ch. KCS49B, C (See Model 9T105)....134
Ch. KCS60, T (See Model 9T89) 122
Ch. KCS60A (See Model 9T147)....134
Ch. KCS61 (See Model 4T101)....139
Ch. KCS62 (See Model 4T101)....139
Ch. KRK-1A (See Model 8PCS41)... 90
Ch. KRK1-1 (See Model 8PCS41)... 90
Ch. KRK1A-1 (See Model 8PCS41)... 90
Ch. KRK4 (See Model 8PCS41)... 90
Ch. KRS20-1 (See Model 8PCS41)... 90
Ch. KRS20A-1 (See Model 8PCS41)... 90
Ch. KRS20B-1 (See Model 8PCS41)... 90
Ch. KRS21A-1 (See Model 8PCS41)... 90
Ch. RC-589 (See Model 54B1)...... 7
Ch. RC-604 (See Model 58AV)..... 1
Ch. RC-605 (See Model 59AV1).... 6
Ch. RC-606 (See Model 67V1)..... 9
Ch. RC-606C (See Model 77V2)..... 39
Ch. RC-608 (See Model 68R1)...... 23
Ch. RC-610 (See Model 610V1).... 31
Ch. RC610A, RC610B (See Model 730TV1).... 70
Ch. RC610C (See Model 610V1).... 31
Ch. RC-613A (See Model 710V2).... 40
Ch. RC-615 (See Model 77V1)..... 38
Ch. RC-616 (See Model 8V111).... 58
Ch. RC-616A, RC-616H (See Model 8V91)..... 56
Ch. RC-616B, RC-616C (See Model 8T241).... 74
Ch. RC-616J, RC-616K (See Model 8T241).... 74
Ch. RC-616N (See Model 8T241).... 74
Ch. RC617A, B (See Model S1000).... 91A
Ch. RC-618, RC-618A (See Model 8V90)..... 56
Chassis RC-618 B, C (See Model 9W101)... 73
Ch. RC-622 (See Model A106)...... 97
Ch. RC-1004E (See Model 55F)...... 4
Ch. RC-1011 (See Model 56X)...... 1
Ch. RC-1017 (See Model 55AU)...... 2
Ch. RC-1017A (See Model 65AU)..... 14
Ch. RC-1023B (See Model 56X10).... 1
Ch. RC-1034 (See Model 65X1)..... 4
Ch. RC-1037, RC-1037A (See Model 64F1)...... 4
Ch. RC-1037B (See Model 8F43)...... 97
Ch. RC-1038, RC-1038A (See Model 66X1)...... 7
Ch. RC-1040, RC-1040A (See Model 66BX)..... 14
Ch. RC-1040C (See Model 8BX6)...... 44
Ch. RC-1045 (See Model 65BR9)..... 23
Ch. RC-1046, A, B (See Model 66X11).... 27
Ch. RC-1047 (See Model 54B5)..... 17

RCA VICTOR—Cont.
Ch. RC-1050, RC-1050B (See Model 75X11).... 33
Ch. RC-1057A (See Model 77U)...... 38
Chassis RC-1057B (See Model 9Y7) 75
Ch. RC-1059 (See Model 8BX5)..... 46
Ch. RC-1059B, RC-1059C (See Model 9BX5)..... 46
Ch. RC-1060 (See Model 8R71)..... 53
Ch. RC-1060A (See Model 8R72)..... 53
Ch. RC-1061 (See Model 8X61)..... 65
Ch. RC-1064 (See Model 8X53)..... 39
Ch. RC-1064 (See Model 65X1)..... 31
Ch. RC-1065, RC-1065A (See Model 8X541)..... 59
Ch. RC-1066 (See Model 8X521).... 52
Ch. RC-1066A (See Model 8X522).... 52
Ch. RC-1068 (See Model 9BX56).... 79
Ch. RC-1069A, B (See Model 8B41)..... 76
Ch. RC-1070 (See Model 8X71)..... 63
Ch. RC-1070A (See Model X711).....133
Ch. RC-1077 (See Model 9Y51)..... 98
Ch. RC1077A, B (See Model 9Y510)....131
Ch. RC-1079, A (See Model 9X571) 107
Ch. RC-1079B, RC-1079C (See Model 9X561)....101
Ch. RC-1082 (See Model BX6) 103
Ch. RC-1085, RC-1085A (See Model 9X651)....104
Ch. RC-1087 (See Model A55)......109
Ch. RC-1088, RC-1088A (See Model BX55).......102
Ch. RC1089B, C (See Model X551).....129
Ch. RC1090 (See Model 4T101)....139
Ch. RC-1092 (See Model 9T57 122
Ch. RC1094 (See Model A-82).....137
Ch. RC1096 (See Model A-108)....141
Ch. RC1096A (See Model 45-W-10)..138
Ch. RC1098 (See Model B411).....132
Ch. RC1098A (See Model B-411).....132
Ch. RK-117 (See Model 711V2).... 22
Ch. RK-117A (See Model 8TV41).... *
Ch. RK-121 (See Model 612V1).... 17
Ch. RK-121A (See Model 8PCS41).... 90
Ch. RK-121C (See Model RV151).... 61
Ch. RK-135, RK-135A (See Model 8TK29)..... 88
Ch. RK-135A-1 (See Model 8T270)..... 85
Ch. RK135C (See Model 9TW309).. 95A
Ch. RK135D (See Model TA169)........108
Ch. RS-123 (See Model 612V1).... 17
Ch. RS-123A, B, C (See Model 8PCS41).... 90
Ch. RS-123D (See Model RV151).... 61
Ch. RS-126 (See Model 66E)...... 17
Ch. RS-127 (See Model 63E)...... 28
Ch. RS-132F, H (See Model 45EY1)....135

RME
DB-22A .... 50—14
HF10-20 .... 49—17
VHF 2-11 .... 79—14
VHF-152A .... 51—18
45 .... 13—25
84 .... 14—13

RADIOLA
61-1, 61-2, 61-3 (Ch. RC-1011) .... 14—25
61-5 (Ch. RC-1023) 61-10 (Ch. RC-1023B) .. 12—25
61-8, 61-9 (Ch. RC-1034) 27—21
62-2 (See RCA Model 65U-1) 14
75ZU (Ch. RC-1063A) .... 36—19
76ZX11, 76ZX12 (Ch. RC-1058, RC-1058A) ... 36—20
Ch. RC-1011 (See Model 61-1)...... 14
Ch. RC-1023, RC-1023B (See Model 61-5)...... 12
Ch. RC-1034 (See Model 61-8)...... 27
Ch. RC-1058, RC-1058A (See Model 76ZX11)... 36
Ch. RC-1063A (See Model 75ZU)..... 36

RADIO CRAFTSMAN
RC-1 (Tuner), RC-2 (Audio Amp.) .... 39—19
"Kitchenaire" .... 6—14
RC-8 .... 66—13
RC-10 ....110—12
RC100 Tel. Rec.......... 96—9
RC-100A Tel. Rec........117—11

RADIO CRAFTSMAN—Cont.
RC101 Tel. Rec.........142—10
RC200 Tel. Rec.........140—9
RC201 Tel. Rec.......... *

RADIO DEVELOPMENT & RESEARCH CO.
(See Magic-Tone)

RADIOETTE
PR-2 .... 50—15

RADIONIC (See Chancellor)
Y62W, Y728 .... 26—22

RANGER
118 .... 28—27

RADIO MFG. ENGINEERS
(See RME)

RADIO WIRE TELEVISION
(See Lafayette)

RAULAND
BA21 .... 87—10
W-819-A .... 43—16
1814 .... 99—13
1820 ....100—10
1821, 1822 .... 59—17
1825 .... 97—14
1835 .... 60—17
1841 .... 58—19
1904 ....140—10
2100-5 (Sub-station) (See Model 2101-A).... 39
2101-A (Master Station)... 39—20
2105 (Master Station)... 36—21
2206, 2206H. 2212, 2212H, 2218, 2218H, 2224, 2224H .... 80—13
2306, 2312, 2324 (See Model BA21)..... 87
2400 Series .... 33—22

RAY ENERGY
AD .... 7—24
AD4 .... 7—25
SRB-1X .... 13—26

RAYTHEON (Also See Belmont)
A-7DX22P Tel. Rec. (See Model 7DX21).... 81
Models A-10DX24, B-10DX22 Tel. Rec..... 75—14
A-10DX24, B-10DX22 Tel. Rec. Prod. Chge. Bul. 1 ....103—19
C1102 (Ch. 12AX22) Tel. Rec. .... 94—8
C1102, C1104 (Ch. 12AX 22) Tel. Rec. Prod. Chge. Bul. 3.........105—1
C1104 (Ch. 12AX22) Tel. Rec. (See Model C1102) 94
C-1104B (Ch. 12AX26, 12AX27) Tel. Rec......141—11
C-1401 (Ch. 14AX21) Tel. Rec. ....123—12
C1602, A, B, C (Ch. 16AX23, 25, 26) Tel. Rec. .... 99—14
C-1602 (Ch. 16AX22, 16AX25, 16AX26), C1602 Series 2 (Ch. 16AX29) Tel. Rec. Prod. Chge. Bul. 16 ...126—1
C-1614A (Ch. 16AY211) Tel Rec. (See Model C-1615A) 124
C-1614B (Ch. 16AY28) Tel. Rec. (See Model C-1615A).......124
C-1615A (Ch. 16AY211), C-1615B (Ch. 16AY28) Tel. Rec. ....124—8
C-1616A (Ch. 16AY211), C-1616B (Ch. 16AY28) Tel. Rec. (See Model C-1615A) 124
C-1714B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
C-1715A (Ch. 17AY24), C-1715B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
C-1716A (Ch. 17AY24), C-1716B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
C-1718A, C-1719A (Ch. 17AY24) Tel. Rec. (See Model C-1615A) .124
C-1724A (Ch. 17AY21) Tel. Rec. (See Model C-1615A).......124
C-2001A, C-2002A (Ch. 20AY21) Tel. Rec......139–1A
C-2006A (Ch. 20AY21) Tel. Rec. (See Model C-2001A)..139–1A
M701 (Ch. 10AX22) Tel. Rec. (See Model C1102) 94
M701 (Ch. 10AX22) Tel. Rec. Prod. Chge. Bul 3 105—1
M1101 (Ch. 12AX22) Tel. Rec. (See Model C1102) 94
M1101, M1103, M1105 (Ch. 12AX22) Tel. Rec. Prod. Chge. Bul. 3....105—1
M1103 (Ch. 12AX22) Tel. Rec. (See Model C1102) 94
M1105 (Ch. 12AX22) Tel. Rec. (See Model C1102) 94
M1105B, M-1106, M-1107 (Ch. 12AX26, 12AX27) Tel. Rec. (See Model C-1104B)..141
M-1402, M-1403, M-1404 (Ch. 14AX21) Tel. Rec. (See Model C-1401) ..123
M-1601 (Ch. 16AX23, 25, 26) Tel. Rec. (See Model C1602)..... 99

RAYTHEON—Cont.
M-1611A (Ch. 16AY211), M-1611B (Ch. 16AY28) Tel. Rec. (See Model C-1615A) 124
M-1612A (Ch. 16AY211), M-1612B (Ch. 16AY28) Tel. Rec. (See Model C-1615A) 124
M-1613A (Ch. 16AY211), M-1613B (Ch. 16AY28) Tel. Rec. (See Model C-1615A) 124
M-1711A (Ch. 17AY24), M-1711B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
M-1712A (Ch. 17AY24), M-1712B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
M-1713A (Ch. 17AY24), M-1713B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
M-1714A (Ch. 17AY24) Tel. Rec. (See Model C-1615A) 124
P-301 (See Model 7DX21) Tel. Rec. 81
RC-1405 (Ch. 14AX21) (See Model C-1401)....123
RC-1618A (Ch. 16AY211), RC-1618B (Ch. 16AY24) Tel. Rec. (See Model C-1615A) 124
RC-1619A (Ch. 16AY211), RC-1619B (Ch. 16AY28) Tel. Rec. (See Model C-1615A) 124
RC-1718B, RC-1719B (Ch. 17AY21) Tel. Rec. (See Model C-1615A) 124
RC-1720A (Ch. 17AY27) Tel. Rec. 143–1A
RC-2005A (Ch. 20AY21) Tel. Rec. (See Model C-2001A)..139–1A
7DX21, 7DX22P Tel. Rec. 81—13
10AXF43 Tel. Rec. (See Model A-10DX24). 75
10AXF43, 10DX22 Tel. Rec. Prod. Chge. Bul. 1.103—19
10AXF44 Tel. Rec. (See Model C-1102 (Set 94) and Model A-10DX24 (Set 75)]
10DX21, 10DX22 Tel. Rec. (See Model A-10DX24). 75
10DX24 Tel. Rec. (See Model A-10DX24). 75
18DX21A Tel. Rec. (See 7DX21) 81
Ch. 10AX22 (See Model M701) 94
Ch. 12AX22 (See Model C1102) 94
Ch. 12AX26, 12AX27 (See Model C-1104B)..141
Ch. 14AX21 Tel. Rec. (See Model C-1401)........123
Ch. 16AX23, 25, 26 (See Model C1602).... 99
Ch. 16AY28 (See Model C-1615B) 124
Ch. 16AY28 Tel. Rec. Prod. Chge. Bul. 19...132—1
Ch. 16AY210 Tel. Rec.... *
Ch. 16AY211 (See Model C-1615A) 124
Ch. 16AY211 Tel. Rec. Prod. Chge. Bul. 19...132—1
Ch. 17AY21 (See Model C-1714B) 124
Ch. 17AY21 Tel. Rec. Prod. Chge. Bul. 19...132—1
Ch. 17AY24 (See Model C-1715A) 124
Ch. 17AY24 Tel. Rec. Prod. Chge. Bul. 19...132—1
Ch. 17AY27 (See Model RC-1720A).143–1A
Ch. 20AY21 (See Model C-2001A) 139–1A

RECORDIO (Wilcox-Gay)
1C-10 ....146—9
1J10 (Ch. 1J1).........128—12
6A10, 6A20 (Ch. 6A) ..... 10—27
6B10, 6B20, 6B30, 6B32 .. 8—27
7D42, 7D44 (Ch. 7D1)... 52—18
7E40, 7E44 .... 47—20
8J10, 8J50 .... 62—17
9G10 .... 91—10
9G40M, 9G42 .... 86—9
9H40B .... 89—13
Ch. 1J1 (See Model 1J10).128
Ch. 6A (See Model 6A10). 10
Ch. 7D1 (See Model 7D42) 52

REGAL (TOK-FONE)
Tok-Fone (20-watt Amp.) . 13—27
A-16T31 Tel. Rec........ *
AP40, ARP400, ARP450 .. 15—26
BP48 .... 49—18
CD31 Tel. Rec. (See Model 16T31).... 80
CD36 Tel. Rec.......... *
CR761 .... 50—16
FM78 .... 68—14
L-76 .... 5—18
W700 (See Model W800). 14
W800, W801 .... 14—26
W900, W901 .... 13—28
16T31 Tel. Rec......... 80—14
16T36 Tel. Rec......... *
17T22, 17T22DX Tel. Rec. 143—13
19C36 Tel. Rec......... *
20C22, 20C22DX, 20D22, 20D22DX, 20T22, 20T22DX Tel. Rec. (See Model 17T22)....143
22D17, 22D17DX, 22D19, 22D19DX Tel. Rec. (See Model 17T22)....143

REGL (TOK-FONE)—Cont.
205 .... 26—23
208 (See Model W800)... 14
747 .... 27—22
777 .... 53—21
1007 Tel. Rec.......... 83—9
1030, 1031 Tel. Rec. (See Model 16T31).... 80
1049 .... 17—28
1107 .... 41—19
(See Model 1007)...... 83
1207, 1208 Tel. Rec.
1230 Tel. Rec. (See Model 16T31).... 80
1500 .... 38—19
1607 Tel. Rec. (See Model 1007)...... 83
1708, 1708DX Tel. Rec. (See Model 17T22)....143
1749 .... 28—29
2217, 2217DX, 2219, 2219DX Tel. Rec. (See Model 47T22)....143
7152 .... 70—8
7162 .... 69—12
7163 .... 66—14
7251 .... 40—16

REMBRANDT
80 Tel. Rec............ *
130 Tel. Rec........... *
721, 1606, 1606-15, 1950 Tel. Rec......... 65—11

REMLER
MP5-5-3 .... 8—28
5300B, 5300B1, 53001 .. 23—18
5310 .... 40—17
5400, 5410 .... 44—19
5500 "Scottie Pup"..... 27—23
5505, 5510, 5515 "Scottie Pup" (See Model 5500). 27
5520, 5530 "Scottie Junior" (See Model 5500) 27
6000 .... 77—9

RENARD
L-1A, PT-1A, 185T-1 ...... 9—28

SCOTT (E. H.)
Musicale .... 44—20
Music Control, Dynamic Noise Suppressor ..... 46—21
6T11, 6T11A Television Receiver .... 52—19
6T11, 6T11A Tel. Rec. Prod. Chge. Bul. 4.....105—2
13A Tel. Rec........... *
16A .... 40—18
300 Tel. Rec........... *
400 Tel. Rec. (See Model 6T11)..... 52
400 Tel. Rec. Prod. Chge. Bul. 4 ....105—2
510 ....103—14
800-B .... 14—27
800BT Tel. Rec. (See Model 6T11 (Set 52) and Model 800B Set 14)
800BT Tel. Rec. Prod. Chge. Bul. 4..........105—2

SCOTT (H. H.)
111-B ....143—14
112-B ....144—8
210-A .... 79—15
210-B ....145—9
211-A .... 81—14

SEARS-ROEBUCK
(See Silvertone)

SENTINEL
1U-284GA (See Model 284GA) 22
1U-2841, 1U-284NA, 1U-284NI, 1U-284W (See Model 2841)...... 1
1U-285P (See Model 285P) 6
1U-293CT (See Model 293CT) 29
1U-293I, 1U-293T, 1U-293W (See Model 294 Series) 1
1U-294I, 1U-294N, 1U-294T (See Model 294 Series) 1
1U312PG, 1U312PW ....103—15
1U-313I, 1U-313W (See Model 313I)..... 39
1U-314E, 1U-3141, 1U-314W (See Model 314E) 38
1U-316PM, 1U-316PT (See Model 316PM).... 48
1U-335PG, PI, PM, PW..105—9
1U338-I, 1U338-R, 1U338-W ....122—9
1U339-K ....111—12
1U340-C ....129—10
1U416 Tel. Rec.........117—12
1U419, 1U420 Tel. Rec...115—9
1U420B Tel. Rec.........124—9
1U421, 1U422 Tel. Rec. (See Model 412)......100
1U421, 1U422 Tel. Rec. Prod. Chge. Bul. 16....126—1
1U423, 1U424 Tel. Rec. (See Model 1U420B) ..124
1U423, 1U424 Tel. Rec. Prod. Chge. Bul. 19..............132—1
1U423B, 1U423-17 Tel. Rec. (See Model 1U420B).......124
1U424-17 Tel. Rec. (See Model 1U420-B)...124
1U425 Tel. Rec. ....127—10
1U428 Tel. Rec. (See Model 1U425) 127
1U429, 1U430, 1U431 Tel. Rec. (See Model 1U420B)...124
1U429, 1U430, 1U431 Tel. Rec. Prod. Chge. Bul. 25...144—1

SENTINEL—Cont.
1U432 Tel. Rec. (See Model 1U425) 127
1U432 Tel. Rec. Prod. Chge. Bul. 21 ... 136—1
1U435 Tel. Rec. (See Model 1U425) 127
1U435 Tel. Rec. Prod. Chge. Bul. 21 ... 136—1
L-284I, L-284NA, L-284NI, L-284NR, L-284W .... 23—19
284GA .... 22—25
284I .... 1—2
284NA, 284NI (See Model 284I) 1
285P .... 6—27
286P, 286PR .... 23—20
289T .... 6—28
292K .... 16—30
293 Series .... 1—14
293-CT .... 29—22
293I, 293T, 293W (See Model 293 Series). 1
294 Series .... 1—11
294I, 294N, 294T (See Model 294 Series) 1
295-T .... 22—26
296B, 296M .... 46—22
302-I, 302-T, 302-W .... 33—23
305-I, 305-I-3, 305-W, 305-W3 .... 33—24
309-I, 309N, 309-R, 309-W .... 28—30
312PG, 312 PW (See Model 1U312PG) 103
313-I, 313-W .... 39—21
314-E, 314-I, 314-W .... 38—21
315-I, 315-W .... 40—19
316PM, 316PT .... 48—22
332 (See Model 313-I) ... 39
333 (See Model 315-I) ... 40
335PG, PI, PM, PW (See Model 1U-335PG) 105
338-I, 338-R, 338-W (See Model 1U338) 122
339-K (See Model 1U339-K) . 111
340-C (See Model 1U340-C) 129
400TV Tel. Rec. .... 73—11
401, 402 Series Tel. Rec. .. 70—9
405TVM Tel. Rec. (See Model 400TV) 73
406 Series Tel. Rec. (See Model 401 Series) .. 70
407 Series Tel. Rec. ...... *
409 Series Tel. Rec. ...... *
411 Series Tel. Rec. (See Model 401 Series) 70
412, 413, 414, 415 (Series YA, YB, YC, YD, YE, YF) Tel. Rec. .... 100—11
412, 413, 414, 415 Tel. Rec. Prod. Chge. Bul. 4 . 105—2
416 Tel. Rec. (See Model 1U416) 117
419, 420 Tel. Rec. (See Model 1U419) ... 115
420B Tel. Rec. (See Model 1U420B) 124
421, 422 Tel. Rec. (See Model 412) 100
421, 422 Tel. Rec. Prod. Chge. Bul. 16 ... 126—1
423, 424 Tel. Rec. (See Model 1U420B) 124
423, 424 Tel. Rec. Prod. Chge. Bul. 19 .... 132—1
423B, 423-17 Tel. Rec. (See Model 1U420-B) ... 124
424-17 Tel. Rec. (See Model 1U420-B) ... 124
425 Tel. Rec. (See Model 1U425) 127
428 Tel. Rec. (See Model 1U425) 127
429, 430, 431 Tel. Rec. (See Model 1U420B) ... 124
429, 430, 431 Tel. Rec. Prod. Chge. Bul. 25 ... 144—1
432 Tel. Rec. (See Model 1U425) 127
432 Tel. Rec. Prod. Chge. Bul. 21 ... 136—1
435 Tel. Rec. (See Model 1U425) 127
435 Tel. Rec. Prod. Chge. Bul. 21 ... 136—1

SETCHELL-CARLSON
150 Tel. Rec. .... 144—9
416 .... 2—14
427 .... 21—29
437 .... 39—22
447 .... 40—20
458-RD .... 106—13
469 .... 99—15
570 .... 97—15
2500, 2500LP Tel. Rec. (See Model 150) 144

SHERIDAN ELECTRONICS (See Vogue)

SIGNAL
AF252 .... 37—19
141 .... 44—21
241 .... 33—25
341-A .... 39—23
341-T .... 25—23

SILVERTONE
1, 2 (Ch. 132.878) ...... 101—10
5, 6 (Ch. 132.881) ...... 144—10
10, 11 (Ch. 132.896) ..... 144—11
15, 16 (Ch. 132.884, -1, -2) .... 141—12
18 (Ch. 132.877) .... 140—11
20 (Ch. 132.877) (See Model 18) 140
33 (Ch. 548.363) .... 111—13
41, 41A (Ch. 135.245) ... 101—11
51, 53 (Ch. 132.887) .... 112—8
54, 56 (Ch. 132.888) .... 115—10
64, 65 (Ch. 101.859-2) .. 113—8

SILVERTONE—Cont.
67 (101.859-1, 101.859-2) (See Model 64) 113
72 (Ch. 134.111) .... 142—11
101 (Ch. 549.100), 101A (Ch. 549.100-1) Tel. Rec. .... 102—12
102 (Ch. 549.100-2) Tel. Rec. .... *
102A (Ch. 549.100-3) Tel. Rec. .... *
105 (Ch. 132.882) Tel. Rec. .... *
106 (Ch. 132.889) Tel. Rec. .... *
108 (Ch. 549.100) Tel. Rec. (See Model 101) . 102
110, A (Ch. 478.303, A) Tel. Rec. .... *
111 (Ch. 110.700) Tel. Rec. .... *
112 (Ch. 478.289) Tel. Rec. .... 118—9
113 (Ch. 110.700) Tel. Rec. .... *
114 (Ch. 478.302) Tel. Rec. .... *
115 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. .... *
116, 116A (Ch. 110.700-1, -10) Tel. Rec.) .... 139—13
116-16 (Ch. 110.700-90) Tel. Rec. .... *
117-17 (Ch. 110.700-96) Tel. Rec. .... *
120 (Ch. 478.311) Tel. Rec. .... 115—11
122 (Ch. 478.289) Tel. Rec. .... *
125 (Ch. 478.257) Tel. Rec. .... 104—10
127-12 (Ch. 110.700) Tel. Rec. .... *
131, 131A (Ch. 110.700-1, -10) Tel. Rec. (See Model 116) 139
132 (Ch. 110.499-1) Tel. Rec. (See Model 9123). 79
133 (Ch. 100.043) Tel. Rec. .... *
134 (Ch. 100.700-2, -20) Tel. Rec. .... *
135 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. ...... *
138 (Ch. 549.100-3) Tel. Rec. 99A-10
139 (Ch. 110.700) Tel. Rec. .... *
140 (Ch. 110.700) Tel. Rec. .... *
143 Tel. Rec. (See Model 143A) 121
143A (Ch. 100.111) Tel. Rec. .... 121—12
144 (Ch. 478.312) Tel. Rec. .... *
149 (Ch. 100.107-1) Tel. Rec. .... *
150-14 (Ch. 478.338) Tel. Rec. .... 142—12
159 (Ch. 478.309) Tel. Rec. (See Model 120) .. 115
160-12 (Ch. 549.100-4) Tel. Rec. 97A-12
161-16 (Ch. 100.112) Tel. Rec. 99A-10
162-16 (Ch. 110.700-10) Tel. Rec. (See Model 116) 139
165-16 (Ch. 100.120) Tel. Rec. .... 144—12
167-16, 167-16A (Ch. 549.101, -1) Tel. Rec. . *
168-16 (Ch. 549.100-3) Tel. Rec. .... *
173-16 (Ch. 110.700-10) Tel. Rec. (See Model 116) 139
177-19 (Ch. 110.700-40) Tel. Rec. (See Model 116) 139
179-16, 180-16 (Ch. 132.890) Tel. Rec. 130—12
185-16 (Ch. 549.101-2) Tel. Rec. .... *
186-19 (Ch. 549.101-3) Tel. Rec. .... *
189-16 (Ch. 110.700-1, -10) Tel. Rec. (See Model 116) 139
191-16 (Ch. 110.700-50) Tel. Rec. .... *
194-16, 195-16 (Ch. 132.890) Tel. Rec. (See Model 179-16) 130
210 (Ch. 132.880) .... 109—12
215 (Ch. 528.174) .... 117—13
220 (Ch. 528.173) .... 110—13
225 (Ch. 528.171-1) ..... 107—8
237 (Ch. 488.237) .... 145—10
238 (Ch. 548.360-1, 548.361) (See Model 239) 115
239 (Ch. 548.360-1, 548.361) .... 115—12
245 (Ch. 548.358-1) ..... 107—9
246 (Ch. 137.906) .... 111—14
249 (Ch. 548.360-1, 548.361) (See Model 239) 115
1130-17 (Ch. 110.700-96) Tel. Rec. .... *
1135-17 (Ch. 110.700-96) Tel. Rec. .... *
1141-20 (Ch. 110.700-93) Tel. Rec. .... *
1162-16 (Ch. 110.700-90) Tel. Rec. .... *
1162-17 (Ch. 110.700-96) Tel. Rec. .... *
1191-17 (Ch. 110.700-97) Tel. Rec. .... *

SILVERTONE—Cont.
1300 (Ch. 319.200), 1300-1 (Ch. 319.200-1) 90—10
1301 (Ch. 319.190) .... 91—11
1304 (Ch. 185.706) .... *
6002 (Ch. 132.818) .... 5—35
6011 (Ch. 132.816), 6012 (Ch. 132.816A) .. 15—27
6016 (Ch. 132.820) ..... 27—24
6050 (Ch. 132.825-4) .... 15—28
6051 (Ch. 110.451), 6052 (Ch. 110.452) ... 13—29
6071 (Ch. 132.826-1) ... 15—29
6072 (Ch. 110.454) ..... 13—30
6092 (Ch. 101.672-1B), 6093 (Ch. 101.672-1A) 10—28
6100 (Ch. 101.660-1A) .. 6—29
6104 (Ch. 101.662-2D) (See Model 6105) 7
6105 (Ch. 101.622-2B) ... 7—26
6106A (Ch. 101.662-4E) . 29—23
6111 (Ch. 101.662-3C) (See Model 6105) 7
6111A (Ch. 101.662-5F) (See Model 6106A) 29
6200A (Ch. 101.800-3) .. 65—12
6200A (Ch. 101.800-1) .. 9—29
6203 (Ch. 101.800A) (See Model 6200A) 9
6220, 6220A (Ch. Nos. 101.801, 101.801-1A) . 9—30
6230 (Ch. 101.802), 6230 (Ch. 101.802-1) .. 11—21
6285A (Ch. 101.666-1B) . 20—28
6290 (Ch. 101.677-B) .... 20—29
6293 (Ch. 528.6293-2) ... 99—16
6295 (Ch. 528.6295) ..... 98—12
6685 (Ch. 139.150, Ch. 139.150-1), Power Shifter .... 15—30
7010 .... *
7011 .... *
7012 .... *
7013 .... *
7016 .... *
7017 .... *
7020 (See Model 7021) .. 16
7021 (Ch. 101.807, 101.807A) .... 16—31
7025 (Ch. 132.807-2) .... 29—24
7054 (Ch. 101.808) ..... 15—31
7070 (Ch. 101.817) ..... 30—26
7080 (Ch. 101.809) ..... 16—32
7080, 7080A (Ch. 101.809-2) .... 58—20
7085 (Ch. 101.814) ..... 30—27
7086 (Ch. 110.466) ..... 27—25
7090 (Ch. 101.810) ..... 15—32
7095 (Ch. 101.826) (See Model 7115) 16
7100 (Ch. 101.811) ..... 17—29
7102 (Ch. 101.814-1A), (See Model 7085) 30
7103 (Ch. 110.466-1) (See Model 7086) 27
7105, 7106 .... *
7111 (Ch. 434.140) ..... 30—28
7115 (Ch. 101.825), 7116 (Ch. 101.825-1A), 7117 (Ch. 101.825-1B) 16—33
7119 (Ch. 101.825-2C) .. 62—18
7145 (Ch. 436.200) ..... 23—21
7148 (Ch. 431.188), 7148A (Ch. 431.188-1) 23—22
7152 (Ch. 109.626) ..... 25—26
7153 (Ch. 109.627) ..... 26—30
7165 (Ch. 101.823-A, 1A), 7166 (Ch. 101.823, 101.823-1) .... 10—29
7210 (Ch. 101.820) ..... 32—20
7220 (Ch. 161.801-2C) (See 6220) 9
7226 (Ch. 101.819A) .... 31—28
7230 (Ch. 101.802-2A) (See 6230) 11
7300 (Ch. 435.240) ..... 45—22
7350 (Ch. 435.410) ..... 38—22
7351 .... *
7352 .... *
7353 (See Model 7350) ... 38
8000 (Ch. 132.838) ..... 31—29
8003 (Ch. 132.818-1) .... 53—22
8004 (See Model 8003) ... 53
8005 (Ch. 132.839) ..... 33—26
8010 (Ch. 132.840) ..... 40—21
8011 (See Model 8010) .. 40
8020 (Ch. 132.841) ..... 43—17
8021 (Ch. 132.868) ..... 70—10
8022 .... *
8024, 8025 (Ch. 478.206-1) .... 80—15
8050 (Ch. 101.813) ..... 33—27
8051 (Ch. 101.839) ..... 49—19
8052 (Ch. 101.808-1C) ... 68—15
8053 (Ch. 101.808-1D) (See Model 8052) 68
8070 (Ch. 101.817-1A) (See Model 7070) ..... 30—26
8071 .... *
8072 (Ch. 101.834) ..... 34—19
8073 (Ch. 135.243) ...... 84—9
8080 (Ch. 101.852) ...... 52—20
8083, 8083A (Ch. 101.809-1A) (See Model 7080) 58
8084, 8084A (Ch. 101.809-1B) (See Model 7080) 58
8086 (Ch. 101.814-5C) .. 61—18
8086A, 8086B (Ch. 101.814-6C) (See Model 8086) 61
8090 (Ch. 101.821) ..... 49—20
8092 .... *
8097A (Ch. 101.825-4) (See Model 7119) 62
8100 (Ch. 101.829) ...... 51—19
8101, 8101A, 8101B, 8101C (Ch. 101.809-3C) (See Model 7080) 58
8102 (Ch. 101.814-2B) (See Model 8086) 61
8102A (Ch. 101.814-3B) (See Model 8086) 61

SILVERTONE—Cont.
8102B (Ch. 101.814-2B) (See Model 8086) 61
8103 (Ch. 110.473) ..... 56—21
8104 (See Model 8086) .. 61
8105, 8105A (Ch. 101.833) .... 35—20
8106, 8106A (Ch. 101.833-1A) (See Model 8105) 35
8107A, 8108, 8108A (Ch. 101.851), 8109 (Ch. 101.851-1) .... 64—10
8112, 8113 (See Model 8115) 62
8115 (Ch. 101.825-3D), 8115A, B, C (Ch. 101.825-4), 8117 (Ch. 101.825-3E), 8118 (Ch. 101.825-3F), 8118A, B, C (Ch. 101.825-4) (See Model 7119) 62
8124, 8125, 8126 (Ch. 101.831A, Ch. 101.831-1) (See Model 8127) 41
8127, A, B, C (Ch. 101.831A), 8128, A, B, C (Ch. 101.831), Wire Recorder Amp. (Ch. 101.773) .... 41—20
8130 Television Receiver. 49—21
8132 (Ch. 101.854) Tel. Rec. .... 66—15
8133 (Ch. 101.829-1, Ch. 101.846) Tel. Rec. (See Model 8132) 66
8144 (Ch. 431.199) ..... 32—21
8145 (Ch. 109.631) ..... 45—23
8148 (Ch. 109.632) ..... 44—22
8149 (Ch. 109.633) ..... 48—23
8150 (Ch. 109.634) ..... 32—22
8152 (Ch. 109.635) (See Model 8153) 42
8153 (Ch. 109.635), 8153A (Ch. 109.635-1) 42—22
8155 (Ch. 463.155) ..... 57—17
8160 (Ch. 109.636), 8160A (Ch. 109.636A). 50—17
8168 (Ch. 109.638) ...... 46—23
8169 (Ch. 109.638) (See Model 8168) 46
8200 (Ch. 101.800-2B) (See Model 6200A [Ch. 101.800-3]) 65
8201 (See Model 6200A). 65
8210 (Ch. 101.820-1A) ... 71—13
8220, 8221 (Ch. 101.801-3D), 8222 (See 6220) 9
8230 (Ch. 101.835) ...... 59—18
8231 (See Model 8230) .. 59
8260 (Ch. 101.823-2B) (See Models 7165, 7166) 10—29
8270 (Ch. 101.822), 8270A (Ch. 101.822A) .. 57—18
9000 (Ch. 132.857) ..... 65—13
9005, 9006 (Ch. 132.858) 72—11
9022 (Ch. 132.871) ..... 76—17
9054 (Ch. 101.849) ..... 63—16
9073, 9073A (Ch. 135.244), 9073B (Ch. 135.244-1) ...... 83—10
9073C (Ch. 135.243-1) (See Model 9073) 83
9082 (Ch. 135.245) (See Model 41) 101
9101 (Ch. 101.809-3C) (See Model 7080) 58
9102 (See Model 7080) .. 58
9105 (Ch. 132.875) ..... 89—14
9107A (Ch. 101.851-1) (See Model 8107A) 64
9111 (Ch. 110.499) Tel. Rec. (See Model 9123) 79
9112 (Ch. 110.499-1) Tel. Rec. (See Model 9123) 79
9113 (Ch. 110.499) Tel. Rec. (See Model 9123) 79
9114 (Ch. 110.499-1) Tel. Rec. (See Model 9123) 79
9115 (Ch. 478.224), 9116 (Ch. 478.221) Tel. Rec.. 97—16
9119, 9120 (Ch. 101.865) Tel. Rec. ...... *
9120A (Ch. 101.865-1) Tel. Rec. .... *
9121 (Ch. 101.867) Tel. Rec. .... *
9122 (Ch. 101.864) (See Model 8132) 66
9122A (Ch. 101.868) Tel. Rec. .... *
9123 (Ch. 110.499), 9124 (Ch. 110.499-1), Tel. Rec. .... 79—16
9125 (Ch. 478.252) Tel. Rec. .... *
9125A (Ch. 478.253) Tel. Rec. (See Model 125) .. 104
9126 (Ch. 101.499-2) Tel. Rec. (See Model 9123) 79
9127 (Ch. 110.499-2) Tel. Rec. (See Model 9123) 79
9128A (Ch. 101.868) Tel. Rec. .... *
9129 (Ch. 110.499) Tel. Rec. (See Model 9123) 79
9130 (Ch. 110.499-1) Tel. Rec. (See Model 9123) 79
9131 (Ch. 478.210) Tel. Rec. .... 84—10
9132 (Ch. 110.499-1) Tel. Rec. (See Model 9123) 79

SILVERTONE—Cont.
9133, 9134 (Ch. 101.866, Radio Ch. 101.859) Tel. Rec. .... 95—5
9139, 9140 (Ch. 110.499-1) Tel. Rec. (See Model 9123) 79
9153 (Ch. 435.417) ...... 67—16
9161 (Ch. 548.358) ..... 88—10
9260 (Ch. 101.850) ..... 51—20
9270 (Ch. 547.245) ..... 82—11
9280 (Ch. 528.168) ...... 94—9
Ch. 100.043 (See Model 133) ...... *
Ch. 100.107-1 (See Model 149) ...... *
Ch. 100.111 (See Model 143A) 121
Ch. 100.112 (See Model 161-16) 99A-10
Ch. 100.120 (See Model 165-16) ... 144
Ch. 101.660-1A (See Model 6100) 6
Ch. 101.662-2B, 101.662-2D, 101.662-3C (See Model 6105) 7
Ch. 101.662-4E, 101.662-5F (See Model 6106A) .. 29
Ch. 101.666-1B (See Model 6285A) 20
Ch. 101.672-1A, 101.672-1B (See Model 6092) ... 10
Ch. 101.677B (See Model 6290) 20
Ch. 101.773 (See Model 8127) 41
Ch. 101.800-1, 101.800-1A (See Model 6200A). 9
Ch. 101.800-3 (See Model 6200A) 65
Ch. 101.801, 101.801-1A (See Model 6220) 9
Ch. 101.802, 101.802-1 (See Model 6230) 11
Ch. 101.807, 101.807A (See Model 7021) 16
Ch. 101.808 (See Model 7054) 15
Ch. 101.808-1C, 101.808-1D (See Model 8052) .. 68
Ch. 101.809 (See Model 7080) 16
Ch. 101.809-1A, B, 101.809-2, 101.809-3C (See Model 7080) 58
Ch. 101.810 (See Model 7090) 15
Ch. 101.811 (See Model 7100) 17
Ch. 101.813 (See Model 8050) 13
Ch. 101.814, 101.814-1A (See Model 7085) 30
Ch. 101.814-2B, 101.814-3B, 101.814-5C, 101.814-6C (See Model 8086) 61
Ch. 101.817 (See Model 7070) 30
Ch. 101.819A (See Model 7226) 31
Ch. 101.820 (See Model 7210) 32
Ch. 101.821 (See Model 8090) 49
Ch. 101.822, 101.822A (See Model 8270) 57
Ch. 101.823, 101.823A, 101.823-1, 101.823-1A (See Model 7166) 10
Ch. 101.825, 101.825-1A, 101.825-1B (See Model 7115) 16
Ch. 101.825-2C, 101.825-3D, 101.825-3E, 101.825-3F, 101.825-4 (See Model 7119) 62
Ch. 101.829 (See Model 8100) 51
Ch. 101.829-1 (See Model 8132) 66
Ch. 101.831, 101.831A, 101.831-1 (See Model 8127) 41
Ch. 101.833 (See Model 8105) 35
Ch. 101.834 (See Model 8072) 34
Ch. 101.835 (See Model 8230) 59
Ch. 101.839 (See Model 8051) 49
Ch. 101.846 (See Model 8132) 66
Ch. 101.849 (See Model 9054) 63
Ch. 101.850 (See Model 9260) 51
Ch. 101.851, 101.851-1 (See Model 8107A) 64
Ch. 101.852 (See Model 8080) 52
Ch. 101.854 (See Model 8132) 66
Ch. 101.859 (See Model 9133) 95
Ch. 101.859-1, -2 (See Model 64) 113
Ch. 101.864 (See Model 9122) 66
Ch. 101.865 (See Model 9119) ..... *
Ch. 101.865-1 (See Model 9120A) .... *
Ch. 101.866 (See Model 9133) 95
Ch. 101.867 (See Model 9121) ..... *
Ch. 101.868 (See Model 9122A) .... *
Ch. 109.626 (See Model 7152) 25

SILVERTONE—Cont.

Ch. 109.627 (See Model 7153)..... **26**
Ch. 109.631 (See Model 8145)..... **45**
Ch. 109.632 (See Model 8148)..... **44**
Ch. 109.633 (See Model 8149)..... **48**
Ch. 109.634 (See Model 8150)..... **32**
Ch. 109.635, 109.635-1 (See Model 8153)..... **42**
Ch. 109.636, 109.636A (See Model 8160)..... **50**
Ch. 109.638 (See Model 8168)..... **46**
Ch. 110.451, 110.452 (See Model 6051)..... **13**
Ch. 110.454 (See Model 6072)..... **13**
Ch. 110.466, 110.466-1 (See Model 7086)..... **27**
Ch. 110.473 (See Model 8103)..... **56**
Ch. 110.499 (See Model 9123)..... **79**
Ch. 110.499-1 (See Model 9124)..... **79**
Ch. 110.499-2 (See Model 9126)..... **79**
Ch. 110.700, -1, -10, -40 (See Model 116)......**139**
Ch. 132.807-2 (See Model 7025)..... **29**
Ch. 132.816, 132.816A (See Model 6011)..... **15**
Ch. 132.818 (See Model 6002)..... **5**
Ch. 132.818-1 (See Model 8003)..... **53**
Ch. 132.820 (See Model 6016)..... **27**
Ch. 132.825-4 (See Model 6050)..... **15**
Ch. 132.826-1 (See Model 6071)..... **15**
Ch. 132.838 (See Model 8000)..... **31**
Ch. 132.839 (See Model 8005)..... **33**
Ch. 132.840 (See Model 8010)..... **40**
Ch. 132.841 (See Model 8020)..... **43**
Ch. 132.858 (See Model 9005)..... **72**
Ch. 132.868 (See Model 8021)..... **70**
Ch. 132.871 (See Model 9022)..... **76**
Ch. 132.875 (See Model 9105)..... **89**
Ch. 132.877 (See Model 18).......**140**
Ch. 132.878 (See Model 1) **101**
Ch. 132.880 (See Model 210) **109**
Ch. 132.881 (See Model 5)........**144**
Ch. 132.882 (See Model 105)....... *
Ch. 132.884, -1, -2 (See Model 15).......**141**
Ch. 132.887 (See Model 51).......**112**
Ch. 132.888 (See Model 54).......**115**
Ch. 132.889 (See Model 106)....... *
Ch. 132.890 (See Model 179-16)...**130**
Ch. 132.896 (See Model 10).......**144**
Ch. 134.111 (See Model 72).......**142**
Ch. 135.243 (See Model 8073)...... **84**
Ch. 135.243-1 (See Model 9073)...... **83**
Ch. 135.244, 135.244-1 (See Model 9073)...... **83**
Ch. 135.245 (See Model 41).......**101**
Ch. 137.906 (See Model 246)......**111**
Ch. 139.150, 139.150-1 (See Model 6685)..... **15**
Ch. 185.706 (See Model 1304)...... *
Ch. 319.190 (See Model 1301)...... **91**
Ch. 319.200, 319.200-1 (See Model 1300)..... **90**
Ch. 431.188, 431.188-1 (See Model 7148)..... **23**
Ch. 431.199 (See Model 8144)..... **32**
Ch. 431.202 (See Model 8130)..... **49**
Ch. 434.140 (See Model 7111)..... **30**
Ch. 435.240 (See Model 7300)..... **45**
Ch. 435.410 (See Model 7350)..... **38**
Ch. 435.417 (See Model 9153)..... **67**
Ch. 436.200 (See Model 7145)..... **23**
Ch. 463.155 (See Model 8155)..... **57**
Ch. 478.206-1 (See Model 8024)..... **80**
Ch. 478.210 (See Model 9131)..... **84**
Ch. 478.221 (See Model 9115)..... **97**
Ch. 478.224 (See Model 9115)..... **97**
Ch. 478.252 (See Model 9125)..... *
Ch. 478.253 (See Model 125).....**104**

SILVERTONE—Cont.

Ch. 478.257 (See Model 125)......**104**
Ch. 478.289 (See Model 112)......**118**
Ch. 478.309 (See Model 120)......**115**
Ch. 478.311 (See Model 120)......**115**
Ch. 478.338 (See Model 150-14)...**142**
Ch. 488.237 (See Model 237)......**145**
Ch. 528.168 (See Model 9280)...... **94**
Ch. 528.171-1 (See Model 225) **107**
Ch. 528.173 (See Model 220) **110**
Ch. 528.174 (See Model 215)......**117**
Ch. 528.6293-2 (See Model 6293)...... **99**
Ch. 528.6295 (See Model 6295)...... **98**
Ch. 547.245 (See Model 9270)..... **82**
Ch. 548.358 (See Model 9161)..... **88**
Ch. 548.358-1 (See Model 245) **107**
Ch. 548.360-1 (See Model 239)......**115**
Ch. 548.361 (See Model 239)......**115**
Ch. 548.363 (See Model 33).......**111**
Ch. 549.100, 549.100-1 (See Model 101)......**102**
Ch. 549.100-3 (See Model 138)....... **99A**
Ch. 549.100-4 (See Model 160-12).... **97A**

SIMPLON

CA-5 .... 22—27
WVV2 .... 17—30

SKY KNIGHT (See Air Knight)

SKYRIDER (See Hallicrafters)

SKYROVER

N5-RD-250 (9022-N), N5-RD-251 (9022-H) ... 6—31
N5-RD295 (Ch. 5A7) .... 21—30

SKY WEIGHT

81B .... 20—30
82 .... 13—13

SONOGRAPH

BL100 ....122—10
BW100 (See Model BL100) 122

SONORA

RBU-176 .... 5—31
RB-207 (See Model RB-176) 5
RCU-208 .... 5—30
RDU-209 .... 3—29
RET-210 .... 24—24
RGMF-212, RGMF-230 ... 27—26
RKRU-215 (Ch. RKRU) .... 9—31
RMR-219 .... 19—28
RMR-220, RMR-245 (See Model RMR-219).. 19
RQU-222 .... 8—23
RWFU-238 .... 23—24
RX-223 .... 19—29
WAU-243 .... 27—27
WBRU-239 .... 32—23
WCU-246 .... 36—22
WDU-233 .... 25—27
WDU-249 .... 37—20
WEU-262 .... 33—28
WGFU-241, WGFU-242 .. 24—25
WJU-252 .... 36—23
WKRU-254A .... 34—20
WLRU-219A .... 37—21
WLRU-220A (See Model WLRU-219A) 37
WLRU-245A (See Model WLRU-219A) 37
WXTU-700, WXTUA-700A Tel. Rec. .... *
YB-299 ....112—9
100 .... 41—21
101 .... 48—24
102 .... 53—23
171 ....109—13
172 (See Model 171).....109
302, 303 Tel. Rec....... 97A-13
306 ....108—11
401 .... 47—21
402A (See Model RMR-219) 19
402F (See Model WLRU-219A) 37

SOUND, INC.

"Intersound" .... 7—27
MB6P3, MB6P6, MB6P30, MB6R4 .... 35—21
MB7E3 .... 28—31
MB7E8 .... 26—24
5R2 .... 28—32

SPARKS-WITHINGTON (See Sparton)

SPARTON

4AW17 (Ch. 417)....... 50—18
4AW17-A (Ch. 417A).... 49—22
5AH06, 5A106 (See Model 5AW06) 4
5AI16 (Ch. 5-16) .... 30—29
5AM26-PS (Ch. 5-26-PS) . 5—17
5AW06 (Ch. 5-06) ...... 4—17
5AW16 (Ch. 5-16) See Model 5AI16 (Ch. 5-16) 30
6AM06 (Ch. 6-06) .... 34—21
6AM26 (See Model 6AW26PA) 15
6AW26PA (Ch. PC5-6-26) 15—33
6-66A (Ch. 666A) .... 51—21
7AM46 (Ch. 7-46)....... 1—31
7AM46PA, 7BM46PA, 7BW46PA, 8AM46 (See Model 7AM46).... 1

SPARTON—Cont.

10AB76-PA, 10AM76-PA, 10BM76-PA (See Model 10BW76-PA) ... 15
10BW76-PA (Ch. 10-76PA) 15—34
100, 101 (Ch. 5A7)..... 38—23
102, 103, 104 (See Model 100)...... 38
121 (Ch. 8L9).......... 57—19
122 (See Model 121).... 57
130, 132, 135, 139 (Ch. 5A10) .... 94—10
141 (See Model 121)..... 57
141A (Ch. 8L10)........ 92—6
141XX, 142XX (Ch. 8W10) ....126—12
142 (See Model 121)..... 57
150, 151, 152, 155 (Ch. 4E10) .... 91—12
201 .... *
1000, 1001, 1003 (Ch. 12L7) .... 60—18
1005, 1006, 1007, 1008 (Ch. 8-57) .... 29—25
1010 (Ch. 7L7) .... 35—22
1015 (See Model 10BW76PA) 15
1020, 1021, 1023 (See Model 1000)..... 60
1030, 1030A (Ch. 6L8)... 37—22
1031, 1031A (See Model 1030)..... 37
1035, 1035A, 1036, 1036A, 1037, 1037A, 1039, 1040, 1041 (Ch. 9L8) .... 62—19
1040XX, 1041XX (Ch. 8W10) (See Model 141XX) 126
1051, 1052 (Ch. 6B9).... 58—21
1058, 1059, 1060, 1061, 1064, 1071, 1072 (See Model 121)...... 57
1080 (Ch. 9L8A) (See Model 4900TV)... 64
1080A (Ch. 8L10) (See Model 141A).... 92
1081 (Ch. 9L8A) (See Model 4900TV)... 64
1081A (Ch. 8L10) (See Model 141A).... 92
1085, 1086 (Ch. 8W10) (See Model 141XX) ...126
1090, 1091 (Ch. 8W10) (See Model 141XX) ...126
4900TV (Ch. 24TV9C, 3TV9C, 9L8A) Tel. Rec. 64—11
4916, 4917, 4918 (Ch. 24TL10, 3TL10, 6S10) Tel. Rec. .... *
4920, 4921, 4922 (Ch. 24TM10, 3TM10, 6S10) Tel. Rec. .... *
4935 (Ch. 23TC10) Tel. Rec. 133-1A
4939TV, 4940TV, 4941TV (Ch. 24TV9, 3TV9) Tel. Rec. (See Model 4900TV) 64
4942 (Ch. 23TC10) Tel. Rec. (See Model 4935) 133-1A
4944, 4945 (Ch. 3TB10, 24TB10) Tel. Rec...... 86—10
4951, 4952 (See Model 4900TV) 64
4954 (Ch. 23TC10) Tel. Rec. (See Model 4935) 133-1A
4960 (Ch. 23TC10) Tel. Rec. (See Model 4935) 133-1A
4964, 4965 (Ch. 23TB10, 3TB10) Tel. Rec....... 93A-14
4970, 4971 (Ch. 8S10) (See Model 141A)..... 92
5002, 5003 (Ch. 23TD10) Tel. Rec. ....102—13
5006, 5007 (Ch. 23TD10) Tel. Rec. (See Model 5002) 102
5006X (Ch. 25TK10A) Tel. Rec. ....121—13
5007X (Ch. 25TK10A) Tel. Rec. (See Model 5006X) 121
5010, 5011 (Ch. 19TS10, A) Tel. Rec..........104—11
5014, 5015 (Ch. 19TS10, A) Tel. Rec. (See Model 5010).....104
5025 (Ch. 26SS160) Tel. Rec. ....128—13
5025BA Tel. Rec. (See Model 5025).....128
5025BA Tel. Rec. Prod. Chge. Bul. 22...138—1
5026 Tel. Rec. (See Model 5025).....128
5029, 5030 (Ch. 26SD160) Tel. Rec. (See Model 5025).....128
5035, 5036, 5037 (Ch. 26SS160L) Tel. Rec. (See Model 5025).....128
5052 (Ch. 24TR10, 3TR10) Tel. Rec. 97A-13
5056, 5057 (Ch. 19TS10, A) Tel. Rec. (See Model 5010).....104
5064, 5065 (Ch. 23TB10 and 3TB10) Tel. Rec. (See Model 4964)..... 93A
5068, 5069 (Ch. 24TV9C) Tel. Rec. (See Model 4900TV) 64
5071, 5072 (Ch. 19TS10, A) Tel. Rec. (See Model 5010).....104
5075BA Tel. Rec. (See Model 5025).....128
5075BA Tel. Rec. Prod. Chge. Bul. 22...138—1

SPARTON—Cont.

5076 (Ch. 26SS160, B) Tel. Rec. (See Model 5025)...........128
5076BA Tel. Rec. (See Model 5025).....128
5076BA Tel. Rec. Prod. Chge. Bul. 22...138—1
5076BB Tel. Rec. (See Model 5025).....128
5077, 5077BA Tel. Rec. (See Model 5025).....128
5077BA Tel. Rec. Prod. Chge. Bul. 22...138—1
5077BB Tel. Rec. (See Model 5025).....128
5079, 5079B Tel. Rec. (See Model 5025).....128
5079B Tel. Rec. Prod. Chge. Bul. 22...138—1
5080, 5080C Tel. Rec. (See Model 5025).....128
5080C Tel. Rec. Prod. Chge. Bul. 22...138—1
5082, 5083 (Ch. 26SD160, 26SD170) Tel. Rec. (See Model 5025 Set 128 and Model 141XX Set 126)
5082, 5083 Tel. Rec. Prod. Chge. Bul. 22...138—1
5085, 5086 (Ch. 2RD190, 25RD190) Tel. Rec.....139—14
5088, 5089, 5090 (26SD160, 26SD170) Tel. Rec. (See Model 5025 Set 128 and Model 141XX Set 126)
5101, 5102, 5103, 5104, 5105 Tel. Rec. (See Model 5025).....128
5101, 5102, 5103, 5104, 5105 Tel. Rec. Prod. Chge. Bul. 22...138—1
5152, 5153, 5154 Tel. Rec. (See Model 5025).....128
5152, 5153, 5154 Tel. Rec. Prod. Chge. Bul. 22...138—1
5158 Tel. Rec. (See Model 5025).....128
5158 Tel. Rec. Prod. Chge. Bul. 22...138—1
5170, 5171 Tel. Rec.....137-1A
5182, 5183 Tel. Rec. (See Model 5025).....128
5182, 5183 Tel. Rec. Prod. Chge. Bul. 22...138—1
5188, 5189 Tel. Rec. (See Model 5025).....128
5188, 5189 Tel. Rec. Prod. Chge. Bul. 22...138—1
Ch. PC-5-6-26 (See Model 6AW26PA). 37
Ch. 2RD190 (See Model 5085).....190
Ch. 3TB10 (See Model 4944)..... 86
Ch. 3TR10 (See Model 5052) 97A
Ch. 3TV9, 3TV9C (See Model 4900TV)... 64
Ch. 4E10 (See Model 150) 91
Ch. 5A7 (See Model 100). 38
Ch. 5-06 (See Model 5AW06).... 4
Ch. 5A10 (See Model 130) 94
Ch. 5-16 (See Model 5A116).... 30
Ch. 5-26PS (See Model 5AM26PS). 5
Ch. 6B9 (See Model 1051) 58
Ch. 6L8 (See Model 1030) 37
Ch. 6-06 (See Model 6AM06).... 34
Ch. 7L7 (See Model 1010) 35
Ch. 7-46 (See Model 7AM46).... 1
Ch. 8L9 (See Model 121). 57
Ch. 8L10 (See Model 141A) 92
Ch. 8S10 (See Model 141A) 92
Ch. 8W10 (See Model 141XX) 126
Ch. 8-46 (See Model 8AM46).... 1
Ch. 8-57 (See Model 1005) 29
Ch. 9L8 (See Model 1035) 62
Ch. 9L8A (See Model 4900TV).... 64
Ch. 10-76PA (See Model 10BW76PA) 15
Ch. 12L7 (See Model 1000) 60
Ch. 19TS10, 19TS10A (See Model 5010).....104
Ch. 23TB10 (See Model 4964)..... 93A
Ch. 23TC10 (See Models 4935, 4942, 4954, 4960) .... *
Ch. 23TD10 (See Model 5002).....102
Ch. 24TB10 (See Model 4944)..... 86
Ch. 24TR10 (See Model 5052) 97A
Ch. 24TV9, 24TV9C (See Model 4900TV)... 64
Ch. 25RD190 (See Model 5085).....139
Ch. 25TK10A (See Model 5006X) 121
Ch. 26SD160, 26SD170, 26SS160, B, L (See Model 5025).....128
Ch. 417 (See Model 48W17).... 50
Ch. 417A (See Model 48W17A).. 49
Ch. 666A (See Model 6-66A).... 51

SPIEGEL (See Aircastle)

STARK

410 .... 40—22
1010 .... 88—2
1020 .... 89—5

STARRETT

Gotham Tel. Rec........101—12
Henry Hudson, Henry Parks Tel. Rec. .... 92—7
John Hancock Tel. Rec.... 96—10
Nathan Hale Tel. Rec.... 87—12
Robert E. Lee Tel. Rec. (See Model Henry Hudson) 92
17BM1 (Ch. 12S1) Tel. Rec. .... *
20BM1 (Ch. 15S1) Tel. Rec. .... *
27BM1 (Ch. 12S1) Tel. Rec. .... *
29AM1 (Ch. 14S1) Tel. Rec. .... *
30BM1 (Ch. 15S1) Tel. Rec. .... *
37BB1 (Ch. 12S1) Tel. Rec. .... *
27BM1 (Ch. 12S1) Tel. Rec. .... *
39AM1 (Ch. 14S1) Tel. Rec. .... *

STEELMAN

200 .... 23—25
303 .... 19—31
350, 351 .... 21—31

STEWART-WARNER

AVC1 (Code 9054B), AVC2 (Code 9054C) AVT1 (Code 9054-A) Tel. Rec. 64—12
A51T1 (Code 9020-A), A51T2 (Code 9020-B), A51T3 (Code 9020-C), A51T4 (Code 9020-D) .. 17—32
A61CR1 (Code 9034-C), A61CR2 (Code 9034-D), A61CR3 (Code 9034-E), A61CR4 (Code 9034-F) . 39—25
A61P1 (Code 9036-A), A61P2 (Code 9036-B), A61P3 (Code 9036-C) .. 42—23
A72T1 (Code 9026-A), A72T2 (Code 9026-B), A72T3 (Code 9026-C), A72T4 (Code 9026-D).. 32—24
A92CR3, A92CR3S (Code 9028-C), A92CR6, A92CR6S (Code 9028-F) 29—26
B51T1, B51T2, B51T3 (Code 9044A, B, C).... 58—22
B61T1, B61T2 (Code 9046A, B) .... 59—19
B72CR1 (Code No. 9038A) 47—22
B92CR1, B92CR2, B92CR3, B92CR4, B92CR8, B92CR9, B92CR10 (Codes 9043A, B, C, D, K, L, M)............ 65—14
C51T1 (Code 9054-A), C51T2 (Code 9054-B) .. 41—22
T-711 (Code 9031-A) Tel. Rec. 95A-12
T-711M (Code 9031-AM) Tel. Rec. (See Model T-711)..... 95A
T-712 (Code 9031-B) Tel. Rec. (See Model T-711)..... 95A
TRC-721 (Code 9037-A) Tel. Rec. (See Model T-711)..... 95A
51T46 (Code 9024-B), 51T56 (Code 9024-C) .. 39—24
51T126 (Code 9018-C), 51T136 (Code 9018-F), 51T146 (Code 9018-H), 51T176 (Code 9018-B) . 15—35
61T16 (Code 9022-A), 61T26 (Code 9022-B).. 1—6
62T16 (Code 9023-C), 62TC16 (Code 9023-D), 62T26 (Code 9023-E), 62TC36 (Code 9023-F). 2—21
72CR16, 72CR26 .... 18—28
9000-B .... 11—22
9001-C, D, E, F .... 8—29
9002-A, 9002-B, 9002-P, 9002-R .... 38—24
9005-A, B .... 13—31
9007-A, F, G .... 10—30
Models 9100A, 9100B, 9100C, 9100D, 9100E, 9100F, 9100G, 9100H Tel. Rec............. 75—15
9103-B,-C, 9104-A,-B,-C Tel. Rec. ....105—10
9106A, B Tel. Rec.......118—10
9108A, B, 9109A, B Tel. Rec. (See Model 9106A) 118
9113A Tel. Rec. (See Model 9106A)....118
9120-A, -B, -C, -D, -E, -F Tel. Rec. 119-1A
9121-A, 9121-B, 9122-A Tel. Rec. ....138—9
9150-B, 9150-D, 9150-DZ 140—12
9151-A ....106—14
9152-A,-B,-C ....102—14
9153-A ....108—12
9154-C, 9154-CZ ....142—13
9200-A, -C, -D, -FA, -G Tel. Rec.........132—13
9202-C, -DA, -DB, -DD, -E, -F Tel. Rec........141-1A

STRATOVOX

579-1-58A .... 6—32

STROMBERG-CARLSON

AM-43 ....129—11
AM-48, AM-49..........131—14
AP-50 ....130—13
AR-37 ....128—14
AU-29 ....125—11
AU-32 ....133—12
AU-33 ....134—10

STROMBERG-CARLSON—Cont.
AU-34 128—15
AU-35 138—10
AU-36 132—14
AU-42 137—12
AV-38, AV-39 126—13
TC-10 Tel. Rec. 79—17
TC-10 Tel. Rec. Prod. Chge. Bul. 1 103—19
TC-19 Tel. Rec. 97—17
TC-125 Tel. Rec. 95A-13
TS-15, TS-16, TS-125 Series Tel. Rec. 72—12
TV-10L, TV-10LW (112020) Tel. Rec. *
TV-10PM, TV-10PY (112025, 112022) Tel. Rec. *
TV-12 Series PHOTOFACT Servicer . 88
TV-125 (Ch. TV-12) 68—16
16 Series Tel. Rec. 135—12
17 Series Tel. Rec. (See Series 16) 135
24 Series Tel. Rec. 138—11
32 11—23
116 Series Tel. Rec. (See 16 Series) 135
117 Series Tel. Rec. (See Model 119CDM) 130
119CDM, 119 CM Tel. Rec. 130—14
119M5A, D, G, I, M, R Tel. Rec. (See Model 119CDM) 130
119 RPM2 Tel. Rec. (See Model 119CDM) 130
317RPM, 317TM Tel. Rec. 146—10
1020 (See Model 1220 Series) 50
1100-H, 1100-HI 20—31
1101-HB, 1101-HI (Ch. 112002), 1101-HM, 1101-HW, 1101-HY (Ch. 112001) 2—9
1101-HPW 41—23
1105 (Series 10-11) 18—29
1110-HW, 1110-PTW (Series 10) 18—30
1120 (See Model 1220 Series) 50
1121-HW, LW, M1-0, M2-W, M2-Y, PFM, PFW, PGM, PGW, PLM, PLW, PSM (Series 10-11-12) . 10—31
1135-PFM, 1135-PLM, 1135-PLW (Series 10-11) 23—26
1200 57—20
1202 (Series 10) 55—21
1204 (Ch. 112021) 34—22
1210M2-M, 1210M2-W, 1210M2-Y, 1210PGM, 1210PLM, 1210PGW (Series 10-11) 37—23
1220 Series 50—19
1235 Series 49—23
1400 (See Model 1200) 57
1407PFM, 1407PLM 58—23
1409M2-M, 1409M2-Y, 1409M-2W, 1409M3-A, 1409M3-M, 1409PG-M, 1409PG-W 62—20
1500 132—15
1507 133—13

STUDEBAKER
S-4624, S-4625 21—32
S-4626, S-4627 19—32

SUPREME (Lipan)
711 68—17
712S 63—17
733 60—19
738LP 64—13
750 55—22

SWANK
5 Tube Radio-phono (DU101) 5—21
ER61 17—33

SYLVANIA
1-075 (Ch. 1-139) Tel. Rec. 92—8
1-076 (Ch. 1-108) Tel. Rec. 96—11
1-076 (Ch. 1-108) Tel. Rec. Prod. Chge. Bul. 2 103—20
1-090 (Ch. 1-168) Tel. Rec. 99—17
1-113, 1-114 Tel. Rec. (See Model 1-075) 92
1-124, 1-125 Tel. Rec. (See Model 1-075) 92
1-125-1 (Ch. 1-186) Tel. Rec. 113—9
1-128 (Ch. 1-108) Tel. Rec. (See Model 1-076). 96
1-128 (Ch. 1-108) Tel. Rec. Prod. Chge. Bul. 2 103—20
1-177 (Ch. 1-186) Tel. Rec. (See Model 1-075) 92
1-197 (Ch. 1-139) Tel. Rec. (See Model 1-075) 92
1-197-1 (Ch. 1-186) Tel. Rec. (See Model 1-125-1) 113
1-210 (Ch. 1-139) Tel. Rec. (See Model 1-075). 92
1-245, 1-246 (Ch. 1-139) Tel. Rec. (See Model 1-075) 92
1-245-1, 1-246-1 (Ch. 1-186) Tel. Rec. (See Model 1-125-1) 113
1-247 (Ch. 1-168) Tel. Rec. (See Model 1-090) 99
1-247-1 (Ch. 1-231) Tel. Rec. *
1-250, 1-251, 1-252 (Ch. 1-215) 103—16
72M, 73B, M (Ch. 1-366) Tel. Rec. (See Model 4120M) 124
510B, 510H, 510W (Ch. 1-215) (See Model 1-250) 103

SYLVANIA—Cont.
540B, 540H, 540M 119—11
1110X (Ch. 1-329 Tel. Rec. (See Model 1210X) 128
1210X (Ch. 1-381) Tel. Rec. 128—16
2130B, W (Ch. 1-462) Tel. Rec. (See Model 5130B) 120
2130M (Ch. 1-462) Tel. Rec. (See Model 5130B) 120
2140B, M (Ch. 1-462) Tel. Rec. (See Model 5130B) 120
2221M (Ch. 1-387) Tel. Rec. 137—13
4120M (Ch. 1-260) Tel. Rec. 124—10
4130B, 4130E, 4130M, 4130W (Ch. 1-260) Tel. Rec. (See Model 4120M) 124
5130B, M, W (Ch. 1-290) Tel. Rec. 120—10
5130B, M, W, (Ch. 1-290) Tel. Rec. Prod. Chge. Bul. 17 128—1
5140B, M (Ch. 1-290) Tel. Rec. (See Model 5130B) 120
5140B, M (Ch. 1-290) Tel. Rec. Prod. Chge. Bul. 17 128
5150M (Ch. 1-274) Tel. Rec. 131—15
6110X (Ch. 1-261) Tel. Rec. (See Model 4120M) 124
6120B, 6120M, 6120W (Ch. 1-261) Tel. Rec. (See Model 4120M) 124
6130B, 6130M, 6130W (Ch. 1-261) Tel. Rec. (See Model 4120M) 124
6140M, W (Ch. 1-271) Tel. Rec. (See Model 5130B) 120
7110X (Ch. 1-366) Tel. Rec. (See Model 4120M) 124
7110XB (Ch. 1-441) Tel. Rec. *
7110XF (Ch. 1-366-66) Tel. Rec. (See Model 4120M) 124
7110XFA (Ch. 1-442) Tel. Rec. (See Model 5150M) 131
7111M (Ch. 1-441) Tel. Rec. *
7111MA (Ch. 1-366) Tel. Rec. (See Model 4120M) 124
7120B, 7120M, 7120W (Ch. 1-366) Tel. Rec. (See Model 4120M) 124
7120BF, MF, WF (Ch. 1-366-66) Tel. Rec. (See Model 4120M) 124
7120MFA (Ch. 1-442) Tel. Rec. (See Model 5150M) 131
7130B, 7130M, 7130W (Ch. 1-366) Tel. Rec. (See Model 4120M) 124
7130BF, MF, WF (Ch. 1-366-66) Tel. Rec. (See Model 4120M) 124
7130E (Ch. 1-366 Tel. Rec. (See Model 4120M) 124
7130MFA (Ch. 1-442) Tel. Rec. (See Model 5150M) 131
7140 M,W (Ch. 1-356) Tel. Rec. (See Model 5130B) 120
7140MA, 7140WA (Ch. 1-437) Tel. Rec. (See Model 5150M) 131
7150M (Ch. 1-357) Tel. Rec. (See Model 5150M) 131
7160B (Ch. 1-357) Tel. Rec. (See Model 5150M) 131
Ch. 1-139 (See Model 1-075) 92
Ch. 1-168 (See Model 1-090) 99
Ch. 1-186 (See Model 1-125-1) 113
Ch. 1-215 (See Model 1-250) 103
Ch. 1-260 (See Model 4120M) 124
Ch. 1-261 (See Model 4120M) 124
Ch. 1-271 (See Model 5130B) 120
Ch. 1-274 (See Model 5150M) 131
Ch. 1-290 (See Model 5130B) 120
Ch. 1-357 (See Model 5150M) 131
Ch. 1-366, 1-366-66 (See Model 4120M) 124
Ch. 1-381 (See Model 1210X) 128
Ch. 1-387 (See Model 2221M) 137
Ch. 1-437 (See Model 5150M) 131
Ch. 1-442 (See Model 5150M) 131

TELECHRON
8H67 "Musalarm" 44—23

TELECOIN
M5TS4 25—28

TELECRAFT
30T14A-056 Tel. Rec. (Similar to Chassis) 119—3
38T12A-058 Tel. Rec. (Similar to Chassis) 109—1
317T3 Tel. Rec. (Similar to Chassis) 72—4
318T4 Tel. Rec. (Similar to Chassis) 85—3

TELECRAFT—Cont.
318T45 Tel. Rec. (Similar to Chassis) 85—3
318T4-872 Tel. Rec. (Similar to Chassis) 85—3
318T6A Tel. Rec. (Similar to Chassis) 85—3
318T6A-950 Tel. Rec. (Similar to Chassis) 85—3
318T9A-900 Tel. Rec. (Similar to Chassis) 78—4
518T6A Tel. Rec. (Similar to Chassis) 85—3
518T9A-918 Tel. Rec. (Similar to Chassis) 78—4
518T10A-916 Tel. Rec. (Similar to Chassis) 78—4
2318T6A-954 Tel. Rec. (Similar to Chassis) 85—3
2318T9A-912 Tel. Rec. (Similar to Chassis) 78—4

TELE-KING
C716X Tel. Rec. *
T-516 Tel. Rec. *
16CD3CR Tel. Rec. *
114 Tel. Rec. 141—13
116, 116C Tel. Rec. (See Model 114) 141
117, 117C, 117LO Tel. Rec. (See Model 114) 141
162 Tel. Rec. 129—12
172 (Ch. TVG) Tel. Rec. (See Model 201) 131
174 (Ch. TVG) Tel. Rec. (See Model 201) 131
201, 202 Tel. Rec. 131—16
203 (Ch. TVG) Tel. Rec. (See Model 201) 131
210 Tel. Rec. *
310 Tel. Rec. *
410 Tel. Rec. 88—12
416 Tel. Rec. *
510 Tel. Rec. (See Model 410) 88
512 Tel. Rec. (See Model 410) 88
516 Tel. Rec. (See Model 114) 141
612 Tel. Rec. (See Model 410) 88
710 Tel. Rec. (See Model 410) 88
712 Tel. Rec. (See Model 410) 88
716 Tel. Rec. (See Model 162) 129
816-3CR Tel. Rec. *
916C Tel. Rec. (See Model 162) 129
919C Tel. Rec. (See Model 114) 141
920 (Ch. TVG) Tel. Rec. (See Model 201) 131
1014 (Ch. TVG) Tel. Rec. (See Model 201) 131
1016 (Ch. TVG) Tel. Rec. (See Model 201) 131
Ch. TVG Tel. Rec. (See Model 201) 131

TELEQUIP
Ch. 12TR, 14T, 14TR, 16T, 16TR, 19T, 19TR Tel. Rec. *
C316MF Tel. Rec. *
C317MF Tel. Rec. *
C320MF Tel. Rec. *
C516D Tel. Rec. *
C517D Tel. Rec. *
C519D Tel. Rec. *
C617D Tel. Rec. *
C619D Tel. Rec. *
C620D Tel. Rec. *
C720D Tel. Rec. *
C820D Tel. Rec. *
T216L Tel. Rec. *
T217L Tel. Rec. *
T416D Tel. Rec. *
T417D Tel. Rec. *
T417MF Tel. Rec. *
5135, 5136, 5140A 11—24

TELESONIC (Medco)
1635 20—22
1636 21—33
1642 20—23
1643 21—34

TELE-TONE
TV149 Television Rec. 56—22
TV-170 Tel. Rec. 83—12
TV-208 Tel. Rec. 90—11
TV208TR Tel. Rec. 95—6
TV-209 Tel. Rec. (See Model TV-249) 57
TV-209 Tel. Rec. Prod. Chge. Bul. 21 136—1
TV-210 Tel. Rec. (See Model TV-249) 57
TV-210 Tel. Rec. Prod. Chge. Bul. 21 136—1
TV-220 Tel. Rec. (See Model TV208TR) 95
TV-245, 246 Tel. Rec. *
TV-249 Television Rec. 57—21
TV-249 Tel. Rec. Prod. Chge. Bul. 21 136—1
TV-250 Tel. Rec. 91—13
TV-254 Tel. Rec. (See Model TV-250) 91
TV-255, TV-256 (Ch. TS) Tel. Rec. 101—13
TV259 Tel. Rec. (See Model TV249) 57
TV-282 Tel. Rec. 71—14
TV-283 Tel. Rec. (See Model TV-285) 87
TV-284 Tel. Rec. 93—10
TV-285 Tel. Rec. 87—13
TV-286, 287, 288 Tel. Rec. (See Model TV-284) 93
TV-300, TV-301 (Ch. TAA, TAB) Tel. Rec. 99A-12

TELE-TONE—Cont.
TV-300, TV-301 (Ch. TW) Tel. Rec. 107—10
TV-304, TV-305 (Ch. TAA, TAB) Tel. Rec. (See Model TV-300) 99A
TV-304, TV-305 (Ch. TX) Tel. Rec. (See Model TV-300) 107
TV-306, TV-307 (Ch. TY, TZ) Tel. Rec. 104—12
TV-308 (Ch. TAC) Tel. Rec. 109—14
TV314 (Ch. TAJ) Tel. Rec. 125—12
TV-315 (Ch. TAA, TAB) Tel. Rec. 115—13
TV-316 (Ch. TAH) Tel. Rec. 135—13
TV-317 Tel. Rec. *
TV318 (Ch. TAM) Tel. Rec. 124—11
TV322, TV323 (Ch. TAM) Tel. Rec. (See Model TV318) 124
TV324, TV325, TV326 (Ch. TAP, TAP-1 TAP-2) Tel. Rec. 127—12
TV328, TV329 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. (See Model TV324) 127
TV-330, TV-331, TV-332, TV-333 (Ch. TAO) Tel. Rec. 145—11
TV335, TVJ36 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. (See Model TV324) 127
TV340 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. (See Model TV324) 127
TV345 (Ch. TAP, TAP-1, TAP-2) Tel. Rec. (See Model TV324) 127
TV-352 Tel. Rec. (See Model TV-324) 127
TV-355, TV-357 (Ch. 8001, 8002, 8003) Tel. Rec. (See Model TV-330) 145
TV-358, TV-359 (See Model TV-324) 127
TV-360, TV-365 (Ch. 8001, 8002, 8003) Tel. Rec. (See Model TV-330) 145
100, 100-A, 101, 109 (Ch. Series A) 39—26
109 (Ch. Series J) 8—30
110 (See Model 117-A) 1
111, 113 (See Model 100) 39
117-A (Ch. Series "D") 1—35
119, 120 (See Model 117-A) 1
122, 123 (See Model 100) 39
124 (See Model 117-A) 1
125 (See Model 100) 39
126 (See Model 117-A) 1
127, 130, 131 (See Model 100) 39
132 (See Model 117-A) 1
133 11—25
134 13—32
135 14—29
138 (Ch. Series N) 23—27
139, 140, 141 (Ch. Series H) (See Model 135) 14
142, 143, 144 (See Model 145) 23
145 (Ch. Series "R") 23—28
148 (Ch. Series S) 24—26
149 (Ch. Series H) (See Model 135) 14
150 (Ch. Series T) 38—25
151 (Ch. Series S) (See Model 148) 24
152 (Ch. Series R) (See Model 145) 23
156 (Ch. Series U) 35—23
157 (Ch. Series H) (See Model 135) 14
157 (Ch. Series AE) 49—24
158 (Ch. Series AT) 59—20
159 (Ch. Series AA) 38—26
160 (Ch. Series Y) 36—24
161, 162 (Ch. Series T) (See Model 150) 38
163, 164 (Ch. Series H) (See Model 135) 14
165 (Ch. Series AG) 50—20
166 (Ch. AE) (See Model 157) 49
167, 168, 171 (Ch. Series T) (See Model 150) 38
172 (Ch. Series U) (See Model 156) 35
174 (Ch. Series T) (See Model 150) 38
176 (Ch. Series U) (See Model 156) 35
182 51—22
183 53—24
185 (Ch. Series AH) 52—21
190 (Ch. Series AZ) 61—19
195 (Ch. Series BH) 71—15
198 (See Model 158) 59
200 (Ch. Series AZ) (See Model 190) 61
201 (Ch. Series AX) 74—9
205 (Ch. Series BD) 73—12
206 127—11
214 (Ch. Series AZ) (See Model 190) 61
215 (Ch. Series BD) (See Model 205) 73
228 (Ch. BL) 144—13
232 (Ch. Series BP) (See Model 205) 73
235 (Ch. BQ) 141—14
Ch. Series A (See Model 100) 39
Ch. Series AA (See Model 159) 38
Ch. Series AE (See Model 157) 49

TELE-TONE—Cont.
Ch. Series AG (See Model 165) 50
Ch. Series AH (See Model 185) 52
Ch. Series AT (See Model 158) 59
Ch. Series AX (See Model 201) 74
Ch. Series AZ (See Model 190) 61
Chassis Series BD (See Model 205) 73
Chassis Series BH (See Model 195) 71
Ch. BL (See Model 228) 144
Ch. BQ (See Model 235) 141
Ch. Series C (See Model 134) 13
Ch. Series CA (See Model 133) 11
Ch. Series D (See Model 117A) 1
Ch. Series H (See Model 135) 14
Ch. Series K (See Model 109) 8
Ch. Series N (See Model 138) 23
Ch. Series R (See Model 145) 23
Ch. Series S (See Model 148) 24
Ch. Series T (See Model 150) 38
Ch. TAA, TAB (See Model TV-315) 115
Ch. TAC (See Model TV-308) 109
Ch. TAH (See Model TV-316) 135
Ch. TAJ (See Model TV314) 125
Ch. TAM (See Model TV318) 124
Ch. TAO (See Model TV-330) 145
Ch. TAP, TAP-1, TAP-2 (See Model TV324) 127
Ch. TS (See Model TV-255) 101
Ch. TW, TX (See Model TV-300) 107
Ch. TY, TZ (See Model TV-306) 104
Ch. Series U (See Model 156) 35
Ch. Series Y (See Model 160) 36
Ch. 8001, 8002, 8003 (See Model TV-330) 145

TELEVOX
RP 22—29
27JB-2W 20—32
27K-W 20—33
27-P-T 22—28

TEL-VAR (See Audar)

TEMPLE
E-301 21—35
E-510 2—3
E-511 11—26
E-512, E-514 (See Model E-510) 2
E-519 (See Model E-510) . 2
F-301 12—26
F-611 9—32
F-616 5—38
F-617 12—27
G-410 27—28
G-415 43—18
G-418, G-419 26—25
G-513 23—29
G-515 17—34
G-516 18—31
G-518 29—27
G-521 28—33
G-522 26—26
G-619 22—30
G-622 44—24
G-721 (See Model G-722). 24
G-722 24—27
G-723 (See Model G-722). 24
G-724 38—27
G-725 34—23
G-1430 43—19
G-4108 (See Model G-418) 26
G-7205 (See Models G-721, G-722, G-723) . 24
H-411 47—23
H-521 (See Model G-521) 28
H-622 (See Model G-622). 44
H-727 (See Model G-725) 34
TV-1776, TV-1777, TV-1778, TV-1779 Tel. Rec. 66—16

TEMPOTONE
500 E Series 2—8

TEMPLETONE (See Temple)

THORDARSON
T-30W08A 8—31
T-31W10A 30—30
T-31W10-AX 57—22
T-31W25A 9—33
T-31W50A 20—34
T-32W00, T-32W10 76—18

TONE PAK
AC8HF 24—28

TRAD
T-20, A Tel. Rec. 133—14
TT63SH Tel. Rec. *

TRANSVISION
Chassis Model A Tel. Rec. 107—11
Chassis A-3 Tel. Rec. 130—15
WRS-3 Tel. Rec. 112—10

TRANSVUE
17XC, 17XT Tel. Rec. (Similar to Chassis)....132—8
20XC, 20XT Tel. Rec. (Similar to Chassis)....132—8
601 (Ch. 16AX23, 25, 26) Tel. Rec. .... *
610 (Ch. 16AX23, 25, 26) Tel. Rec. .... *
1400T Tel. Rec. (Similar to Chassis)....132—8
1700C, T Tel. Rec. (Similar to Chassis)....132—8
2000C Tel. Rec. (Similar to Chassis)....132—8

TRAV-LER
10T Tel. Rec............ 86—11
12L50, A Tel. Rec.......108—13
12T Tel. Rec. (See Model 10T)............... 86
14B50, A, 14C50, A Tel. Rec. (See Model 12L50).........108
16G50A Tel. Rec. (See Model 12L50).........108
16R50A, 16T50A Tel. Rec. (See Model 12L50).........108
16T Tel. Rec. (See Model 10T)....... 86
20A50 Tel. Rec.........146—11
62R50, 63R50 Tel. Rec... *
64G50, 64G50-1, 64G50-2 Tel. Rec. (See Model 20A50)....146
64R50, 64R50-1, 64R50-2 Tel. Rec. (See Model 20A50)....146
75A50, 75A50-1, 75A50-2 Tel. Rec. (See Model 20A50)....146
114-1A, -2 Tel. Rec...... *
117-3, -4 Tel. Rec....... *
119-5 Tel. Rec.......... *
5000 (See Model 5000I).. 11
5000I .... 11—27
5002 Series (Ch. 109) .... 12—28
5007, 5008, 5009 (Ch. 104) .... 1—36
5010, 5011, 5012 (Ch. 105) .... 2—5
5015 .... 36—25
5019 .... 23—30
5020 (Ch. 800) .... 11—28
5021 .... 43—20
5022 ....101—14
5027 .... 31—30
5028 .... 34—24
5029 .... 33—29
5030, 5031 .... 32—25
5036 .... 54—19
5049 .... 45—24
5051 .... 32—26
5054 .... 36—26
5056-A .... 90—12
5060, 5061 ....116—11
5066 .... 42—24
6040 .... 49—25
6050 .... 56—23
7000, 7001 .... 59—21
7003 (Ch. 501) .... 12—29
7014 (See Model 7000)... 59
7016, 7017 .... 84—11
7023 .... 83—13
7036 ....112—11
Chassis 104 (See Model 5007)..... 1
Chassis 105 (See Model 5010)..... 2
Chassis 109 (See Model 5002)..... 12
Chassis 501 (See Model 7003)..... 12
Chassis 800 (See Model 5021)..... 11

TRELA
HW301 .... 14—28

TRUETONE
D1034B, C (See Model D1046A)..102
D1046A ....102—15
D1046C, D (See Model D1046A)..102
D1090 Tel. Rec......... *
D1092 Tel. Rec......... *
D1612 .... 28—34
D1644 .... 12—30
D1645 (Factory 26A76-650) 6—33
D1747, D1748 .... 32—27
D1752 (Factory 7901-14) . 34—25
D1835 (Factory Model 25A86-856) .... 44—25
D1836, D1836A (Factory 26A85-856) .... 45—25
D1840 (Fact. No. 138PCXM) .... 46—24
D1845 .... 31—31
D1846A, B, C .... 40—23
D1850 (Series A)........ 51—23
D1949 .... 60—20
D1950, D1951 (See Model D1850) 51
D1952 (See Model D1949) 60
D1990, D1992 (Factory No. 7AF22) Tel. Rec....... 69—13
D1991, B, D1993, B, D1994 Tel. Rec........ 77—11
D1996 Tel. Rec. (See Model D2983).... 68
D1997A Tel. Rec........ *
D1998A Tel. Rec........ *
D2017, D2018 ....101—15
D2020 ....106—15
D2025A (Fact. Mod. 26A95-906) .... 83—14
D2027A .... 97—18
D2050A Tel. Rec......... *
D2603 (Factory No. 461) . 13—33
D2604 .... 13—34
D2605 (Factory Model 2AW2) .... 9—34
D2606 .... 65—15

TRUETONE—Cont.
D2612 (Code SW-9022-G) 3—9
D2613 .... 13—37
D2615 (Factory Model 6D110) .... 2—18
D2616 (Factory Model 6D117) .... 10—32
D2616-B .... 31—32
D2619 (Factory No. 2701) 27—29
D2620 .... 1—28
D2621 .... 4—32
D2622 .... 14—30
D2623 .... 11—29
D2624 (Factory 27D14-600) 2—6
D2626 (Fact. No. 457-2).. 52—22
D2630 (Factory 27D14-602 Issue A) ... 1—10
D2634 .... 12—31
D2640 (Factory No. 459) . 43—21
D2642 .... 12—32
D2644 (Factory No. 101C) 11—30
D2645 .... 4—39
D2661 (Factory 4B19) .... 2—23
D2663 (Ch. 4C1) .... 11—31
D2665 (Factory 4B114 Series A) .... 22—31
D2692 .... 39—28
D2709 (Factory No. 470) . 27—30
D2710 (Factory No. 24D22-630BR) .... 23—31
D2718 (Factory No. 227D14-638IU) .... 23—32
D2743 .... 25—29
D2745 (See Model D1645) 6
D2748 (Ch. 7156) .... 26—27
D2806, D2807 (Factory Model 181) .... 44—26
D2810 (Factory No. 24D24-730BB) .... 36—27
D2815 .... 48—25
D2819 (Factory No. 26A82-738) .... 35—24
D2851 .... 38—28
D2906 (Factory No. 189).. 69—14
D2910 .... 65—16
D2919 (Fact. No. 6DF21). 59—22
D2963 .... 73—13
D2982 Tel. Rec.......... *
D2983 Tel. Rec.......... 68—18
D2985 Tel. Rec.......... 70—11
D2987 (See Model 1990) Tel. Rec. 69
D2988, D2989 Tel. Rec.... *
D2990 Tel. Rec.......... *
D3615 (Factory 25BD2-606) 18—32
D3619 (Factory 5P110) ... 10—33
D3630, D3630N .... 19—33
D3720 .... 24—29
D3721 (Factory 110BX) .. 32—28
D3722 (Fact. No. 472)... 51—24
D3809 (Factory No. 178) . 43—22
D3810 .... 39—27
D3811 (Fact. No. 114BXH) .... 47—24
D3840 .... 49—26
D3910 (Fact. Model 140611) .... 74—10
D4142A ....142—14
D4620 (Factory No. 5C12) 26—28
D4630 (Factory 26C19-61) 7—28
D4818 (Fact. No. 134DX) 45—26
D4832 (Fact. No. 25C22-82) .... 47—25
D4842 (Fact. No. 26C21-81) .... 50—21
2D1088A Tel. Rec. .....105—11
2D1088B Tel. Rec........145-1A
2D1089A Tel. Rec.......113—10
2D1089B ....136—14
2D1093A, 2D1094A Tel. Rec. ....119—12
2D1095 Tel. Rec.........134—11
2D1185A Tel. Rec........ *
2D1190A Tel. Rec........ *
2D1194A Tel. Rec........ *
2D2052 Tel. Rec. (See Model 2D1095)..134
2D2053 Tel. Rec.........120—11

ULTRADYNE
L-46 .... 4—21

UNITED MOTORS SERVICE
(See Delco or Buick, Chevrolet, Oldsmobile and Pontiac)

U. S. TELEVISION
C-12923P Tel. Rec....... *
C16030 Tel. Rec........ 99A-12
C19031 Tel. Rec. (See Model C16030)... 99A
CFM-12823P Tel. Rec..... *
CFM-15925 Tel. Rec...... *
CFM-16926 Tel. Rec...... *
K-25936 Tel. Rec........ *
K-30936 Tel. Rec........ *
KFM-25-PIC Tel. Rec..... *
KFM-25836 Tel. Rec...... *
KFM-30836 Tel. Rec...... *
KRF-15933 Tel. Rec...... *
KRV-12831P Tel. Rec..... *
KRV-15831P Tel. Rec..... *
T-3X4836 Tel. Rec....... *
T502M, T502P Tel. Rec... *
T-507, T-507M Tel. Rec... *
T-525L Tel. Rec......... *
T621M, T621P Tel. Rec... *
T-10823 Tel. Rec........ 89—15
T-10925 Tel. Rec........ *
T-12823 Tel. Rec........ *
T-12923P Tel. Rec....... *
T-15823 Tel. Rec........ *
T-15925 Tel. Rec........ *
T16030 Tel. Rec. (See Model C16030)... 99A
T19031 Tel. Rec. (See Model C16030)... 99A
5A16, 5B16, 5C16 (See Model 5C66 Early). 17
5A66, 5B66, 5C66, 5D66MPA .... 24—30
5C66 Early .... 17—9
8-16M (Dumbarton) ..... 26—29

UNITONE
88 .... 5—26

V-M
150 ....139—15
980 ....138—12
1001-A .... 10—34

VAN-CAMP
576-1-6A .... 7—29

VIDEO CORP. OF AMERICA (See Videola)

VIDEODYNE
10FM, 10TV, 12FM, 12TV Tel. Rec. .... 69—15

VIDEOLA
VS-160, VS-161 Tel. Rec.. 92—9
VS-165, VS-166, VS-167, VS-168 Tel. Rec. (See Model VS-160).... 92

VIDEO PRODUCTS
630FM3B, 630K3B Tel. Rec. .... *

VIEWTONE
RC-201A, RRC-201 .... 11—32

VISION MASTER
14MC, MT Tel. Rec. (Similar to Chassis)....117—8
16MC, 16MT, 16MXC, 16MXCS, 16MXT, 16MXTS Tel. Rec. (Similar to Chassis)....117—8
17MC, 17MT, 17MXC, 17MXCS, 17MXT, 17MXTS Tel. Rec. (Similar to Chassis)....117—8

VIZ
RS-1 .... 14—31

VOGUE
532 A-P .... 11—33
Ch. Models 553R, 554R .. 8—32

WARWICK (See Clarion)

WATTERSON
ARC-4591A .... 16—36
PA-4585, APA-4587 ..... 3—2
RC-4581 .... 16—35
4581 .... 3—32
4582 .... 6—34
4782 .... 24—31
4790 .... 16—34
4800 .... 43—23

WEBSTER-CHICAGO
66-1A .... 34—26
100-608 ....121—14
100-621 ....113—11
130 ....119—13
161-1 .... 55—23
288 ....117—14
362 ....105—12
760 ....112—12
762 (See Model 362)....105

WEBSTER ELECTRIC
81-15, 81A-15 ....142—15
82-25, 82A-25, 83-25....143—15
84-25 ....145—12
85-25 ....144—14

WEBSTER (Telehome)
W606M .... 56—24
604M .... 57—23

WESTERN AUTO (See Truetone)

WESTINGHOUSE
H-104, H-105 .... 4—11
H-104A, H-105A, H-107A, H-108A .... 21—36
H-107, H-108, H-110, H-111 .... 4—19
H-113, H-114, H-116 (See Model H-117)..... 11
H-117, H-119 .... 11—34
H-122 .... 6—35
H-122A, H-122B (See Model H-122)..... 6
H-125, H-126 .... 3—19
H-130 (See Model H-122) . 6
H-133 .... 14—34
H-137 (See Model H-138). 6
H-138 .... 6—36
H-147 .... 31—33
H-148 .... 15—37
H-148A (See Model H-148) 15
H-153, H-153A (Ch. V-2103) .... 35—25
H-154 (See Model H-104A) 21
H-155 (See Model H-153). 35
H-156 (See Model H-153) 35
H-157 (Ch. V-2122) ..... 33—31
H-161 (Ch. V-2118)...... 34—27
H-162 (See Model H-117). 11
H-164 (Ch. V-2119-1) ... 36—28
H-165 .... 32—29
H-166, H-167 (See Model H-164)..... 36
H-168, H-168A, H-168B (Ch. V-2118) (See Model H-161) 34
H-169 (Ch. V-2124-1) ... 37—24
H-171, H-171A, H-171C (Ch. V-2103) (See Model H-153) 35
H-178 (Ch. V-2123) ..... 35—26
H-181 Tel. Rec.......... *
H-182 (Ch. V-2128), (Ch. V-2128-1) .... 53—25
H-183, H-183A .... 48—26
H-184 (See Model H-153) 35
H-185 (Ch. V-2131, V-2131-1) .... 54—20
H-186M, H-187 (Ch. V-2132) .... 60—21
H-188 (Ch. V-2133)...... 51—25
H-190, H-191, H-191A (Ch. V-2134) .... 59—23
H-195 (See Model H-184). 54

WESTINGHOUSE—Cont.
H-196 Tel. Rec.......... 65—17
H-196A (CHV-2130-1) Tel. Rec. (See Model H-196) 65
H196A (DX) (Ch. V-2130-11DX or V-2130-12DX) Tel. Rec. 84—13
H-198 (Ch. V-2137-2).... 73—15
H-199 (Ch. V-2137-1).... 69—16
H-202 (Ch. V-2128-2).... 50—22
H-203 (Ch. V-2137)..... 62—21
H-204 (See Model H-202). 50
H-207A (Ch. V-2130-1, V-2137) Tel. Rec. (See Model H-196)......... 65
H207A (DX) (Ch. V-2130-11DX or V-2130-12DX and Radio Ch. V-2137) Tel. Rec. (See Model H196A (DX)) 84
H207B (DX) (Ch. V-2130-21DX or V-2130-22DX and Radio Ch. V-2137) Tel. Rec. (See Model H196A (DX)) 84
H-210, H-211 (Ch. V-2144, V-2144-1) ... 61—20
H-212 (Ch. V-2137) (See Model H-203) 62
H-214, H-214A (Ch. V-2103-3) .... 75—16
H-216, H-216A (Ch. V-2146-05, V-2146-45, V-2149-1) Tel. Rec..... 97A-14
H-217, H-217A (Ch. V-2146-1, V-2137, V-2149) Tel. Rec...... *
H-217, H-217A (Ch. 2146-11DX, V-2137, V-2149) Tel. Rec. (Supp. to H-217B, Set 91)..... 99A-14
H-217B (Ch. V-2146-35DX, V-2137, V-2149) Tel. Rec. .... 91—14
H-220 (See Model H-190). 59
H-223 (Ch. V-2150-01, V-2150-02) Tel. Rec.... 78—14
H-225 (DX) (Ch. V-2130-31DX or V-2130-32DX) Tel. Rec. (See Model H196A (DX)) 84
H-226 (Ch. 2146-21DX, 2146-25DX, 2149) Tel. Rec. (See Model H-217B) 91
H-231 (Ch. 2150-51 and V-2137-3 or V-2137-3S, V-2149-2) Tel. Rec. 99A-14
H-242 (Ch. 2150-31) Tel. Rec. 97A-14
H-251 (Ch. V-2150-81, -82, -84) Tel. Rec...... 99A-14
H300T5, H301T5 (Ch. V-2148) .... 88—14
H-302P5 (Ch. V-2151-1).. 91—15
H303P4, H304P4 (Ch. V2153) .... 89—16
H-307T7, H-308T7 (Ch. V-2136) ....100—13
H-309P5, H-309P5U (Ch. V-2156) ....101—16
H-310T5, H-310T5U, H-311T5, H-311T5U (Ch. V-2161, V-2161U). 99—18
H-312P4, H-312P4U, H-313P4, H-313P4U, H-314P4, H-314P4U, H-315P4, H-315P4U (Ch. V-2153-1) .... 98—13
H-316C7 (Ch. V-2136-1).112—13
H-317C7 (Ch. V-2136-1) (See Model H316C7)...112
H-318T5, U (Ch. V-2157, U).......117—15
H-320T5, U (Ch. V-2157, U) (See Model H-318T5) 117
H-321T5, U, H-322T5, U (Ch. V-2157-1, U) (See Model H-318T5)..117
H-323T5, U (Ch. V-2157-2, U) (See Model H-318T5) 117
H-324T7, H-325T7, U (Ch. V-2136-2) ....113—13
H-326C7 (See Model H-316C7) 112
H-327T6U (Ch. V-2157-3U) ....126—14
H-328C7, U (Ch. V-2136-4) ....137—15
H334T7U, H-335T7U (Ch. V-2136-5U) .....142—16
H-336T5U, H-337T5U (Ch. V-2157U)..........134—12
H-338T5U (Ch. V-2157-4U) .....140—13
H-341T5U (Ch. V-2157-4U) (See Model H-338T5U).140
H-342P5U, H-343P5U (Ch. V-2156-1U) .....138—13
H-600T16 (Ch. V-2150-61, A, B) Tel. Rec........ 98—14
H-601K12, H-602K12 (Ch. V-2150-41) Tel. Rec. (See Model H-600T16).. 98
H-603C12 (Ch. V-2152-01 & V-2149-3) Tel. Rec...100—14
H-604T10, H-604T10A (Ch. V-2150-91A, -94, -94A) Tel. Rec. (Supp. to H-609T10, Set 95)..... 99A-14
H-605T12 (Ch. V-2150-101) Tel. Rec... 97—19
H-606K12 (Ch. V-2150-111, A) Tel. Rec.......120—12
H-607K12 (Ch. V-2150-111, A) Tel. Rec. (See Model 606K12)...120
H-608C12 (Ch. V-2152-01, V-2149-3) Tel. Rec. (See Model H-603C12)..100

WESTINGHOUSE—Cont.
H-609T10 (Ch. V-2150-94C) Tel. Rec... 95—7
H-610T12 (Ch. V-2150-136) Tel. Rec...........105—13
H-611C12 (Ch. V-2152-16) Tel. Rec. ....112—14
H-613K16 (Ch. V-2150-146) Tel. Rec.........107—12
H-614T12 (Ch. V-2150-136) Tel. Rec. (See Model H610T12)..105
H-615C12 (Ch. V-2152-16) Tel. Rec. (See Model H-611C12) 112
H-617T12 (Ch. V-2150-176) Tel. Rec. ....103—17
H-617T12 (Ch. V-2150-176, U, V-2150-177U) Tel. Rec. Prod. Chge. Bul. 10 ....116—1
H-618T16 (Ch. V-2150-186) Tel. Rec. (See Model H-617T12)..103
H-618T16 (Ch. V-2150-186, A, C, CA) Tel. Rec. (See Model H-617T12) Prod. Chge. Bul. 10...116
H-619T12,U (Ch. V-2150-176,U) Tel. Rec. (See Model H-617T12).103
H-619T12 (Ch. V-2150-176, U, V-2150-177U) Tel. Rec. (See Model H-617T12) Prod. Chge. Bul. 10...116
H-620K16 (Ch. V-2150-186) Tel. Rec. (See Model H-617T12)..103
H-620K16 (Ch. V-2150-186, A, C, CA) Tel. Rec. (See Model H-617T12) Prod. Chge. Bul. 10...116
H-622K16 (Ch. V-2150-186,A,C,CA) Tel. Rec. (See Model H-617T12)..103
H-622K16 (Ch. V-2150-186, A, C, CA) Tel. Rec. (See Model H-617T12) Prod. Chge. Bul. 10...116
H-625T12 (Ch. V-2150-197) Tel. Rec...114—11
H-626T16 (Ch. V-2172) Tel. Rec. ....116—13
H-627K16 (Ch. V-2171) Tel. Rec. (See Model H-626T16)..116
H-628K16, H-629K-16 (Ch. V-2171) Tel. Rec. (See Model H-626T16).116
H-630T14 (Ch. V-2176) Tel. Rec. (See Model H-626T16).116
H-633C17, H-634C17 (Ch. V-2173) Tel. Rec. ....122—11
H-636T17 (Ch. V-2175) Tel. Rec. (See Model H-626T16).116
H-637T14 (Ch. V-2177) Tel. Rec. (See Model H-626T16).116
H-638K20 (Ch. V-2178) Tel. Rec. ....129—13
H-639T17 (Ch. V-2192, -1) Tel. Rec..............133—15
H-640T17 (Ch. V-2175-3, -4), H-640T17A (Ch. V2192) Tel. Rec. (See Model H-639T17)..133
H-641K17 (Ch. V-2175-1, -5), H-641K17A (Ch. V-2192-1) Tel. Rec. (See Model H-639T17)..133
H-642K20 (Ch. V-2178-1, -3) Tel. Rec. (See Model H-638K20)......129
H-642K20A (Ch. V-2194, V-2194A, V-2194-1) Tel. Rec. ....137—16
H-643K16 (Ch. V-2179, V-2179-1) Tel. Rec. ..127—13
H-646K17 (Ch. V-2192) Tel. Rec. (See Model H-639T17) 133
H-647K17 (Ch. V2175-3) Tel. Rec. (See Model H-639T17) 133
H649T17 (Ch. V-2192-4) (See Model H639T17)..133
H650T7 (Ch. V2192-4) (See Model H639T17)..133
H651K17 (Ch. V-2192) (See Model H639T17)..133
H-651K17 (Ch. V-2200-1) Tel. Rec. 141-1A
H652K20 (Ch. V-2194-2, -3) (See Model H638K20) 129
H-654T17 (Ch. V-2175-3, -4, V-2192, -1) Tel. Rec. (See Model H-639T17) 133
H658T17 (Ch. V-2192 or V-2192-1) Tel. Rec. (See Model H639T17)..133
H663T17 (Ch. V-2192, -2) (See Model H639T17)..133
H-1251 (See Models H-125, H-126) 3
Ch. V-2102 (See Model H-104).... 4
Ch. V-2102-1 (See Model H-138).... 6
Ch. V-2103 (See Model H-153).... 35
Chassis V-2103-3 (See Model H-214).... 75
Ch. V-2107 (See Model H-133).... 14
Ch. V-2118 (See Model H-161).... 33
Ch. V-2119-1 (See Model H-164).... 36

WESTINGHOUSE—Cont.

Ch. V-2120 (See Model H-165).... 32
Ch. V-2122 (See Model H-157).... 33
Ch. V-2123 (See Model H-178).... 35
Ch. V-2124-1 (See Model H-169).... 37
Ch. V-2127 (See Model H-183).... 48
Ch. V-2128, V-2128-1 (See Model H-182).... 53
Ch. V-2128-2 (See Model H-202).... 50
Chassis V-2130-1 (See Model H-196).... 65
Ch. V-2130-11DX, V-2130-12DX (See Model H196A [DX])... 84
Ch. V-2130-21DX, V-2130-22DX (See Model H196A [DX])... 84
Ch. V-2130-31DX, V-2130-32DX (See Model H196A [DX])... 84
Ch. V-2131, V-2131-1 (See Model H-185).... 54
Ch. V-2132 (See Model H-186M).... 60
Ch. V-2133 (See Model H-188).... 51
Ch. V-2134 (See Model H-190).... 59
Ch. V-2136 (See Model H-307T7) 100
Ch. V-2136-1 (See Model H-316C7).. 112
Ch. V-2136-2 (See Model H-324T7).. 213
Ch. V-2136-4 (See Model H-328C7).. 137
Ch. V-2136-5U (See Model H-334T7U). 142
Ch. V-2137 (See Model H-203).... 62
Ch. V-2137-1 (See Model H-199).... 69
Chassis V-2137-2 (See Model H-198).... 73
Ch. V-2137-3, V-2137-3S (See Model H-231) 97A
Ch. V-2144, V-2144-1 (See Model H-210).... 61
Ch. V-2146-05 (See Model H-216) 97A
Ch. V-2146-11DX (See Model H-217) 99A
Ch. V-2146-21DX, V-2146-25DX (See Model H-217B).... 91
Ch. V-2146-35DX (See Model H-217B).... 91
Ch. V-2146-45 (See Model H-216)..... 97A
Ch. V-2148 (See Model H300T5)... 88
Ch. V-2149 (See Model H-217B).... 91
Ch. V-2149-1 (See Model H-216)..... 97A
Ch. V-2149-3 (See Model H-603C12). 100
Ch. V-2150-01, V-2150-02 (See Model H-223)..... 78
Ch. V-2150-11 (See Model H-606K12). *
Ch. V-2150-31 (See Model H-242).... 97A
Ch. V-2150-41 (See Model H-600T16).. 98
Ch. V-2150-51 (See Model H-231) 99A
Ch. V-2150-61, A, B (See Model H-600T16). 98
Ch. V-2150-81, -82, -84 (See Model H251)..... 99A
Ch. V-2150-91A (See Model H-604T10).. 99A
Ch. V-2150-94 (See Model H-604T10, A)... 99A
Ch. V-2150-94C (See Model H-609T10) ..... *
Ch. V-2150-101 (See Model H-605T12) 97
Ch. V-2150-111, A (See Model H-606K12). 120
Ch. V-2150-136 (See Model H-610T12).. 105
Ch. V-2150-146 (See Model H-613K16)...... 107
Ch. V-2150-176,U (See Model H-617T12).. 103
Ch. V-2150-177U (See Model H-617T12, Set 103 and Prod. Chge. Bul. 10, Set 116)
Ch. V-2150-186, A, C, CA (See Model H-617T12). 103
Ch. V-2150-197 (See Model H-625T12)... 114
Ch. V-2151-1 (See Model H-302P5)... 91
Ch. V-2152-01 (See Model H603C12) 100
Ch. V-2152-16 (See Model H-611C12). 112
Ch. V-2153 (See Model H303P4)... 89
Ch. V-2153-1 (See Model H-312P4) 98
Ch. V-2156 (See Model H-309P5).. 101
Ch. V-2156-1U (See Model H-342P5U). 138
Ch. V-2157, U, -1, -1U, -2, -2U (See Model H-318T5) 117
Ch. V-2157-3U (See Model H-327T6U) 126
Ch. V-2157-4U (See Model H-338T5U). 140
Ch. V-2158-1A (See Model H-626T16)...... *

WESTINGHOUSE—Cont.

Ch. V-2161, V-2161U (See Model H-310T5)... 99
Ch. V-2162-3, -6 (See Model H-626T16)...... *
Ch. V-2171 (See Model H-626T16).. 116
Ch. V-2173 (See Model H-633C17). 122
Ch. V-2175-1, -3, -4, -5 (See Model H-639T17).. 133
Ch. V-2175, V-2176, V-2177 (See Model H-626T16) 116
Ch. V-2178, -1, -3 (See Model H-638K20)....... 129
Ch. V-2192, -1 (See Model H-639T17)...... 133
Ch. V-2192-2, -4 (See Model H-639T17). 133
Ch. V-2194, V-2194A, V-2194-1 (See Model H-642K20A) ... 137
Ch. V-2194-2, -3 (See Model H-638K20). 129
Ch. V-2200-1 (See Model H-651K17). 141—1A

WILCOX-GAY

(Also See Majestic)
(Also See Recordio)

G403, G404 Tel. Rec. (See Majestic Model 12T2).. 108
G-414, G-614, G-624, G-914 Tel. Rec. (See Majestic Model G-414). 133
OD-446M (OD Series) Tel. Rec. .... 101—17
OF439-1-C (Ch. OF Series) Tel. Rec. .... 98—15
OD Series (See Model OD-446M).. 101
OL Series Tel. Rec......... *
9D Series Tel. Rec......... *
9W Series Tel. Rec........ *

WILLYS-OVERLAND

8030 .... 50—23

WILMAK

W-446 "DENchum" ...... 21—11

WOOLAROC

3-1A (Ch. 6-9022-J), 3-2A (Ch. 6-9022-K) .. 6—37
3-3A (Code 7-9003-D) .... 6—38
3-5A .... 22—32
3-6A/5 .... 24—32
3-9A, 3-10A .... 7—30
3-11A (Ch. 56A76) .... 8—33
3-12A/3 .... 23—33
3-13A, 3-14A, 3-15A, 3-16A .... 34—28
3-17A, 3-18A .... 34—29
3-20A .... 24—33
3-29A .... 7—31
3-61A (See Model 3-71A) 36
3-70A .... 31—34
3-71A .... 36—29

ZENITH

G500 (Ch. 5G40)........ 83—16
G503 (Ch. 5G41)........ 99—19
G510, G510Y (Ch. 5G02). 84—14
G511, G511W, G511Y (Ch. 5G01) .... 85—14
G516 (Ch. 5G03)....... 109—15
G615, G615W, G615Y (Ch. 6G05) .... 86—14
G660, G663, G665 (Ch. 6G01) .... 96—12
G723 (Ch. 7G04)....... 104—13
G724 (Ch. 7G02)....... 103—18
G725 (Ch. 7G01Z)...... 101—18
G881, G882, G883, G884, G885 (Ch. 8G20)...... 98—16
G-2322 (Ch. 23G22) Tel. Rec. .... 98—17
G2322Z (Ch. 23G24) Tel. Rec. 91A-13
G-2322Z1 (Ch. 23G24Z1) Tel. Rec. .... *
G2327Z (Ch. 23G24) Tel. Rec. (See Model G2322Z)... 91A
G-2340, R (Ch. 23G22) Tel. Rec. (See Model G2322) 98
G2340RZ, Z (Ch. 23G24) Tel. Rec. (See Model G2322Z)... 91A
G2340Z1, RZ1 (Ch. 23G24Z1) Tel. Rec.... *
G2346R (Ch. 23G22) Tel. Rec. (See Model G2322) 98
G2350RZ, Z (Ch. 23G24) Tel. Rec. (See Model G2322Z)... 91A
G2353E (Ch. 23G22) Tel. Rec. (See Model G2322) 98
G2353EZ (Ch. 23G24) Tel. Rec. (See Model G2322Z)... 91A
G2353EZ1 (Ch. 23G24Z1) Tel. Rec. .... *
G2356EZ (Ch. 23G24) Tel. Rec. (See Model G2322Z)... 91A
G2420E (Ch. 24G20) Tel. Rec. .... 93—11
G2420-EOX (Ch. 24G20-OX) Tel. Rec. (See Model G2420E)... 93
G2420R (Ch. 24G20) Tel. Rec. (See Model G2420E)... 93
G2420-ROX (Ch. 24G20-OX) Tel. Rec. (See Model G2420E)... 93
G2437RZ, G2438RZ, Z, G2439RZ (Ch. 24G26).. 91A-12
G2441 (Ch. 24G24) Tel. Rec. (See Model G2322) 98

ZENITH—Cont.

G2441R (Ch. 24G22/24) Tel. Rec. (See Model G2322).... 98
G2441RZ, Z (Ch. 24G26) Tel. Rec. (See Model G2437RZ).. 91A
G2441Z1, RZ1 (Ch. 24G26Z1) Tel. Rec.... *
G2442E, R (Ch. 24G22/24) Tel. Rec. (See Model G2322) 98
G2442RZ (Ch. 24G26) Tel. Rec. (See Model G2437RZ).. 91A
G2442EZ1, RZ1 (Ch. 24G26Z1) Tel. Rec.... *
G2448R (Ch. 24G22/24) Tel. Rec. (See Model G2322) 98
G2448RZ (Ch. 24G26) Tel. Rec. (See Model G2437RZ).. 91A
G2448RZ1 (Ch. 24G26Z1) Tel. Rec. .... *
G2454R (Ch. 24G21) Tel. Rec. (See Model G2420E)... 93
G-2454-ROX (Ch. 24G21-OX) Tel. Rec. (See Model G2420E)... 93
G2951, R, OX, ROX, G2952, R, ROX (Ch. 29G20, -OX) Tel. Rec. 95—8
G2957, R (Ch. 23G23 & Radio Ch. 6G20) Tel. Rec. (See Model G2322) 98
G2958R (Ch. 23G23 & Radio Ch. 6G20) Tel. Rec. (See Model G2322) 98
G3509R (Ch. 24G23/25 & Radio Ch. 6G20) Tel. Rec. (See Model G2322) 98
G3062 (Ch. 24G23/25 & Radio Ch. 6G20) Tel. Rec. (See Model G2322) 98
G3157RZ, Z (Ch. 23G24, 8G20/22) Tel. Rec..... 91A-13
G3157Z1, RZ1 (Ch. (Ch. 23G24Z1) Tel. Rec. *
G3158RZ (Ch. 23G24, 8G20/22) Tel. Rec. (See Model G3157RZ).. 91A
G3158RZ1 (Ch. 23G24Z1) Tel. Rec. .... *
G3173RZ, Z (Ch. 23G24, 8G20/22) Tel. Rec. (See Model G3157RZ).. 91A
G3174RZ (Ch. 23G24, 8G20/22) Tel. Rec. (See Model G3157RZ).. 91A
G3259RZ (Ch. 24G26, 8G20/22) Tel. Rec... 91A-12, 13
G3259RZ1 (Ch. 24G26Z1) Tel. Rec. .... *
G3262Z (Ch. 24G26, 8G20/22) Tel. Rec. (See Model G3259RZ).. 91A
G3262Z1 (Ch. 24G26Z1) Tel. Rec. .... *
G3275RZ (Ch. 24G26, 8G20/22) Tel. Rec. (See Model G3259RZ).. 91A
G3276Z (Ch. 24G26, 8G20/22) Tel. Rec. (See Model G3259RZ).. 91A
H615 (Ch. 6G05)....... 140—14
H661E, H661R (Ch. 6H01) .... 125—13
H665,R,RZ,Z (Ch. 6H01) (See Model H661E) ... 125
H723 (Ch. 7H04) .... 122—12
H723Z (Ch. 7H04Z)...... 134—14
H724 (Ch. 7H02) .... 126—15
H725 (Ch. 7G01Z)...... 135—15
H880, H880R (Ch. 8H20 Revised) .... 127—15
H2229R, H2230E,R (Ch. 22H21) Tel. Rec. ..... 127—1A
H880RZ (Ch. 8H20)...... 114—12
H-1083E (Ch. 10H20) (See Model H2437E)... 120
H1086R, H1087R (Ch. 10H20) (See Model H2437E) 120
H2029R, H2030E, H2030R (Ch. 20H20) Tel. Rec... 144—13
H2041R (Ch. 20H20) Tel. Rec. (See Model H2029R)... 144
H2052R, H2053E (Ch. 20H20) Tel. Rec. (See Model H2029R)... 144
H2226E, R, H2227E, H2227R (Ch. 22H20) Tel. Rec. .... 114—13
H2241R (Ch. 22H21) Tel. Rec. (See Model H2229R) .... 127—1A
H2250R (Ch. 22H20) Tel. Rec. (See Model H2226R)... 114
H2252R, H2253E (Ch. 22H21) Tel. Rec. (See Model H2229R) ...... 127—1A
H2255E (Ch. 22H20) Tel. Rec. (See Model H2226R) 114
H2328E, EZ, R, RZ (Ch. 23H22, Z) Tel. Rec...... 118—11
H2329R, RZ (Ch. 23H22, Z) Tel. Rec. (See Model H2328EZ) 118
H2352R, RZ, H2353E, EZ (Ch. 23H22, Z) Tel. Rec. (See Model H2328EZ).. 118
H2437E, R, H2438R, H2439R (Ch. 24H20) Tel. Rec. .... 120—13
H2445R (Ch. 24H21) Tel. Rec. (See Model H2437E) 120
H2447R (Ch. 24H21) Tel. Rec. (See Model H2437E) 120

ZENITH—Cont.

H2449E (Ch. 24H20) Tel. Rec. (See Model 112437E) 120
H2868 (Ch. 20H20, Radio Ch. 8H20E) Tel. Rec... *
H3068R (Ch. 22H21) Tel. Rec. (See Model H2229R) .... 127—1A
H3074 (Ch. 20H20, Radio Ch. 10H20Z) Tel. Rec.. *
H3267, R (Ch. 24H20 and Radio Ch. 8H20) Tel. Rec. [See Model H2437E (Set 120) and Model H880RZ (Set 114)]
H3273E, H3274R (Ch. 22H21) Tel. Rec. (See Model H2229R) ...... 127—1A
H3467R (Ch. 24H20 and Radio Ch. 10H20) Tel. Rec. (See Model H2437E) 120
H3469E (Ch. 24H20) Tel. Rec. (See Model H2437E)....... 120
H3475R (Ch. 24H20 and Radio Ch. 10H20) Tel. Rec. (See Model H2437E) 120
H3477R (Ch. 24H21 and Radio Ch. 10H20) Tel. Rec. (See Model H2437E) 120
H3478E (Ch. 24H21 and Radio Ch. 10H20) Tel. Rec. (See Model H2437E) 120
4G800 (Ch. 4E41) .... 35—27
4G800WZ, 4G800YZ, 4G800Z (Ch. 4E41Z)... 52—23
4G903, 4G903Y (Ch. 4F40) .... 76—20
4K016 (Ch. 4C52) .... 6—39
4K035 (Ch. 4C53) .... 6—40
5D011, 5D027 (Ch. 5C01, 5C01Z) .... 3—17
5D810 (Ch. 5E02) ...... 54—21
5G003 (Ch. 5C40) .... 17—35
5G003Z (Ch. 5C40Z), 5G003ZZ (Ch. 5C40ZZ) 30—31
5G036 (Ch. 5C51) .... 30—32
5R080-5R086 (Ch. 5C02, 5C04) ..... 4—4
6D014, 6D014W, 6D029, 6D029G (Ch. 6C01) ... 9—35
6D015, 6D015Y, 6D030 (Ch. 6C05, 6C05Z) .... 3—24
6D815, 6D815W, 6D815Y (Ch. 6E05).... 55—24
6G001, 6G001Y (Ch. 6C40) .... 3—14
6G001YZ1 (See Model 6G001) 3
6G004Y (Ch. 6C41) ..... 20—35
6G038 (Ch. 6C50) ...... 32—30
6G801 (Ch. 6E40)....... 53—26
6R060 .... *
6R084 (Ch. 6C21) .... 20—36
6R087 (Ch. 6C22) .... 7—32
6R886 (Ch. 6E02) .... 34—30
7H820, 7H820W (Ch. 7E01) .... 43—24
7H822 (Ch. 7E02), 7H822WZ, 7H822Z (Ch. 7E02Z) .... 55—25
7H918 (Chassis 7F03).... 75—18
7H920, 7H920W (Ch. 7F01) .... 77—13
7H921 (Chassis 7F04).... 73—16
7H922 (Ch. 7F02)....... 87—15
7R070 (Ch. 6C06) .... 37—25
7R887 (Ch. 7E22)....... 54—22
8G005Y (Ch. 8C40) ..... 7—33
8G005YT (Z1) (Ch. 8C40T) (Z1), 8G005YT) (Z2) (Ch. 8C40T) (Z2)..... 53—27
8H023 (Ch. 8C01)....... 4—40
8H032, 8H033 (Ch. 8C20) .... 1—33
8H034 (See Model 8H023) 4
8H050, 8H051, 8H052, 8H061 (See Model 8H032) 1
8H832, 8H861 (Ch. 8E20) 52—24
9H079, 9H079E, 9H079R, 9H081, 9H081E, 9H085R, 9H088R (Ch. 8C21).... 7—34
9H881, 9H882R, 9H885, 9H888R (Ch. 9E21) ... 43—25
9H984, 9H984LP (Ch. 9F22) .... 64—14
9H995 (Chassis 9E21Z)... 74—12
12H090, 12H091, 12H092, 12H093, 12H094 (CH. 11C21) .... 2—20
14H789 (Ch. 13D22) .... 41—24
27T965R (Ch. 27F20) Tel. Rec. (See Model G2951) 95
28T925 E, R (Chassis 28F22) Tel. Rec.............. 64—15
28T926E, 28T926R (Chassis 28F25) Tel. Rec. (See Model 28T925) 64
28T960, 28T961, 28T962, 28T963 (Ch. 28F20, 28F20Z, 28F21) Tel. Rec. (See Model 28T925)........ 64
28T964R (Chassis 28F23) Tel. Rec....... 74—13
37T996 RLP (Ch. 28F23. 9E21Z) Tel. Rec. (See Models 42T999RLP and 9H995). 74
37T998 RLPU (Chassis 28F20, 9E21Z) Tel. Rec. [See Model 28T925 (Set 641 and Model 9H995 (Set 741]
42T999RLP (Chassis 28F23, Radio Ch. 13D22) Tel. Rec. See Model 28T964R) 74

ZENITH—Cont.

Ch. 4C52 (See Model 4K016).... 6
Ch. 4C53 (See Model 4K035).... 6
Ch. 4E41 (See Model 4G800)..... 35
Ch. 4E41Z (See Model 4G800Z)... 52
Ch. 4F40 (See Model 4G903) 76
Ch. 5C01, 5C01Z (See Model 5D011).... 3
Ch. 5C02, 5C02Z (See Model 5R080).... 4
Ch. 5C04 (See Model 5R080).... 4
Ch. 5C40 (See Model 5G003).... 17
Ch. 5C40Z, 5C40ZZ (See Model 5G003Z)... 30
Ch. 5C51 (See Model 5G036).... 30
Ch. 5E02 (See Model 5D810).... 54
Ch. 5G01 (See Model G511) 85
Ch. 5G02 (See Model G510) 84
Ch. 5G03 (See Model G516)......... 109
Ch. 5G40 (See Model G500) 83
Ch. 5G41 (See Model G503)..... 99
Ch. 6C01 (See Model 6D014).... 9
Ch. 6C05, 6C05Z (See Model 6D105).... 3
Ch. 6C06 (See Model 7R070).... 37
Ch. 6C21 (See Model 6R084).... 20
Ch. 6C22 (See Model 6R087).... 7
Ch. 6C40 (See Model 6G001).... 3
Ch. 6C41 (See Model 6G004Y)... 20
Ch. 6C50 (See Model 6G038).... 32
Ch. 6E02 (See Model 6R886).... 34
Ch. 6E05 (See Model 6D815).... 55
Ch. 6E40 (See Model 6G801).... 53
Ch. 6G01 (See Model G660)..... 96
Ch. 6G05 (See Model G615).... 86
Ch. 6G20 (See Model G2957).... 98
Ch. 6H01 (See Model H661E) 125
Ch. 7G01Z (See Model H725)..... 135
Ch. 7E01 (See Model 7H820).... 43
Ch. 7E02, 7E02Z (See Model 7H822).... 55
Ch. 7E22 (See Model 7R887).... 54
Ch. 7F01 (See Model 7H920) 77
Ch. 7F02 (See Model 7H922).... 87
Chassis 7F03 (See Model 7H918).... 75
Chassis 7F04 (See Model 7H921).... 73
Ch. 7G01 (See Model G725)..... 101
Ch. 7G01Z (See Model H725).... 135
Ch. 7G02 (See Model G724)..... 103
Ch. 7G04 (See Model G723)..... 104
Ch. 7H02 (See Model H724) 126
Ch. 7H04 (See Model H723) 122
Ch. 7H04Z (See Model H723Z) 134
Ch. 8C01 (See Model 8H023).... 4
Ch. 8C20 (See Model 8H032).... 1
Ch. 8C21 (See Model 9H079).... 7
Ch. 8C40 (See Model 8G005Y).... 7
Ch. 8C40T(Z1), 8C40T(Z2) (See Model 8G005YT(Z1) 53
Ch. 8E20 (See Model 8H832).... 52
Ch. 8G20 (See Model G881)..... 98
Ch. 8G20/22 (See Model G3157RZ) 91A
Ch. 8H20 (See Model H880RZ) 114
Ch. 8H20 Revised (See Model H880) 127
Ch. 9E21 (See Model 9H881).... 43
Chassis 9E21Z (See Model 9H995).... 74
Ch. 9F22 (See Model 9H984)..... 64
Ch. 10H20 (See Model H2437E)... 120
Ch. 11C21 (See Model 12H090)... 2
Ch. 13D22 (See Model 14H789)... 41
Ch. 20H20 (See Model H2029R)... 144
Ch. 22H20 (See Model H2226R) 114
Ch. 22H21 (See Model H2229R) .... 127—1A
Ch. 23G22 (See Model G2322) Tel. Rec..... 98

ZENITH—Cont.
Ch. 23G23 (See Model G2957) ... 98
Ch. 23G24 (See Model G2322Z) ... 91A
Ch. 23G24Z1 (See Model G2322Z1). *
Ch. 23H22Z (See Model H2328EZ)..118

ZENITH—Cont.
Ch. 24G26Z1 (See Model G2441Z1). *
Ch. 24H20, 24H21 (See Model H2437E)...120
Ch. 27F20 (See Model 27T965R)... 95

ZENITH—Cont.
Ch. 24G20 (See Model G2420E) ... 93
Ch. 24G20-OX (See Model G2420E) ... 93
Ch. 24G21 (See Model G2454R) ... 93
Ch. 24G21-OX (See Model G2454-ROX) ... 93

ZENITH—Cont.
Ch. 24G22/23 (See Model G2441R)... 98
Ch. 24G24 (See Model G2441).... 98
Ch. 24G24/25 (See Model 3059R)..... 98
Ch. 24G26 (See Model G2437RZ).. 91A

ZENITH—Cont.
Ch. 28F20, 28F20Z, 28F21, 28F22 (See Model 28T925) ... 64
Ch. 28F23 (See Model 28T964R).. 74
Ch. 28F25 (See Model 28T925)... 64
Ch. 29G20 (See Model G2951).... 95

RECORD CHANGERS

(CM-1) indicates service data also available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual.

ADMIRAL
RC-150 ...(CM-1) 26—31
RC-160, RC-160A, RC-161, RC-161A (Supplement to RC-200) ...(CM-1) 21—37
RC-170, RC-170A..(CM-1) 31—2
RC-180, RC-181 ..(CM-2) 76—1
RC-182 Supplement (CM-2) 76—2
RC-200 ...(CM-1) 9
RC210, RC211, RC212 (CM-3) 72—1
RC-221, RC-222 ...(CM-3) 79—1
RC220, RC221, RC222 Changes ...(CM-3) 108—2
RC320, RC321, RC322 (See Model RC220 Changes) ...(CM-3) 108
RC400 ...104—1
RC500 ...132—2

AERO
46A ...(CM-1) 19—34
47A ...(CM-2) 77—2

AVIOLA
100 ...(CM-1) 33—32

BELMONT
C-9 ...(CM-2) 34—31

COLUMBIA
104 ...124—2

CRESCENT
C-200 ...(CM-1) 20—37
6 Series ...(CM-3) 89—4
250 Series ...(CM-2) 78—5
350 Series ...(CM-2) 80—3

FARNSWORTH
P-51, P56 ...(CM-1) 13—36
P-72, P73 ...(CM-2) 75—8

GARRARD
RC-60 ...(CM-2) 81—7

GENERAL ELECTRIC
P6 ...(CM-2) 79—8

GENERAL INDUSTRIES
RC130L ...(CM-1) 22—33

GENERAL INSTRUMENT
204 ...(CM-1) 23—34
205 ...(CM-1) 10

LEAR
PC-206A ...(CM-1) 18—33

MAGUIRE
ARC-1 ...(CM-1) 7

MARKEL
70, 71 ...(CM-2) 84—8
74, 75 ...(CM-3) 91—7
74, 75 Supplement...131—11

MILWAUKEE ERWOOD
10700 ...(CM-1) 16—37
11200 ...(CM-2) 86—6
11600 ...(CM-3) 72—7
12300 ...138—5

MOTOROLA
B24RC, B25RC, B27RC, B28RC ..(CM-1) 12—35
RC30 ...(CM-2) 80—9
RC37 ...141—8

OAK
6666 ...(CM-1) 19—35
9201 ...(CM-3) 111—10

PHILCO
D10, D10A ...(CM-1) 14—21
M-4 ...(CM-1) 25—30
M-7 ...(CM-1) 28—35
M-8 ...(CM-2) 83—7
M-9C ...(CM-2) 74—7
M-12C ...(CM-3) 109—9
M-20 ...(CM-3) 103—11
M-22 ...140—6

RCA
RP168 ...(CM-3) 72—10
RP-176 ...(CM-1) 25—31
RP-177 ...(CM-2) 44—27
RP-178 ...(CM-2) 79—12
RP-190 Series ...144—7

SEEBURG
K ...(CM-1) 11—36
L ...(CM-1) 24—34
M ...(CM-1) 32—19
S, SQ ...(CM-2) 78—12

SILVERTONE
101.761-2, 101.762-2 ...(CM-2) 77—10
101.761-3, 101.762-3 ...(CM-2) 83—11
101.762, 101.763 ...(CM-2) 88—11

SPARTON
C48 ...(CM-2) 87—11

THORENS
CD-40 ...(CM-1) 39—29

TRAV-LER
A ...(CM-3) 72—13

UNIVERSAL CAMERA
100 ...(CM-1) 36—30

UTAH
550 ...(CM-1) 8
650 ...(CM-1) 22—34
7000 ...(CM-1) 27—31
7001 ...(CM-2) 83—15

V-M
200-B ...(CM-1) 15—36
400 ...(CM-1) 26—33
400 (Late) ...(CM-2) 90—13
402, 400C ...(CM-2) 82—12
402D, 400D ...(CM-2) 87—14
404 (See Model 405) (CM-3) 73
405 ...(CM-3) 73—14
406, 407 ...(CM-3) 102—16
800 ...(CM-1) 21—38
800-D ...(CM-2) 84—12
802 ...(CM-3) 77—12
910 ...(CM-3) 115—14
950 ...(CM-3) 107—13
950 Supplement...131—17

WEBSTER
50 ...(CM-1) 24—35
56 ...(CM-1) 17—36
70 ...(CM-1) 29—28
77-1 ...137—14
100 ...135—14
106 ...146—12
133 ...(CM-2) 82—13
148 ...(CM-2) 86—12

WEBSTER—Cont.
246 ...(CM-2) 74—11
256 ...(CM-2) 88—13
346 ...(CM-3) 100—12
356, 357 ...(CM-3) 106—16

WESTINGHOUSE
V4914 ...(CM-2) 47—26
V4944 ...(CM-2) 86—13
V6235 ...134—13
V6676 ...136—15

ZENITH
S11468 ...(CM-1) 23—35
S11680 ...(CM-1) 27—32
S14001 ...(CM-2) 75—17
S13675, S14002, S14006, S14008 (CM-2) 85—15
S14004, S14007 ..(CM-2) 79—18
S14012, S14014 (CM-3) 110—14
S14022 ...(CM-3) 112—15
S14023 ...(CM-3) 105—14
S14024, S14025 (See Model S14022) (CM-3) 112
S14026 (See Model S14023) ...(CM-3) 105
S14027 (See Model S14022) ...(CM-3) 112
S-14028, S-14029, S-14030, S-14031 ....145—13
S-14036 (See Model S-14028)..145

MISCELLANEOUS
Series 700F ...(CM-2) 89—9
Series 700F 33/45 (CM-3) 75—11
Series 700FLP ...(CM-2) 101—6
Series 700FS ...(CM-2) 104—8
Series 700R ...(CM-2) 91—8

RECORDERS

AMPRO
730 ...133—4

BRUSH SOUND MIRROR
BK-401 Tape Recorder (CM-1) 42—25
BK-403 ...(CM-2) 78—3
BK-416 ...(CM-2) 81—4

BRUSH MAIL-A-VOICE
BK-501, BK-502, BK-503 ...(CM-1)

CRESCENT
H-1A ...130—5

CRESCENT—Cont.
H-2A1 Series ...(CM-3) 119—4
H-19 Series "Steno" ...122—3
H-22A1 ...125—4
M-2000, M-3000 Series...120—4
1000 Series ...(CM-2)
1000 Series Revised (CM-3) 77—4

CRESTWOOD
CP-201 ...(CM-3) 118—4

EICOR
1000 ...(CM-3) 90—4

GENERAL INDUSTRIES
R70, R90 ...(CM-1) 35—28
250 ...143—8

INTERNATIONAL ELECTRONICS
PT3 ...(CM-2) 88—4

LEAR DYNAPORT
WC-311-D ...(CM-2) 80—8

MAGNECORD AUDIAD
AD-1R ...(CM-2) 84—7

MASCO
375 ...(CM-3) 117—7

RCA
MI-12875 ...(CM-2) 85—12

REELEST
C1A ...123—13

SILVERTONE
70 (Ch. 567.230, 567.231) ...121—11
771 ...(CM-1) 26—32
101.774-2, 101.774-4 (CM-3) 114—10

ST. GEORGE
1100 Series Wire Recorder ..(CM-1) 40—24

WEBSTER-CHICAGO
79-80 Wire Recorder (CM-1) 37—26
178 ...(CM-3) 113—12

WEBSTER ELECTRIC
Ekotape ...(CM-3) 116—12

WIRE RECORDING CORP.
WP ...(CM-2) 76—19

Oscilloscope Modification for 120 Cycle Synchronization

by The Engineering Staff

While performing a visual alignment on AM or FM receivers, or the sound IF in TV receivers, it is often desirable to use a 120-cycle horizontal sweep in the scope. This makes it possible to obtain a "mirrored" image which aids in obtaining a symmetrical pattern. This is especially true in the case of discriminator or ratio detector alignment where an "X" pattern can be used instead of an "S" pattern. In order to synchronize the sweep, however, a 120-cycle signal is required. Many of the later model scopes provide this signal which can be obtained by setting the Sync Selector switch to the 120-cycle position and adjusting the sync amplitude control to the correct level. On earlier model scopes which were not designed to provide the 120-cycle signal, a simple modification can be made to provide this feature.

Any scope employing a full wave rectifier to supply the B+ voltage (not the high voltage for the cathode ray tube) can be modified. Across the input filter capacitor is a 120-cycle signal having a sawtooth waveform with a rather sharp rise on the leading edge. This is due to the peak current through the rectifier. By using a coupling capacitor to block the DC, this sawtooth signal may be coupled to the sync circuit to obtain synchronization at 120 cycles. Since this sync signal is not wanted at all times, provision for switching the signal should be made. On the earlier model scopes having a Sync Selector switch, three positions are usually employed. These provide "Internal," "60 cycle" and "External" sync. If such is the case, it is recommended that the "60-cycle" position be used for the 120-cycle signal.

To make the modification, remove the lead that provides the 60 cycle signal to the switch. This signal is usually obtained from a filament line or from the high voltage of the power transformer through a suitable dropping network. In case of the latter it is suggested that the components be left in the unit so that it could be more easily restored to its original wiring if desired. Connect a .1 mfd. or .25 mfd., 600V, capacitor from the positive terminal of the input filter capacitor to the terminal on the Sync Selector switch from which the lead mentioned above was removed. Thus when a 120-cycle sync signal is required, turn Sync Selector to the 60-cycle position and adjust the Sync Amplitude to synchronize the signal. If desired, the label on the front panel can be changed to read 120 cycles.

The 60-cycle sync signal which has been removed is required only occasionally. It can still be obtained by turning the Sync Selector to "Ext." and connecting a lead from the "Ext. Sync Jack" to a 6.3V AC filament line in the equipment under test.

Below, in Figure 1, is a partial schematic showing the modification on a Sylvania Model 132 scope. Since most all scopes use similar type sync circuits, it will serve as an example for making the modification on other scopes.

APPLICATION OF 120-CYCLE SWEEP

An explanation of how different response curves are obtained on the scope should aid in utilizing 120-cycle sweep for alignment purposes. Ordinarily a 60-cycle sine wave voltage or a 60-cycle saw-tooth voltage is used on the scope to deflect the beam in a horizontal direction. This voltage is obtained from

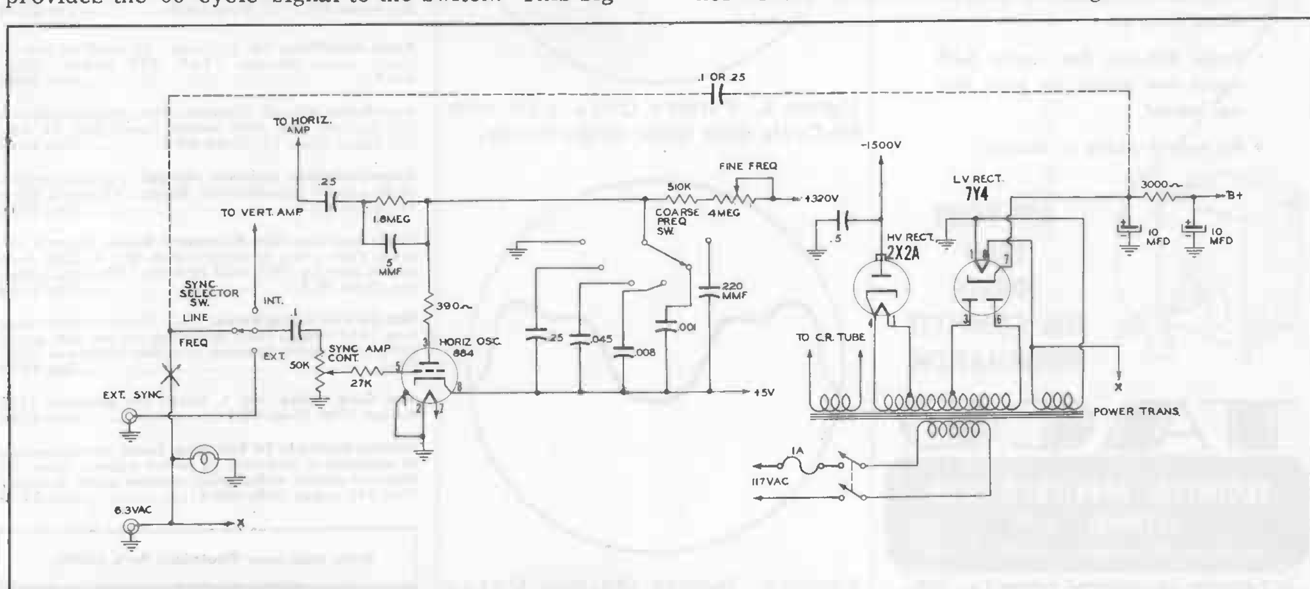

Figure 1. Partial Schematic of Sylvania Type Oscilloscope Showing Modification.

OSCILLOSCOPE MODIFICATION
(Continued from page 51)

the signal generator. As an illustration, if an FM receiver is aligned, a 60-cycle sine wave voltage may be used to deflect the scope beam horizontally. A sweep generator connected to the input of an IF amplifier is set so that the desired excursion frequency of 250 kc is obtained. The connection to the vertical input of the scope is made and the response curve observed. It will be seen that the waveform consists of two superimposed patterns as shown in Figure 2. The patterns may be made more distinct by turning the phasing control on the scope which changes their position in relation to each other. The reason for the two patterns is that the beam travels across the face of the tube in 1/120th of a second or 1/2 cycle, and the return trace requires an equal time. Since the forward and return traces occupy an equal amount of time they will both be visible. If the frequency of the signal applied to the IF amplifier changes from a minimum to a maximum during the forward trace, it will then go through a maximum to minimum range during the retrace period.

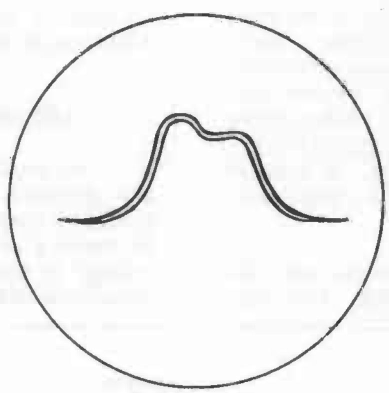

Figure 2. Pattern Obtained with 60-Cycle Sine Wave Scope Sweep.

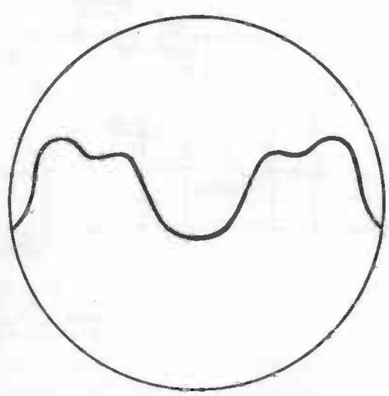

Figure 3. Pattern Obtained Using 60-Cycle Saw-tooth Scope Sweep.

OSCILLOSCOPE MODIFICATION
(Continued from page 52)

Two patterns will be observed on the scope if a 60-cycle saw-tooth sweep voltage is applied to the horizontal deflection plates. These waveforms are shown in Figure 3. Note that the second response curve is reversed. The first waveform represents a time of 1/120th of a second and is the result of the sweep generator frequency changing from minimum to maximum. The second waveform occurs during the next 1/120th of a second, while the sweep frequency is changing from maximum to minimum.

Application of 120-cycle saw-tooth voltage to the horizontal deflection plates will also result in two patterns on the scope. These patterns, however, will be superimposed or mirrored as in Figure 4. The first response curve occurs in one cycle or in 1/120th of a second and the sweep frequency is changing from a minimum to a maximum. The beam retraces rapidly and begins another forward trace. The sweep frequency now goes back from maximum to minimum during this forward trace of the beam, which causes a reversed pattern.

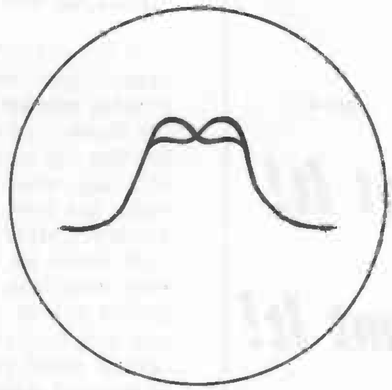
Figure 4. Pattern Obtained When 120-Cycle Saw-Tooth Is Used on Scope.

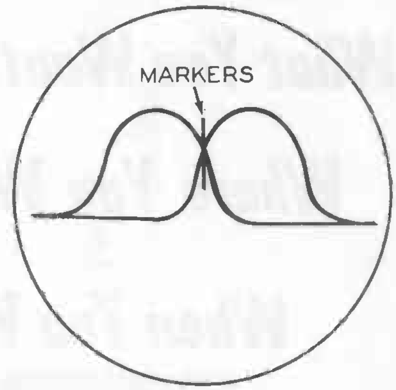

Figure 6. Correct Setting of Signal Generator.

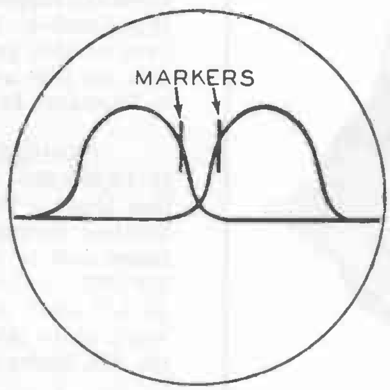

Figure 5. Incorrect Setting of Signal Generator.

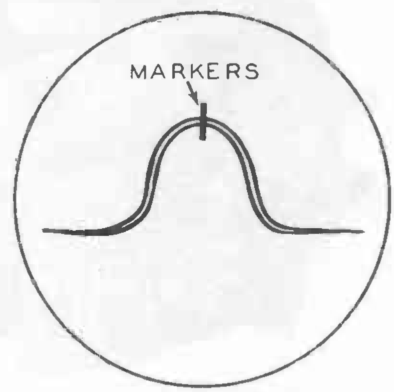

Figure 7. Symmetrical Pattern After Alignment.

This is the point where the 120-cycle sync signal is utilized to hold the saw-tooth oscillator in the scope exactly synchronized with twice the line frequency. If properly synchronized and phased with the output of the sweep frequency signal generator, it will result in a stationary pattern on the oscilloscope.

The use of a marker signal in establishing the correct setting of the sweep signal generator is vitally important. The center frequency of the sweep generator is roughly determined in a preliminary adjustment which results in two patterns appearing on the scope. The marker signal establishes the exact center frequency required and this is evidenced as a pip on each of the two patterns. An incorrectly aligned tuned circuit under test with the sweep generator set slightly off the center frequency will exhibit two patterns as shown in Figure 5.

It will be noted that the marker frequency pips are spaced slightly apart, indicating that the sweep generator is not at the correct center frequency. If the marker occurs at a time when the beam has traversed halfway across the scope and the marker is again present when another trace is half completed, then the sweep generator is correctly set. On the other hand, any variation of the sweep generator from a correct center frequency setting will cause lateral displacement of the marker signal pips.

The sweep generator is now adjusted until the marker pips coincide or are in a straight line in a vertical position. The patterns will then look as shown in Figure 6. Keeping in mind that the pattern must be symmetrical, with the marker at the center, it is then necessary to adjust the tuned circuits under test until a pattern is obtained as in Figure 7.

A little practice in using 120-cycle horizontal sweep should result in faster and more accurate alignment jobs. Remember, however, that this method can be used only when a symmetrical pattern is desired. When aligning for unsymmetrical response curves, such as in video IF amplifier, the synchronized sweep voltage from the signal generator must be used.

"DOLLAR and SENSE" (Cont'd from page 31)

have disappeared. Examples of vanishing TV names are Mercury, Natalie Kalmus, Reeves Soundcraft, Rembrandt, True-Vue, U. S. Television, and Vidcraft.

DIME-STORE COLOR. A rash of transparent color films, some single-color and some even three bands of colors, are now cropping up as color TV imitations. Advantages claimed are that they make the picture any desired color, have no flicker, require no costly adapters or motors, and are easily attached by home owner to any make of set, without need for serviceman. Same effect can be obtained by looking at any receiver through tinted glasses, or by letting a child paint the safety glass window of the set with water colors!

TAPED MUSIC. Pre-recorded reels of magnetic tape, each with half an hour of musical entertainment, are now available at music stores along with low-cost magnetic tape players that have no recording facilities. Of the 14 tape reels now in the

"DOLLAR and SENSE" (Cont'd from page 53)

A-V Tape Library, all but one are instrumental or organ collections ideal for background music in homes, morale music for industry or theme music for flower shows and suchlike. The fourteenth, almost leading the others in popularity so far, is a collection of lively western square dances to which the user calls his own dances. Double-track reels must be reversed after 15 minutes to hear the other track, but cost about $2 less than single-track reels because they have only half the footage of costly plastic tape. Retail prices range from $8.50 for 7.5 inch-per-second single-track to $4.75 for 3.75 inch-per-second double track reels. Though cheaper, the slower speed at present shows noticeable background noise when played on high-fidelity tape equipment; on some 3.75 inch-per-second playback equipment, however, the highs are suppressed so much that the noise is scarcely noticeable. If taped music clicks, servicemen will have another good source of income. Note: servicing data on tape recorders and players has been coming in Photofact Folders right from their beginning.

FIGURES. July 1st figure of N. B. C. Research is 13,088,600 TV sets in use. Best trade guess is that about a third of these have 12-1/2-inch and smaller picture tubes, based on numbers of picture tubes sold to date: 13,000 - 3-inch; 27,000 - 5-inch; 550,000 - 7-inch; 2,450,000 - 10-inch; 3,400,000 - 12-1/2-inch. Some of these tubes have of course gone west, while others are still on dealer shelves, hence the 33% figure is a guess.

AVERAGES. If the average TV set requires 4 service calls per year, each averaging about 1-1/2 man hours of work, and a serviceman puts in 2,000 hours a year, the 13,000,000 sets in use today need an army of 39,000 TV servicemen to keep them running. Are there really that many?

TWIDDLING. Most pre-war TV sets have enough back-of-chassis adjustments with enough range to bring in the CBS color broadcasts in black and white by changing to 405 lines and 144 fields per second. What you get, though, is four miniature pictures instead of one. Similar adjustments can even be made on some makes of post-war receivers. It's just something to try once, though, as the pictures are too small for entertainment viewing. The experiment also gives a variety of weird, futuristic zig-zag patterns, along with practice in getting the controls back to their correct positions.

ADAPTER BURNS. An adapter used to bring in CBS color broadcasts usually gives a smaller picture than before, in the center of the screen. Concentrating the image on a sharply defined smaller area of the phosphor makes it brighter, hence continued operation may cause a discoloration pattern in the phosphor that will be noticeable and objectionable when a full-size black-and-white picture is viewed.

SUNSPOTS ON TV. When the complaint is growls and roars on TV sound, sometimes along with horizontal shimmers and grayish bars standing still or floating up and down the picture, generally occurring around twilight only, don't dash out on a service call because chances are it'll be a dry run. This summer there has been a lot of interstation TV interference due to tropospherics, related to sunspot cycles. The effects are most noticeable in localities 10 to 25 miles from stations. Fortunately, the interference lasts for only about an hour per day anu is expected to disappear at the end of hot weather.

DEAD ON ARRIVAL. According to the National TV Dealers Association, one-third of the TV sets produced were not in good working condition when delivered to dealers. This figure is bad for TV dealer overhead. The public, forever clamoring for discounts, doesn't realize that just making a new set work takes a big hunk out of the dealer's margin of profit.

TRUCE. "If you aren't losing equipment in a war, you meet your goal a little earlier," says DPA-NPA administrator Manly Fleischmann in commenting on effect of Korean truce. This means military electronic production goals could be met with less and less effect on civilian products like TV sets and replacement parts if the guns stop firing all over the world, even though we still continue preparing for all-out war.

TUGBOAT TV. In New York harbor a dumpy little tug equipped with complete TV service facilities makes the rounds of houseboats and other craft to fix their TV sets. On land, similar shops on wheels are bringing service to the home-owner's door in more and more localities. Still another twist, all aimed at eliminating the cost of transporting sets back and forth from user to shop, is Philadelphia TV service dealer Mort Farr's new cash-and-carry shop where owners drop off sets on the way to work in the morning. Most are ready to be picked up the same evening.

"SHOP TALK" (Continued from page 4)

Removal of a tube in either one of the sweep systems will only affect that particular section.

Additional facts which can be useful to you in circuit tracing are the following:

1. The horizontal oscillator, horizontal output, damper, and high-voltage rectifier stages are frequently grouped together in a cage at the left-rear side of the chassis.

2. The vertical sweep oscillator and vertical output amplifier can usually be found by looking for the large vertical output transformer.

3. Another quick way to locate the vertical or horizontal systems is to first locate their respective hold controls and then trace the wires back to the system.

4. Most receivers employ the flyback method of generating high voltage. In such sets, removal of any tube in the horizontal system (from the oscillator on) will remove the high voltage. For those sets which use an RF oscillator to obtain high voltage, removal of any tube in the horizontal sweep system will cause the picture to collapse to a vertical line. The high-voltage will be unaffected.

INTERCARRIER RECEIVERS

The same method of tracing your way through a television set is as applicable to Intercarrier sets as it is with conventional receivers. Suppose you were

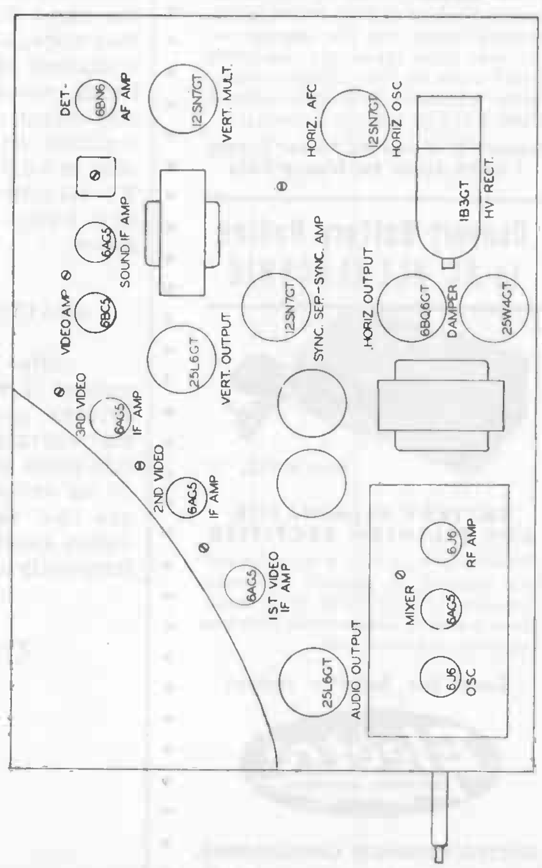

Fig. 2. Tube Layout Diagram of a Tele-Tone Intercarrier Type Receiver.

given a set to repair and you had no idea what type of television set it was. Your first step would be to trace through the RF section to the video IF system. See Figures 2, 3, and 4. In Intercarrier sets sound and video signal separation does not occur until some point beyond the video second detector. Consequently, pulling out any of the video IF tubes clear down to the video second detector will cause both picture and sound to be lost. From the second video detector there are only one or two video amplifier stages to the picture tube and it is a simple matter to determine where the signal separation occurs.

In this respect the beginner is often fooled by those Intercarrier receivers wherein the signal separation does not occur until after the last video amplifier. Naturally, in this instance, pulling out the final video amplifier tube will remove both picture and sound. In other words, removal of any tube in the video circuit will give the same indication.

The sound IF system in all Intercarrier receivers operates at the same 4.5 mc frequency. Furthermore, only the sound signal is contained in the sound system and hence removal of any of these tubes will affect only the sound. The remainder of the receiver is comparable in all respects to conventional TV circuits and will lend itself to the same sort of analysis given above.

ANALYSIS BY TUBE TYPES

After you have done a certain amount of work on television receivers, you will come to recognize that certain tubes are used in certain parts of the television receiver, or for certain functions. Following are the various stages of a television receiver and the tubes most frequently used in them.

Front End Stages

6AG5
6J6
6AK5
12AT7
6BH6
6C4
6BJ6
7F8
6CB6

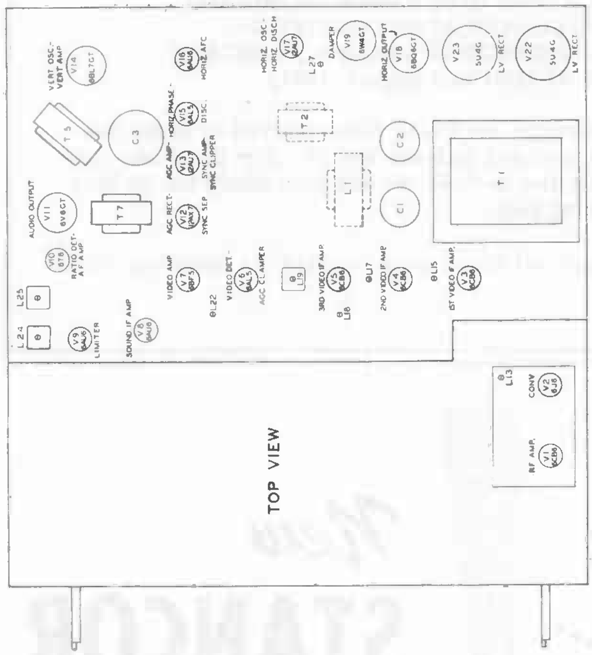

Fig. 3. Chassis Top View of a Sylvania Intercarrier Type Receiver.

Front End Stages (Cont'd.)

6BC5
6BQ7
12AV7

Video IF Stages

6AU6
6BA6
6AG5
6CB6
6BC5

Sound IF Stages

6AU6
6BA6

Video Detector

1N34
1N64
6AL5
1N60

Sound Disc & First Audio*

6T8
6AL5
6AT6*
6BN6
6AV6*
6S8
6SQ7*

*These tubes are used for audio only.

Audio Output Amp.

6V6
6Y6
6AS5
6AQ5
25L6
6L6

Video Amplifiers

6AC7
6K6
6AU6
6AH6
6SN7
7C5
12AU7
6AG7

High Voltage Rectifiers

(a) Flyback Power Supply
1X2A
1B3/8016
1X2

(b) RF Type of Power Supply
25L6
35L6
6Y6

Low Voltage Rectifiers - Selenium Rectifiers

5U4
5V4
5Y3
25Z6

Horizontal Damper

6W4
5V4
25Z6
25W4
6AS7

Horizontal Output Amplifier

6BG6
6CD6
6BQ6
50B5
6AQ5
19BG6
6AV5-GT
25BQ6
6AU5

Horizontal Oscillator

6SN7
6K6
12AU7
12SN7

Horizontal AFC

6AL5
6AC7 & 6AL5
1/2 6SN7
1/2 12SN7

Vertical Oscillator & Amplifier

6V6
12SN7
12AU7
6SN7
6AQ5
6J5
6SL7
6K6
12BH7
6BL7
6C4

Sync Amplifiers & Clippers

12SN7
6SN7
12AT7
6BN6
6SK7
6SH7
12AU7
6AU6

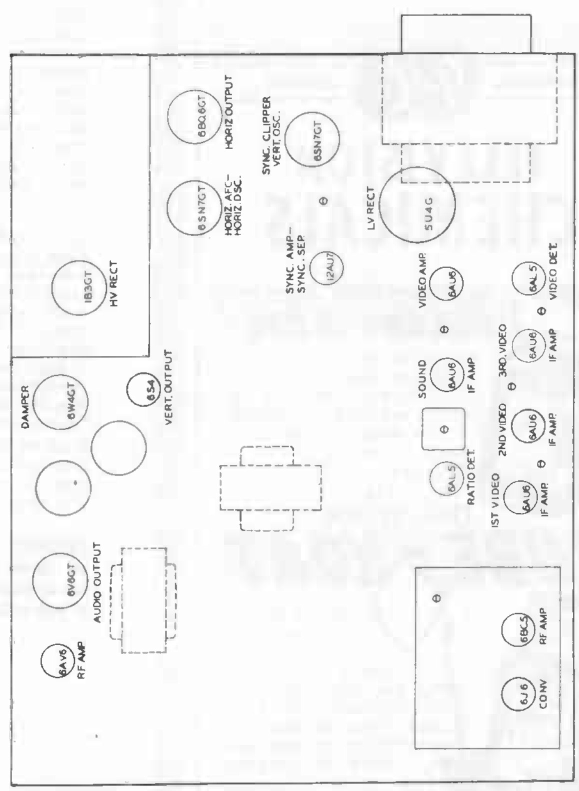

Fig. 4. Layout of an Intercarrier Type Receiver in which the Video and Sound IF Systems are Located Side by Side.

PARTS LIST FOR IMPEDANCE MEASURING
and NULL INDICATOR DEVICES - -
PHOTOFACT INDEX and TECHNICAL DIGEST
No. 27 (July and August, 1951)

Through an oversight the Parts List referred to in the subject article was not included in Issue No. 27. For those who are interested in building the devices we are presenting the omitted Parts List on the facing page.

We want to thank all those who wrote in outlining this omission.

PARTS LIST

(Impedance Measuring Unit)

Item	Description	Part No.
V1	Current Load	Sylvania - 6V6GT or equivalent
V2	Rectifier	Sylvania 6X5GT or equivalent
C1	50 mfd. @ 150 V	(Aerovox - PRS 150/50 (Cornell-Dub. - BR5015A (Sprague - TVA-1414
C2A*	20 mfd. @ 450 V	(Aerovox - AF444J
B	20 mfd. @ 450 V	(Cornell-Dub. - UP22245
C	20 mfd. @ 450 V	(Sprague - TVL-3780
C3	40 mfd. @ 450 V	(Aerovox - AF8J (Cornell-Dub. - UP4045 (Sprague - TVL-1725
C4	.1 mfd. @ 600 V	(Aerovox - P688-1 (Cornell-Dub. - PTE6P1 (Sprague - 6TM-P1
C5	.25 mfd. @ 600 V	(Aerovox - 684-25 (Cornell-Dub. - GT6P25 (Sprague - 6TM-P25
R1	25,000 ohm, 1/2 watt Bias Control with switch	(Centralab - B-26-S (IRC - Q11-120, 76-1 (Clarostat - AG-40-S, FS-3, SWB
R2	25 ohm, 3 watt Low Range Control	(Centralab - V-111 (Clarostat - 58-25
R3	25,000 ohm, 4 watt High Range Control	Clarostat - 58-25K
R4	750 ohm, 10 watt	IRC - 1-3/4 A-750
R5	2000 ohm, 10 watt	IRC - 1-3/4 A-2000
R6	25,000 ohm, 10 watt	IRC - 1-3/4 A-25K
T1	Power Transformer	(Merit - P-3148 (Stancor - PM-8404
L1	Filter Choke (15 hy.)	(Stancor - C-1420 (Merit - C-3192 (Chicago - R-23110

* Item 2 may be 2 section electrolytic if null indicator is not to be included in the unit.

(Additional Parts Required when the Null Indicator Is Included)

Item	Description	Part No.
V3	1st AF Amplifier	Sylvania - 6AU6 or equivalent
V4	2nd AF Amplifier & Detector	Sylvania - 12AU7 or equivalent
V5	Null Indicator	Sylvania - 6U5 or equivalent
C6	25 mfd. 25 V	(Aerovox - PRS25/25 (Cornell-Dub. - BR252A (Sprague - TVA-1205
C7	.1 mfd. 600 V	(Aerovox - P688-1 (Centralab - DF-104 (Cornell-Dub. - PTE6P1 (Sprague - 6TM-P1
C8	.01 mfd. 600 V	(Aerovox - P688-01 (Centralab - D6-103 (Cornell-Dub. - PTE6S1 (Erie - GP2-333-103 (Sprague - 6TM-S1
C9	.1 mfd. 600 V	(Aerovox - P688-1 (Centralab - DF-104 (Cornell-Dub. - PTE6P1 (Sprague - 6TM -P1
C10#	.002 mfd. 600V	(Aerovox - P688-002 (Centralab - D6-202 (Cornell-Dub. - PTE6D2 (Erie - GP2-333-202 (Sprague - 6TM-D2
C11	.1 mfd. 600 V	(Aerovox - P688-1 (Centralab - DF-104 (Cornell-Dub. - PTE6P1 (Sprague - 6TM-P1

(Additional Parts Required when the Null Indicator Is Included - Cont'd.)

Item	Description	Part No.
C12	.05 mfd. 600V	(Aerovox - P688-05 (Centralab - D6-503 (Cornell-Dub. - PTE6S5 (Sprague - 6TM-S5
R7	500,000 ohm, 1/2 watt Gain Control	(Centralab - B-60 (IRC - Q13-133 (Clarostat - AG-60-Z, FS-3
R8	2700 ohm, 1/2 watt	IRC BTS-2700
R9	2.2 megohm, 1/2 watt	IRC - BTS-2.2 meg.
R10	470,000 ohm, 1/2 watt	IRC - BTS-470K
R11	33,000 ohm, 1/2 watt	IRC - BTS-33K
R12	1200 ohm, 1/2 watt	IRC - BTS-1200
R13	470,000 ohm, 1/2 watt	IRC - BTS-470K
R14	68,000 ohm, 1/2 watt	IRC - BTS-68K
R15	1 megohm, 1/2 watt	IRC - BTS-1 meg.
T2	Interstager Transformer	(Chicago - IN-14 (Merit - A-2914 (Stancor - A-53-C

\# Value of C10 depends upon interstager transformer employed. Select capacitance value which will resonate secondary of T2 at 1000 cycles. See text.

♦ ♦ Continued from page 19 ♦ ♦

horizontal deflection circuit must be modified to accomplish the faster retrace.

Adaptation of Monochrome Receivers

Several problems are encountered when trying to modify present monochrome receivers for reception of both color and monochrome transmissions in black and white. Each model or chassis type may present a somewhat different problem.

As discussed previously, 12, 24 and 84 cycle hum may be present when operating at the 144 cycle field rate. Precautions must be taken to minimize hum defects. Proper filtering of the RF, IF, and video stages as well as additional power supply filtering may be helpful. Shielding of the picture tube and yoke will also aid in preventing stray hum fields.

In the vertical sync circuit, two vertical integration circuits should be employed with switching provided to connect the proper integrator.

The vertical oscillator must be capable of operating at both 60 and 144 cycles. Two frequency determining circuits must be employed along with switching to connect the proper circuit. Since the vertical retrace time of the color system must be accomplished in 347 microseconds, or less, as compared to 833 microseconds in the monochrome system, two discharge circuits must also be employed and switched. The vertical hold control is normally a front panel control, although in some receivers this control along with the size and linearity controls are on the rear panel. It will be necessary to employ two controls for each function, and switch each of these controls for proper setting of hold, height and linearity.

TABLE A. COMPARISON OF STANDARDS

Standard	Monochrome System	CBS Color System
Field Rate	60	144
Horiz. Line Rate	15,750	29,160
Lines Per Frame	525	405
Lines Per Field	262.5	202.5
Color Frame Freq.		48
Color Picture Freq.		24
Frame Freq.	30	72
Field Time	16,667 u sec.	6,944 u sec.
Frame Time	33,334 u sec.	13,888 u sec.
One Horiz. Sweep	66.5 u sec.	34.3 u sec.
Horiz. Blanking Interval	10.16 to 11.4 u sec.	5.5 to 6.2 u sec.
Horiz. Retrace Interval	8.3 u sec.	4.5 u sec.
Horiz. Sync Pulse Interval	5.08 u sec.	2.74 u sec.
Vert. Blanking Interval	833 to 1330 u sec.	347 to 555 u sec.
Vert. Sync Pulse Interval	27.3 u sec.	14.75 u sec.
Equalizing Pulse Interval	2.54 u sec.	1.37 u sec.
Geometric Resolution	200,000	83,000

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- Top screw adjustments on traps, IF, RF, and mixer circuits.
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If the same deflection coils are to be used for both positions, more power must be supplied at the 144 cycle position to maintain the same current in the deflection coils. Some receivers have sufficient power in reserve to accomplish vertical deflection at the 144 cycle position. It may be necessary to add another tube or install a larger tube in receivers where the vertical output stage is already working at maximum capacity.

The horizontal oscillator must be capable of operating at both frequencies, 15,750 and 29,160 cycles per second. The wide variation in these two frequencies makes it advisable to employ separate components for each of the adjustments in the horizontal deflection system. Switching must be provided to connect the proper component in the circuit. The horizontal hold, lock-in adjustment, stabilizing circuit adjustment, discharge capacitor, width, linearity, and drive across the grid of the output tube, are typical of the changes that must be made in the horizontal deflection circuit.

The horizontal deflection and high voltage circuits are the most critical. Additional power is required in the deflection circuit to maintain proper width for 29,160 cycle operation. This requires the addition of another horizontal output tube in receivers which are already working at maximum output. The horizontal retrace time of 4.5 microseconds required for 29,160 cycle operation is difficult to obtain with most existing horizontal output transformers. A new transformer designed for operation at both frequencies may be required.

It should be born in mind that considerable experimentation may be required to satisfactorily adapt an existing set for CBS color reception, since peculiarities in design may cause operating differences.

♦ ♦ Continued from page 24 ♦ ♦

output transformer with a Stancor A-8129 transformer, shown in Figure 8. The original transformer was removed from the HV cage by unsoldering the leads and taking out the four machine screws securing it to the cage. The Stancor A-8129 transformer was then mounted in the same position, with the four machine screws, and wired into the circuit as shown in Figure 9. Note that the original width coil and .05 mfd. capacitor are used in the converted circuit. Other than for these last mentioned differences, the conversion using this transformer was completed in the same manner as given in the complete description of the conversion employing the Merit HVO-7 transformer.

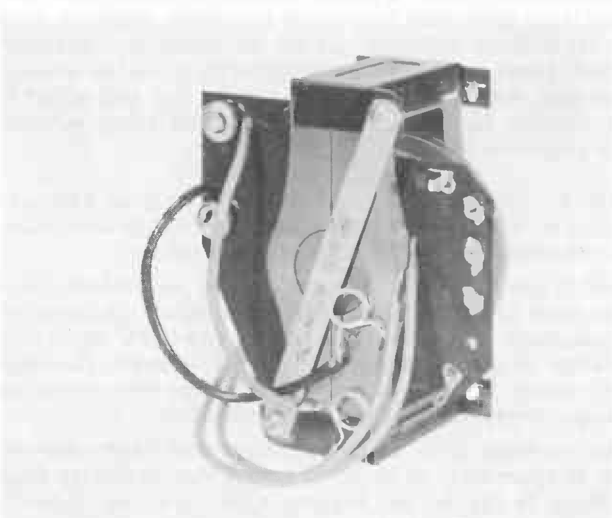

Figure 8. Stancor A-8129 Transformer.

PARTS LIST

Item	Description	
1	Horizontal Output Transformer	Merit HVO-7 Stancor A-8129
1	Deflection Yoke	Merit MD-70-F
1	Width Coil	Merit MWC-1
	(Not used when horizontal output transformer A-8129 is employed)	
1	39 Ohm, 1 watt resistor	IRC BW1-39
1	390 Ohm, 1/2 watt resistor	IRC BTS-390
2	560 Ohm, 1/2 watt resistor	IRC BTS-560
1	1000 Ohm, 1/2 watt resistor	IRC BTS-1000
1	3300 Ohm, 1/2 watt resistor	IRC BTS-3300
1	470K Ohm, 1/2 watt resistor	IRC BTS-470K
1	.004 mfd., 600 volt capacitor	(Aerovox P688-004 (Cor.-Dub. PTE 6D4 (Sprague 6TM-D4
1	.5 mfd., 600 volt capacitor	(Aerovox P684-5 (Cor.-Dub. GT6P5 (Sprague TC-5
1	Type 6BL7GT Tube	Sylvania 6BL7
1	Type 20CP4A Tube	Sylvania or Thomas 20CP4A
1	Single Magnet Ion Trap	
1	High Voltage Lead	

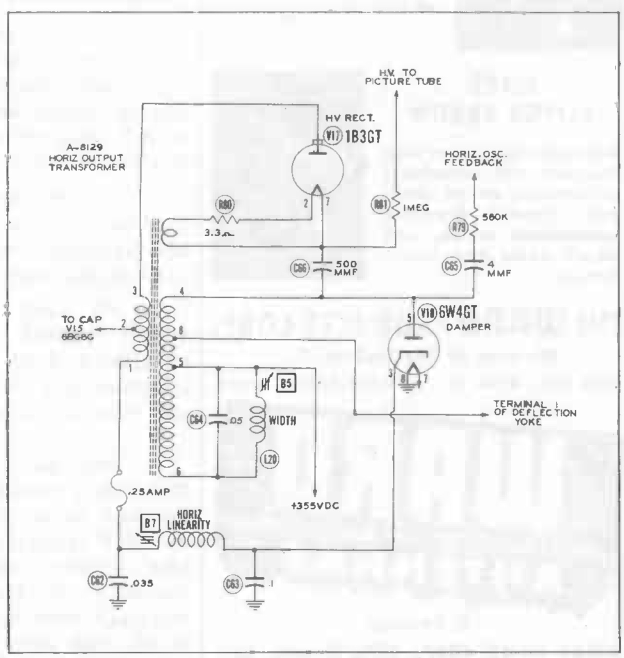

Figure 9. Schematic After Conversion. (Type A-8129)

+ More or Less −

The subject of television interference is receiving an increasing amount of attention, not only from the standpoint of editorial treatment but from the listening and viewing public as well. The importance of the subject will continue to increase as new VHF television markets open up and also as the new services in UHF regions are inaugurated.

There are many different kinds of television interference, ranging from appliance sources to those originating in other television and radio transmissions. There isn't any cure-all for the problem. Each case of interference must be identified and analyzed, and individual protective, or corrective, measures applied.

Following are several examples of television interference to illustrate the differing nature of such sources:

(a) The central Indiana area receives television service from WFBM-TV of Indianapolis, operating on Channel 6 (82-88 mc). Columbus, Indiana, approximately 35 miles distant, could ordinarily expect satisfactory reception on Channel 6, but it happens that Columbus has an excellent FM Station - WCSI, with a concentrated audience in the Columbus area as well as in the surrounding territory. Since a large number of the receivers in the Columbus area operate with a low-side oscillator, and since the station frequency is 93.7 mc, it follows that the local oscillator frequency of such receivers is 93.7 mc minus the IF frequency of 10.7 mc, or 83 mc.

Any of these receivers not properly equipped to suppress local oscillator radiation puts out a signal right in the video carrier of Channel 6. This isn't just a theoretical case. A large number of these sets have radiation to such extent that they ruin television reception within an area of two or three blocks from their location. As far as effect is concerned, it doesn't matter whether these radiations occur directly from the antenna of the receivers or through the power lines, or both; but any effort to eliminate them must identify the means of radiation and apply suitable corrective measures to suppress them.

An interesting twist here is that some of the television receiver manufacturers attempting to merchandise receivers in this area also manufactured the very FM receivers which are causing the trouble.

(b) We have heard of several instances, concerning apartment house TV reception in Metropolitan areas, where two transmissions in the same band have caused considerable difficulty. It seems that TV receivers having inadequate radiation suppression characteristics, tuned to Channels 2 or 7, will set up sufficiently strong radiation to interfere with reception of Channels 5 or 11, respectively, on nearby television sets.

(c) We have also received notes on several instances where the television receiver itself is apparently at fault. It seems that perfectly legal and licensed transmissions in the 20 mc regions are coming directly through because of inadequate tuner rejection.

(d) Last but not least, have you ever tried to listen to a radio receiver located in a room adjacent to an operating TV set? The horizontal oscillator of the television receiver frequently has sufficient radiation that harmonics of its 15,750 kc frequency will produce a very annoying whistle and buzz in the radio receiver.

And, as if we haven't had enough radiation problems existing up to this time, consider those which can conceivably occur when we put converters on present-day VHF television receivers to enable them to pick up UHF transmissions. You can cover a rather large sheet of paper with the possibilities of sum-and-difference frequency beats possible in such systems. It certainly will do the service technician no harm to become familiar with the problems encountered in television interference elimination. Not only is there a wide field now - - - it will be even wider in the future.

J. R. R.

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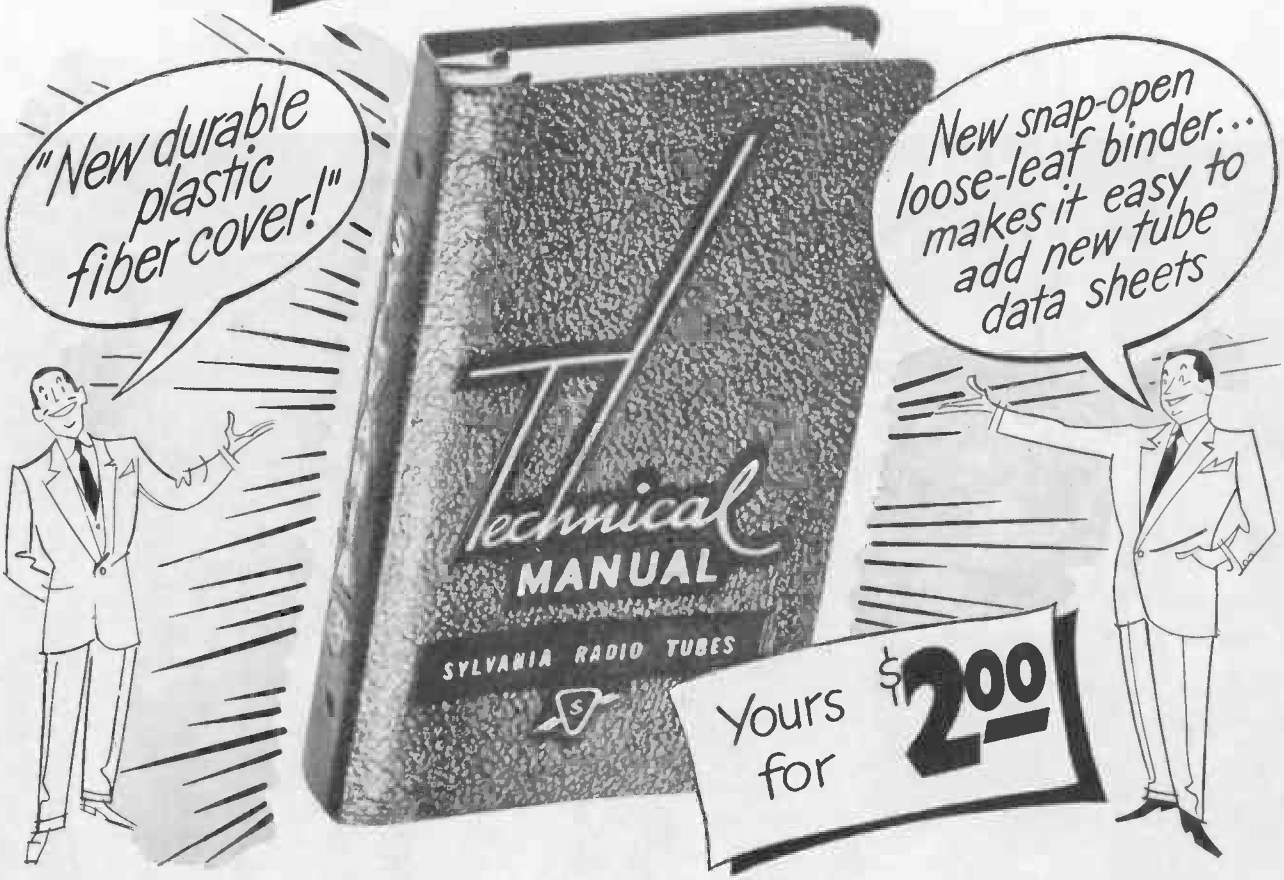

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Here are just a few of the New Tube Types added to the 1951 Manual

OA3	6AS6	6BG7	25W4
IN60	6AX6	12AU7	1274
5AX4	6BA5	12BN6	5642
6AB4	6BF7	19BG6	5692
6AJ5	6BQ7	25AU5	5719

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