HANDBOOK

on the

Stromberg-Carlson

No. 70 Series

RADIO RECEIVERS

STROMBERG-CARLSON TELEPHONE MFG. CO.

100 Carlson Road, Rochester, N. Y.

Handbook on the
STROMBERG-CARLSON
No. 70 Series Radio Receivers

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FOREWORD

BETTER tone quality in Radio and Phonograph reproduction has been the aim of the Radio Industry since its inception. The Stromberg-Carlson No. 70 series Receivers, covered by this handbook, introduce several outstanding contributions to better tone, such as real high fidelity frequency range with an exceptionally smooth response and sound projection from the front of the cabinet only.

Inasmuch as the radio receiver is only one element in a series of many units constituting a Broadcast System, and as the over-all quality is only as good as the weakest link in this chain of units, it is of importance that the listener has a general knowledge of the broadcast system structure and its limitations, if full listening enjoyment is to be obtained. Therefore, this handbook includes, besides information on the installation and operation of the No. 70 series Receivers, some semi-technical information on how high fidelity reproduction is obtained.

For the convenience of the reader, this book is divided into the following five chapters:

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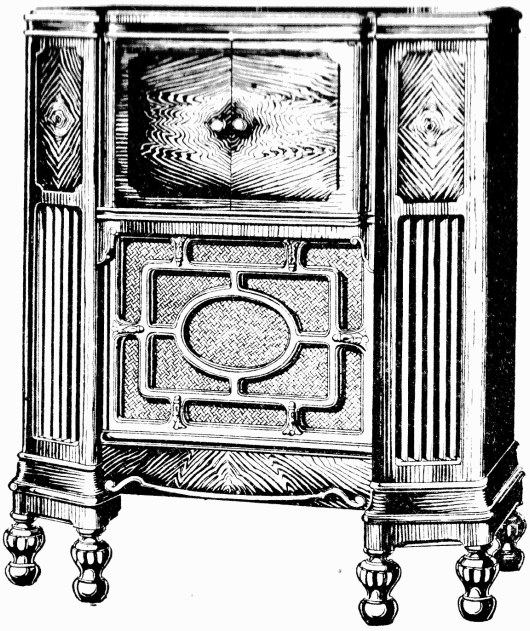


Fig. 1
Front View of Stromberg-Carlson No. 70 Radio with Doors Closed over Controls. Height, 42¾ in.; Width, 33¼ in.; Depth, 19 in.

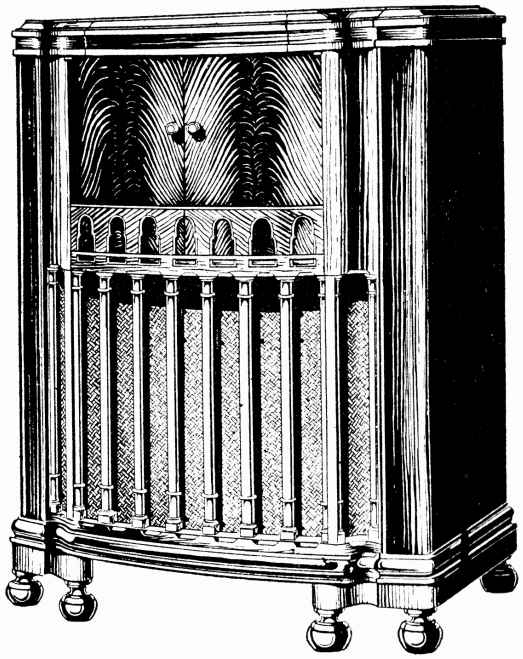


Fig. 2
Front View of Stromberg-Carlson No. 72 Radio and Automatic Phonograph with Doors and Fall Board Closed over Radio and Phonograph Controls. Height, 47½ in.; Width, 34½ in.; Depth, 23⅜ in.

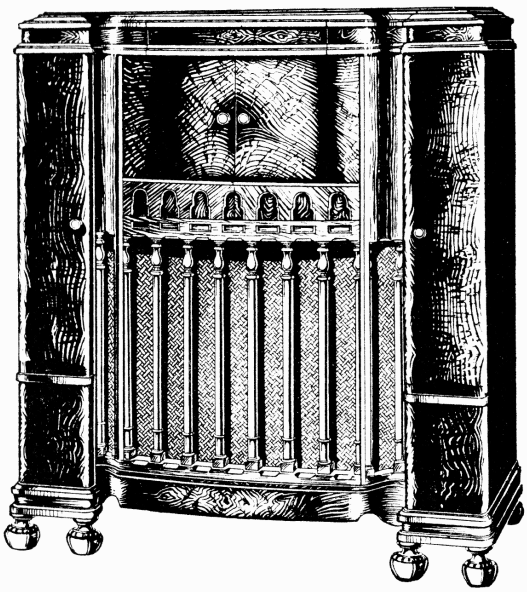


Fig. 3
Front View of Stromberg-Carlson No. 74 Grand Radio and Automatic Phonograph with Doors and Fall Board Closed over Radio and Phonograph Controls. Height, 48 in.; Width, 41 in.; Depth, 23⅜ in.

CHAPTER 1

INSTALLATION AND OPERATION OF THE RADIO APPARATUS IN THE NOS. 70, 72 AND 74 RECEIVERS

1—General:

The Nos. 70, 72 and 74 Stromberg-Carlsons are a new line of Deluxe Receivers combining the latest ideas in all-wave Superheterodyne circuit design, real high fidelity reproduction with large dynamic (volume) range and a revolutionary Stromberg-Carlson development of sound reproducing system employing an acoustical labyrinth (Patent Applied For) to extend the bass response, provide reproduction from the front of the cabinet only and to avoid all cabinet resonance distortions. Audio reproduction is further improved by employing sound diffusing vanes in front of the treble speaker opening for the directional higher pitched tones and a broad speaker opening in the cabinet front for wide angle sound diffusion, thereby providing for uniformly excellent reproduction in all parts of the room.

Increased undistorted volume range is obtained by a new design of double speaker system (bass speaker and treble speaker units) with dividing network, combined with an acoustical labyrinth, to prevent sound radiation from the back of the bass speaker cone into the cabinet with attendant cavity "rain barrel effects" and other volume limiting distortions.

These are the first radio and phonograph reproducing instruments that have been designed as complete high quality reproducing systems, including radio chassis, speakers and acoustical treatment of the enclosing cabinet. (See Chapter 5.) All models have provisions for Te-lek-tor equipment as explained in Chapter 4.

These receivers are of the "All-Wave" type with four tuning ranges covering from 520 kilocycles to 23,000 kilocycles (576 meters to 13 meters) as shown in Fig. 7.

The No. 70 is a Radio Receiver of 15-watts output, housed in a new type of cabinet as shown in Fig. 1.

The No. 72 is a Radio and Automatic Phonograph of 15-watts output, enclosed in a new type of cabinet as shown in Fig. 2.

The No. 74 is a Radio and Automatic Phonograph of 30-watts output, housed in a cabinet of similar design to that of the No. 72 but with larger dimensions as shown in Fig. 3.

There are two designs of Radio Chassis and two designs of Speaker Systems used in these new No. 70 series Stromberg-Carlson instruments, as follows:

The Nos. 70 and 72 Receivers employ a 13-tube chassis with auditorium size Low Frequency (Bass) Speaker and a special design of High Frequency (Treble) Speaker with a Frequency Dividing Network as shown in Figs. 4, 5 and 21.

The No. 74 Receiver uses a 15-tube chassis (total of 16 tubes, including Bass Speaker Rectifier Tube) with a large auditorium size Low Frequency (Bass) Speaker and a special design of High Frequency (Treble) Speaker with a Frequency Dividing Network as shown in Figs. 6 and 21.

There are also two designs of Phonograph Chassis used in these No. 70 series instruments, as follows:

The No. 72 Receiver employs the Stromberg-Carlson No. 5 Automatic Record Changing Phonograph Chassis, with governor type of electrical motor, as illustrated and described in Chapters 2 and 3 of this book.

The No. 74 Receiver uses the Stromberg-Carlson No. 6 Automatic Record Changing Phonograph Chassis, with Constant Speed type of Electrical Motor, as shown in Chapters 2 and 3 of this book.

2—Selecting a Location for the Receiver:

The Nos. 70, 72 and 74 Receivers are so designed acoustically that they can be located tightly against a wall, at any desired distance away from a wall, or cross the corner of a room, without any cabinet cavity resonance distortions (See Figs 29 and 30). This is an exclusive feature in these receivers, which provides complete freedom in this particular requirement of location. It must be remembered, however, that the acoustics of the room in which the receiver is located play an important part in obtaining correct reproduction. In the average home living room, which has floor coverings (rugs), window drapes and the usual chair and couch cushions (which provide a certain amount of sound absorption) the reproduction will be normal.

A bare room, or one with little or no sound absorbing materials will allow sound reflections from the room walls to continue over an appreciable length of time, giving a "live effect" with "blurred" tones. Under such conditions, the Fidelity Control should be used in "SR" (standard fidelity) position and the Tone Control used, if necessary. On the other hand, too much sound absorption material in a room will give a "dead effect" as the high audio frequencies will be absorbed to a greater extent than the low audio frequencies. Under these conditions, the Tone and Fidelity Controls should be turned up for maximum practicable reproduction of high frequency tones, so as to counteract the absorbent effect.

In no case should a large piece of furniture (especially one containing much sound absorbing material, such as a couch or large upholstered chair) be placed directly in front of a radio cabinet, even though a space of 5 or 6 feet be left between the furniture and the cabinet front.

The people in a room add to the amount of sound absorption, so that a crowded room will greatly change the tonal balance of the reproduction (greater absorption of high audio frequencies) as compared to the results obtained when only a few persons are present. In this case the reproduction will sound less brilliant than with a smaller audience.

3—Unpacking and Installing the Receiver:

After deciding on the best location for the receiver, proceed to unpack and install the instrument as follows:

(a)—Removing Packing Material:

Remove all packing material from the inside of the cabinet, including the material used for holding the tubes in place during shipment. Preserve all this special packing material, along with the packing case, if this receiver is to be reshipped at any future date. (See Chapter 2 for Special Instructions for Unpacking the Phonograph Chassis in the Nos. 72 and 74 Receivers.)

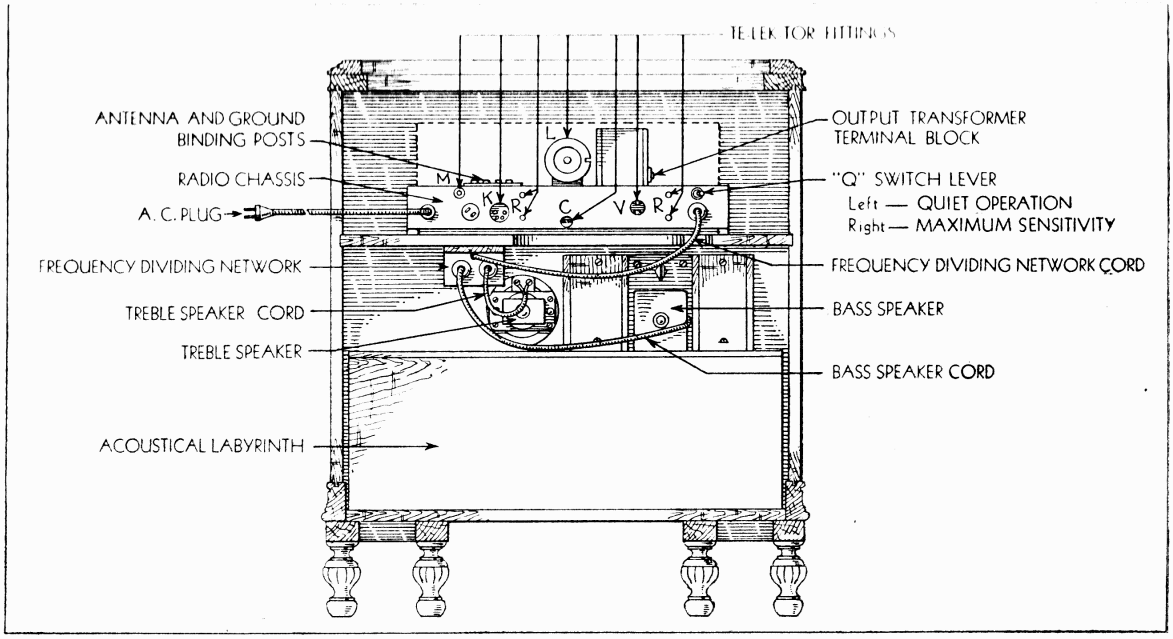


Fig. 4
Rear View of No. 70 Radio with Apparatus Cords Properly Connected.

(b)—Checking Tubes

Inspect the tubes that come installed in the receiver chassis to be sure that they are fully inserted in their respective sockets and that the grid clips are in place on the top contact caps of the tubes. Remove the top cover from the tube shields for making these checks. Be sure that the shields, including the top cover, are in place before operating the receiver. (See the paper diagram on the rear of the radio chassis for the correct types and positions of the tubes in the receiver.) The No. 74 Radio and Phonograph uses a Rectifier Tube in the Bass Speaker as shown in Fig. 6. The perforated metal shield for protecting this tube, is easily removed by lifting up and taking off towards the left.

(c)—Loosening the Radio Chassis Bolts:

Loosen all of the chassis mounting bolts (used for holding the radio chassis securely on the cabinet shelf during shipment) about three full turns so that the chassis will be floating on the soft rubber cushions and the control shafts and knobs are free from touching the wooden panel. When the chassis is floating freely, it can be moved easily a small distance in any direction with a light pressure of the fingers on the chassis base. **The receiver will not operate properly if these bolts are left tightened. Before reshipping the radio set (or delivering a short distance by truck) be sure that all chassis bolts are securely tightened to prevent the chassis from getting loose in the cabinet or the control shafts accidentally becoming bent or otherwise damaged.**

The location and number of chassis bolts in each receiver are as follows:

No. 70 Radio—Four chassis bolts, located under the chassis shelf at the rear of the cabinet.

Nos. 72 or 74 Radio and Phonograph—Six chassis bolts, four of which are accessible from the front of the cabinet,

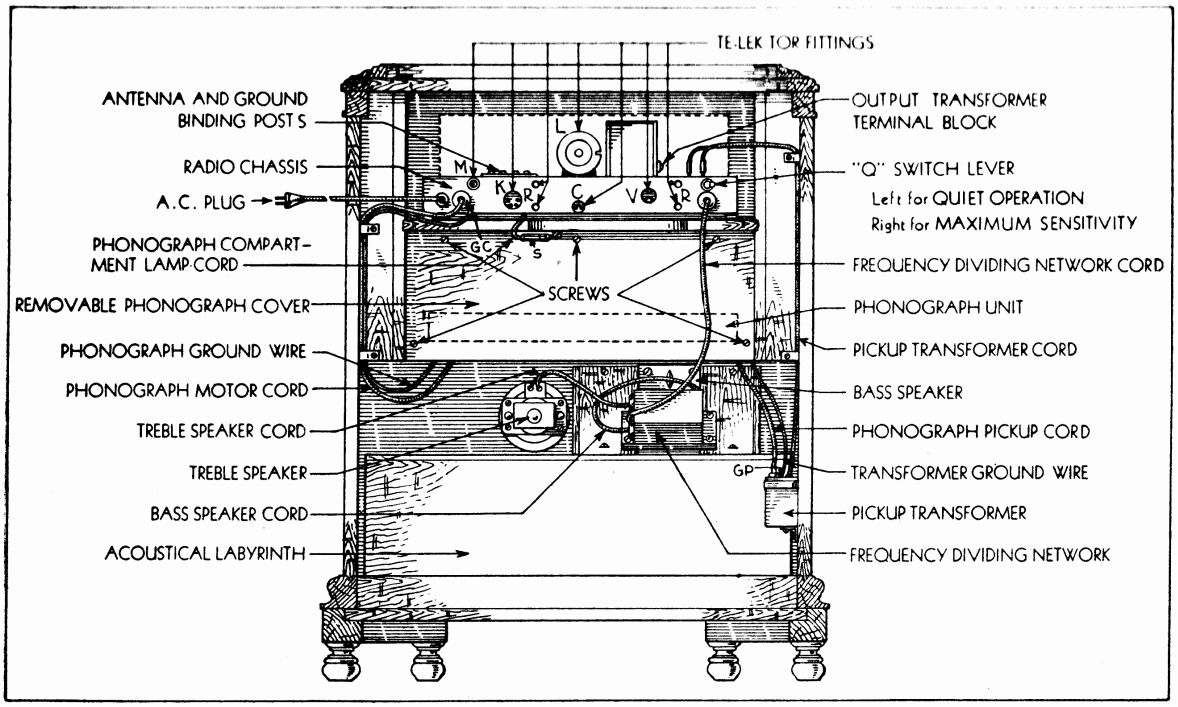


Fig. 5
Rear View of No. 72 Radio and Phonograph with Apparatus Cords Properly Connected.

in the "roof" of the phonograph compartment and two at the rear of the cabinet, under the chassis shelf. (See Chapter 2, Article 1, for "Unpacking the Phonograph Unit".)

(d)—Connecting Cords:

See that all connecting cords at the rear of the cabinet are properly connected and that the plugs on the ends of these cords are fully inserted in their respective jacks or receptables.

The No. 70 Radio (less Te-lek-tor Equipment) has four connecting cords shown in Fig. 4.

The No. 72 Radio and Phonograph (less Te-lek-tor Equipment) has eight connecting cords with plug or pin tip connections and two single conductor apparatus grounding cords with screw type terminal clips ("GC" and "GP") all as shown in Fig. 5. The Phonograph Compartment Lamp has a bayonet type connector, shown at "S", which must be separated at this point, if at any time the chassis is removed from the cabinet.

The No. 74 Radio and Phonograph (less Te-lek-tor Equipment) has nine connecting cords with plug or pin tip connections and two single conductor apparatus grounding cords with screw type terminal clips ("GC" and "GP"), all as shown in Fig. 6. The Phonograph Compartment Lamp has a bayonet type connector, shown at "S", which must be separated at this point, if at any time the chassis is removed from the cabinet.

(e)—Replacing Fuses:

If at any time the radio set fails to operate (dial and meter lights fail to light when the on-off switch is turned to "on" and the "Fidelity Knob" pushed in, and the Power Cord ("A. C. Plug") is properly connected to the house electric current sup-

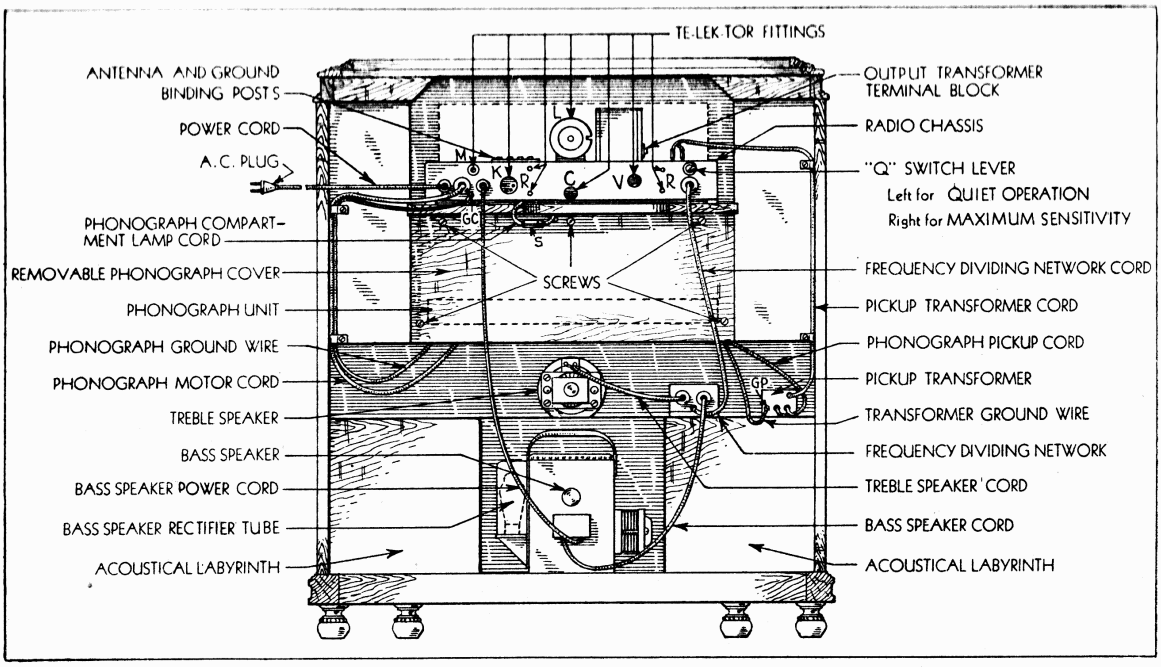


Fig. 6
Rear View of No. 74 Grand Radio and Phonograph with Apparatus Cords Properly Connected.

ply check the chassis fuse to see whether it has been "burned out". The Radio Chassis Fuse is located on the top of the radio chassis, directly behind the "Antenna and Ground Binding Posts" (looking at the rear of the chassis). This fuse is protected by a rectangular metal cover, which is held in place by two screws. Removing the Radio Chassis Rectifier Tube makes this Fuse Cover fully accessible. **Before removing the Fuse Cover see that the Radio Set "A. C." Plug is disconnected from the house current supply.** See that the correct rating of fuse is employed in making replacements as follows:

The Nos. 70 and 72 Radios use the Stromberg-Carlson P-25156 Fuse, 3 amperes rating.

The No. 74 Radio uses the Stromberg-Carlson P-25476 Fuse, 3½-ampere rating.

Always replace the Fuse Cover, fastening it tightly with the two screws, before reconnecting the receiver to the house current supply. If the chassis fuse continues to burn out with no apparent reason, consult an authorized Stromberg-Carlson Dealer for service advice.

(f)—Dial and Meter Lamps:

These Nos. 70, 72 and 74 Radio Chassis are provided with four lamps for the Selectorlite Dial and one lamp for the Tuning Meter. The Tuning Meter lamp lights when the receiver is turned "on" (for either radio or phonograph) but only one of the four dial lamps is illuminated, namely, the one associated with the tuning range for which the Range Switch happens to be set at the time.

Each of these five lamps is mounted in a removable socket, held in place by a spring clip, so as to be readily slipped off the

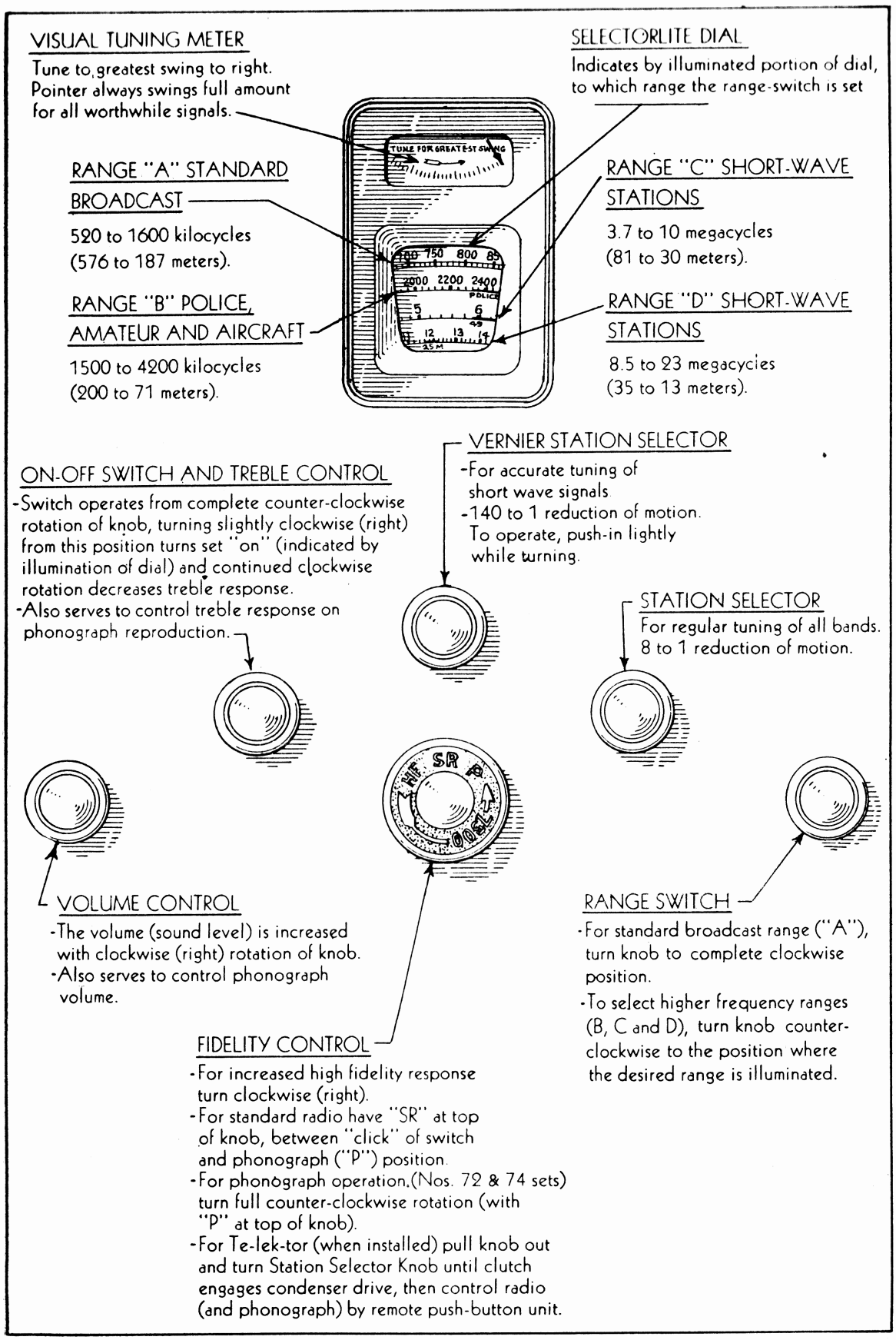


Fig. 7
Location and Operation of the Radio Controls for the Nos. 70, 72 and 74 Receivers.

Dial Bracket for lamp replacements. A drop of sealing compound is used to lock each lamp in its socket, preventing it jarring loose during shipment. This seal can be cut through with a knife blade, or heated with a match to soften, before unscrewing the lamp. Replacements should be made with the Stromberg-Carlson P-18630 Pilot Lamp (6 volt).

In addition to the above, there is a Phonograph Compartment Lamp, in the Nos. 72 and 74 Radio and Phonographs, located above the Phonograph Unit and accessible from the front of the cabinet. The same P-18630 Lamp used for the dial and meter illumination, is employed for this phonograph compartment. (See Chapter 2, Article 11, "Replacing the Phonograph Compartment Lamp".) When testing this lamp, be sure that the Lamp Switch (Fig. 10) is turned to the "on" position.

(g)—Antenna and Ground:

The Antenna plays a very important part in the successful operation of any radio receiver, particularly so when short-wave reception is concerned. For good practical results a simple "L" type antenna about 100 feet in length can be used with this Receiver for all tuning ranges. Good antenna materials such as insulators, wire, etc., must be used to secure good results. As the efficiency of any antenna varies greatly with the frequency of the received waves, a given length may be excellent at certain frequencies and relatively poor at others. Therefore, to secure uniform results with a receiver such as the No. 70 type, an antenna of adjustable length would be theoretically desirable. However, in practice if it is desired to use a long antenna for the two lower frequency ranges and a short antenna for the two higher frequency ranges, the automatic antenna selector will select the correct antenna for the range involved. This automatic antenna selector operates in the range switch, and needs no attention from the user except the initially correct connections of the antenna systems.

If the receiver is situated in an electrically "noisy" location, then a special "All Wave Noise Reducing Antenna" with transposed lead-in may be used to advantage. In this case the antenna proper should be as high and as far away from the source of the local electrical disturbing "noises" as possible. (Consult your dealer for recommendation as to the best type of antenna to use in your particular location.)

The special Antenna Switching Circuits provided in the No. 70 series Receivers allow for most efficient operation of various types of antennas. The proper connections of these antennas to the binding posts of the receiver chassis are shown in Fig. 8.

Diagram "A" in Fig. 8 shows the use of a single long antenna for all four tuning ranges of the receiver. In this case a shielded type lead-in must not be used.

Diagram "B" in Fig. 8 shows the use of two antennas; a Long Antenna for Ranges A and B, and a Short Antenna for Ranges C and D. The long antenna can be any regular broadcast antenna, with the lead-in of the shielded or transmission line type, if the installation is in a noisy location. The antenna for Ranges C and D can be about 25 to 30 feet in length and the greater part should be unshielded by buildings.

Diagram "C" in Fig. 8 illustrates the use of a regular broadcast antenna for Ranges A and B (with a shielded or transmission line lead if necessary), and a transposed lead-in for the

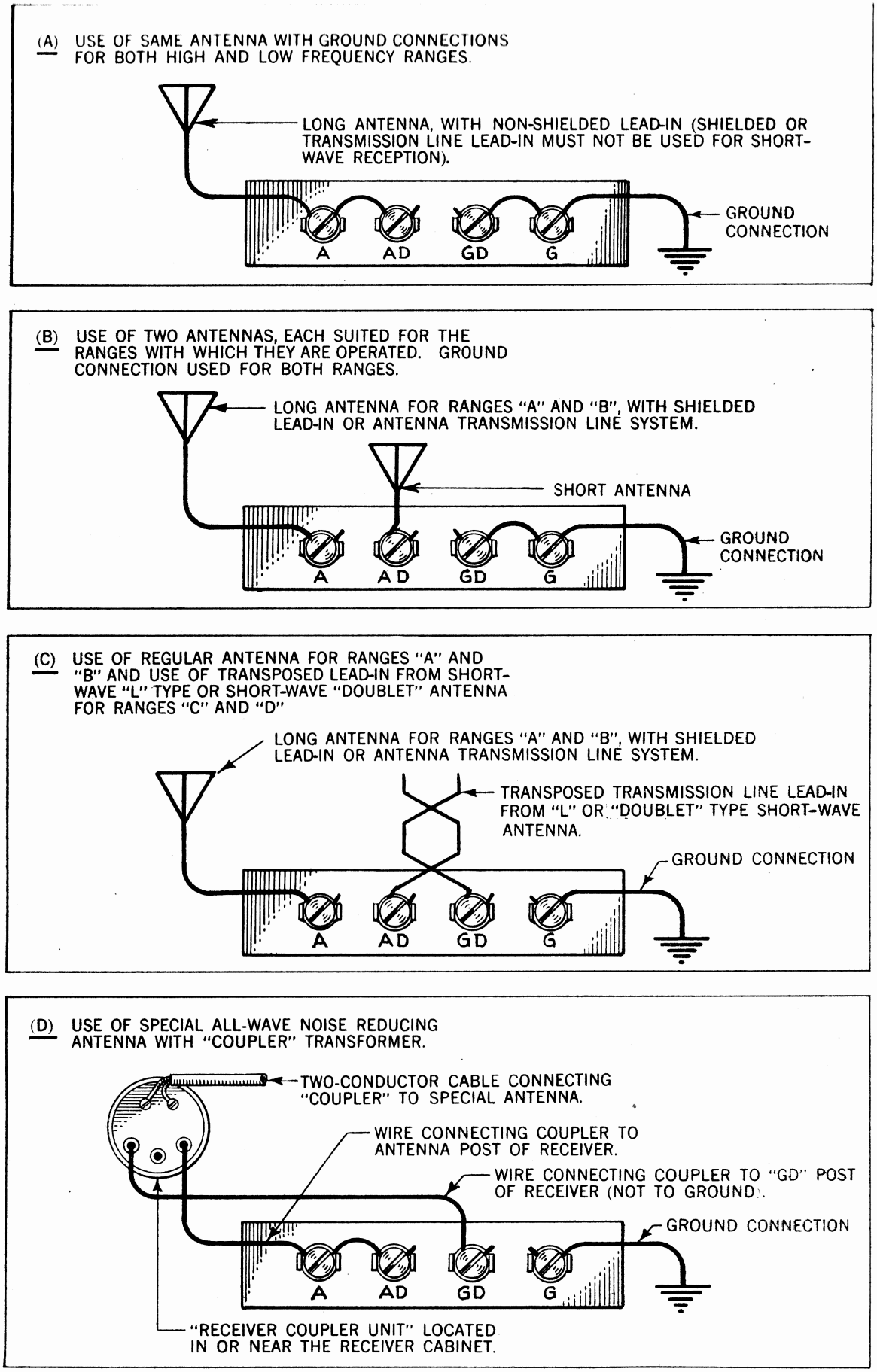


Fig. 8
Connections of Various Types of Antennas to the Antenna and Ground Binding Posts of Nos. 70, 72 and 74 Radios.

short-wave antenna for Ranges C and D. This short-wave antenna may be of either the Doublet Type or "L" type with transposed lead-in.

Diagram "D" in Fig. 8 shows the proper connection to a particular type of All-Wave Noise Reducing Antenna employing a Coupler Transformer at the radio set. Follow the printed instructions accompanying the antenna outfit, for more complete installation details.

Do not use the short-wave tuning ranges in conjunction with a shielded lead-in or with a transmission line system designed for the standard broadcast and police ranges only.

Best results will be insured by grounding the receiver in the conventional manner to a water pipe or radiator or to a metallic pipe or stake driven from five to eight feet into the soil. The ground lead should be short, preferably not more than fifteen feet in length and connected to a clean portion of the pipe or stake surface by means of an approved ground clamp.

(h)—Power Supply:

Connect the power cord (A. C. Plug) of the receiver to an Electrical Outlet supplying alternating current at 105 to 125 volts and at the frequency (cycles) specified on the chassis. **This connection should not be made until after the receiver is unpacked and checked as outlined in the previous paragraphs and the antenna and ground leads are connected.** It is advisable to select an electrical outlet which is not controlled by a house lighting switch, so that the current will always be available when the On-Off switch of the Receiver is operated.

(i)—Radio Control Knobs:

There are six control knobs on the front of the radio chassis panel as shown in Fig. 7. These knobs are concealed by two hinged cabinet doors, as shown in Figs. 1, 2 and 3.

The Right Hand Door is provided with a wood strip to prevent the light from the dial lamps showing through the clearance slot between the doors. Thus, the **Left Hand Door should be opened first,** after which the Right Hand Door is free to be opened. This arrangement makes the "On-Off" and "Volume Control" Knobs quickly accessible by opening the one door (left hand side).

In order to prevent incorrect manipulation of the several control knobs, certain electrical interlocks are provided in the chassis circuits, such as:

—Automatically Disconnecting the "Treble Control" Circuit when the Fidelity Control Knob is turned towards the High Fidelity ("H. F.") position.

—Automatically Restoring the Tuning Circuits for maximum selectivity (Regardless of the Setting of the Fidelity Control Knob) when the "Range Switch" Knob is turned to any of the Short-Wave Ranges (Ranges B, C and D).

—Automatically Disconnecting the "Q" Circuit (if set for "Quiet" Operation) when the "Range Switch" is turned to any of the Short-Wave Ranges (Ranges B, C and D) so as to insure maximum sensitivity for short-wave operation.

—Automatically Connecting the "Treble Control" Knob into circuit when the "Range Switch" is tuned to any of the Short-Wave Ranges (Ranges B, C and D) so as to be available for "noise reduction" when listening to short wave signals under unfavorable receiving conditions.

(j)—Selectorlite Dial:

The dial window employed in the No. 70 series Receivers is of the small, inobtrusive type best adapted to the fine furniture lines of these cabinets, yet permitting a long dial scale and large numerals for legibility. The selectorlite illumination of one scale at a time automatically indicates the condition of the Range Switch and Antenna Selector Switch. The pointer, being the **shadow** of a rod behind the dial, is seen in the same plane as the calibrations and hence gives exactly the same reading whether the dial is viewed straight-on, or from above, or from any angle. The Visual Tuning Meter is located where it, too, can be seen while tuning.

4—Operating Procedure for the Radio Receiver:

Following is a correct sequence for operating the No. 70 series Receivers (See Fig. 7 for location of Knobs):

First—Turn the **"On-Off" Switch Knob** to "On" position (stop when click occurs). The dial and tuning meter then will be illuminated. Wait for a few seconds for the tubes to reach operating temperatures. See that large knob (lower center) is pushed "In".

Second—Set the **Range Switch Knob** for the frequency range in which desired station is located. The illuminated portion of the dial indicates to which range the switch is set.

Third—Set the **Fidelity Control Knob** at "SR" position (lettering "SR" at top). This is just counter-clockwise from where switch clicks.

Fourth—Turn the **Volume Control Knob** clockwise for about one-half of its rotation.

Fifth—Turn the Station Selector Knob to set the dial to the position for the listed frequency of the desired station. Rotate the dial slowly over a short range either side of that setting, noting if the pointer of Visual Tuning Meter swings. If nothing is heard turn Volume Control still further clockwise and repeat. For finer tuning, especially on Short-Wave stations, use the **Vernier Selector Knob.**

It is desirable to become familiar with the American Broadcast Range before endeavoring to tune in foreign short-wave stations.

Sixth—After receiving the signal, reduce the Volume Control and **Sharpen the Tuning** by using the indication of the Tuning Meter (Pointer on Tuning Meter always swings full amount for all worthwhile signals) or by selecting midpoint of response if signal is very weak. At this setting the fine quality of reproduction of which the receiver is capable is obtained and background noise is reduced to a minimum. Now, adjust Volume Control for desired listening level.

Due to the effect of the heating of the apparatus, it may be necessary to occasionally retune short wave stations slightly for the first half hour of operation to maintain satisfactory audio quality.

Seventh—When receiving conditions are noisy, use **Treble Control Knob** for reducing response to higher audio frequencies ("Noise

Reduction"). This control acts when the short-wave ranges are in use, and on the broadcast band (Range A), only when Fidelity Control is in "SR" position.

Eighth—When reception conditions warrant, the fidelity of the receiver can be increased by turning the **Fidelity Control Knob** clockwise. For highest fidelity this control should be turned completely clockwise but as high fidelity transmission and reception require the use of more than present-day channel separations (See Figs. 41 and 42), you may hear "cross-talk" or interference when using the full fidelity setting. In such case, turn the Fidelity Control back (counter-clockwise) until such interference stops. In other words, **the Fidelity Control should be set as far clockwise as possible without bringing in interference.** When maximum selectivity is desired the Fidelity Control should be set at "SR".

> It is always most satisfactory to tune the receiver with the Fidelity Control in the "SR" position by using the meter and also tuning for maximum low frequency response. **Under no conditions should the receiver be tuned for maximum low frequency response with the Fidelity Control at any other than the "SR" position.**

Ninth—When tuning, use Station Selector Knob for rapid rotation of dial and **Vernier Selector Knob** for fine tuning, such as is required for short-wave operation. **Do not use the Selector Knobs for reducing volume as the quality will be sacrificed.**

Tenth—The **"Q" Switch** located on the back of the chassis as shown in Figs. 4, 5 and 6, is provided for adjusting the Quiet Automatic Volume Control System. When the switch lever is toward the center of the chassis, the quieting circuit (for interchannel noise suppression) is in operation. When the lever is toward the end of the chassis, the quieting action is removed and the sensitivity of the receiver is greatest.

Eleventh—For operating the **Automatic Phonograph Units** in the Nos. 72 and 74 Receivers, follow the instructions given in Chapter 2 of this book. To change from Radio to Phonograph, pull the Fidelity Control Knob towards you and turn counter-clockwise from the "SR" position to the "P" position, and then push the knob in. Follow the reverse procedure when changing from Phonograph to Radio. When this Fidelity Knob is in the Phonograph ("P") position, it automatically connects the phonograph pickup into the circuit, allowing the Volume Control Knob to be used for controlling the volume of phonograph reproduction. The Treble Control may also be used when reproducing phonograph programs and on regular lateral cut records, it should be set about ¼ turn clockwise, or to a position where the "needle scratch" is reduced, yet the treble response is not impaired.

Twelfth—When through operating, turn the **"On-Off" Switch Knob** completely counter-clockwise to turn the receiver "off". The dial and meter lamps go out when this is done.

5—Rasping or Rattling Reproduction and Excessive Hum:

Chapter 5 of this book describes the many advantages of the new audio features incorporated in the Nos. 70, 72 and 74 Receivers. It also outlines some of the deficiencies in present-day broadcasting, **which must not be mistaken for defective operation of the receivers.**

Over-modulation at the broadcast transmitter or overload of amplifiers anywhere in the system from broadcast microphone to the loud speakers in the radio receiver will result in distortion. This shows up as rasping, rattling sounds (Figs. 43 and 44) which fall principally in the range reproduced by the high frequency loud speaker only. Consequently, if the latter were disconnected the rattling would appear to stop and the high frequency loud speaker might be unjustly condemned as the seat of the trouble.

Many broadcast transmitters have, in the past, been consistently over-modulated, the resulting distortion being unnoticed in ordinary radio receivers of limited tonal range. High Fidelity Receivers will reproduce these distortions because of their ability to respond to a very wide range of the desired tones. These difficulties in broadcast transmission undoubtedly will be overcome in the near future.

Also, it will be noticed that a High Fidelity Receiver is somewhat more sensitive to overload when attempting to operate at abnormally high volumes than is the ordinary receiver. This is due (as explained above) to the wide frequency range of the system and is not a result of defective loud speaker operation.

Do not mistake hum from broadcast stations for defective operation of receiver. If the "hum" is from the broadcast station, it will be heard only when listening to that particular station and not on all other stations. More than one station, however, may be transmitting "hum" along with the speech and music. Broadcasters are making improvements in equipment and circuits to overcome these disturbances.

When one or more No. 2A3 Output Tubes are "worn out" and require replacement, both should be changed and several tubes tested in various combinations to secure matched tubes for minimum hum in the receiver. Stromberg-Carlson Authorized Dealers are acquainted with the servicing procedure.

6—Notes on Short-Wave Reception:

The design of the No. 70 series Receivers is such that no special skill or previous experience is needed for proper short-wave operation, but the full operating possibilities can be obtained only by those familiar with the general characteristics of short-wave transmission. The following is a brief summary of data which has been collected mainly by experimental observations which should be helpful, particularly to beginners, in the operation of short-wave receivers.

In the **19-Meter Band** and below, stations situated at a distance of 1500 miles or greater will give the most satisfactory signals. These signals will usually be heard during daylight hours and seldom after sundown or when any appreciable portion of the transmission path is in darkness.

The reception of transmitters in the **25-Meter Band** is most usual when the receiver is 1,000 miles or more away from the transmitter. Transmission in this band over distances less than 2,000 miles will be received best during the daytime. Still more distant stations may be heard after dark under favorable conditions.

The greatest reliability of service from the stations in the **31-Meter Band** is at distances exceeding 800 miles. Good reception in this band is possible both day and night from distant stations.

Transmissions in the **49-Meter Band** are most reliable when received at a distance of 300 miles or more. However, good reception at distances greater than 1,500 miles can be expected only when a large portion of the signal path is in darkness.

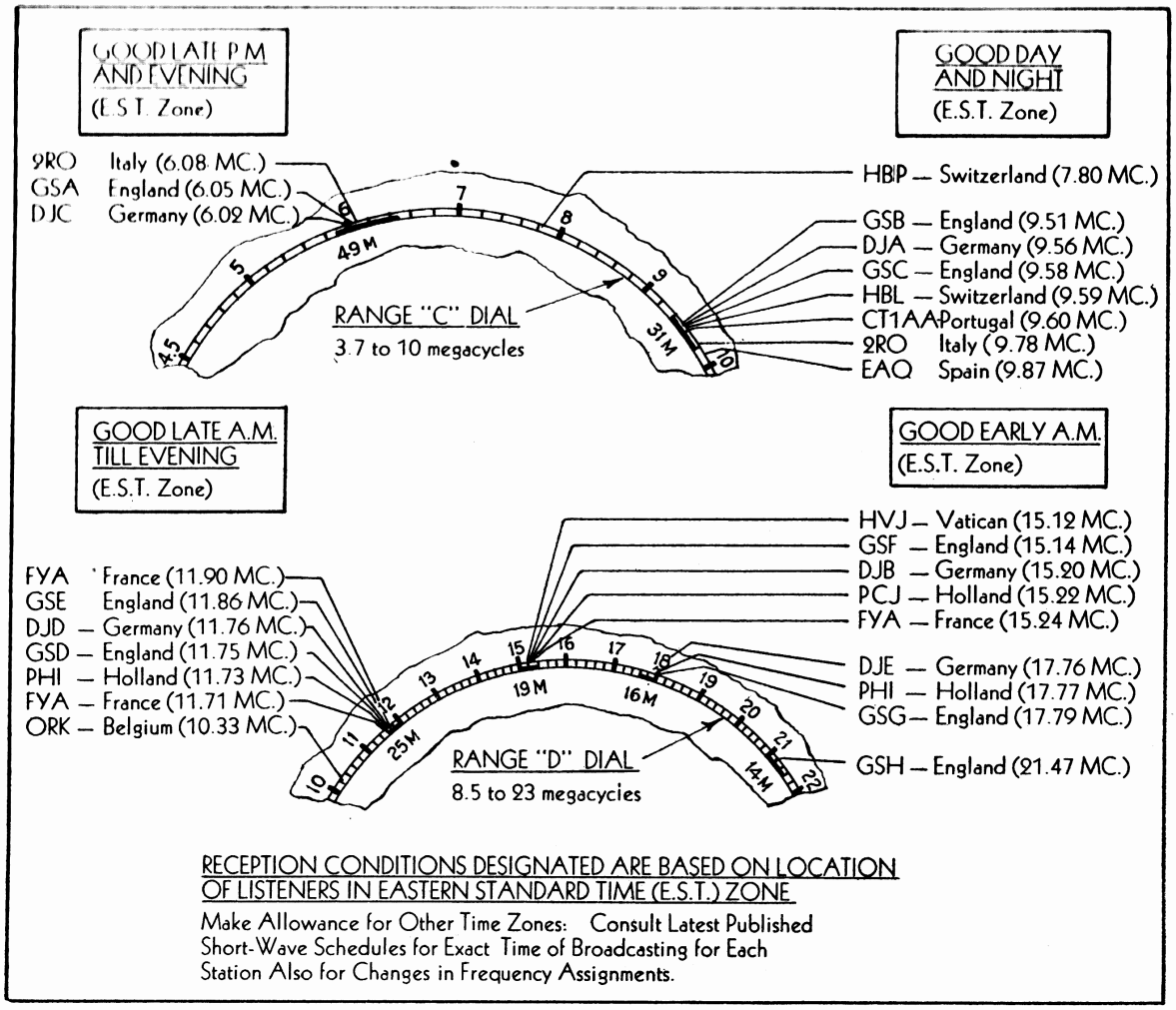


Fig. 9
Location of European Short-Wave Stations on the Tuning Dials of Nos. 70, 72 and 74 Radios, with schedule of Best Receiving Time for each Frequency Group.

Fig. 9 shows in diagram the location on the tuning dials of the No. 70 series Receivers of some of the European short-wave stations that are heard regularly in the United States, also the time of day when certain wave lengths are heard best. This is in accordance with the statements made in the four preceding paragraphs.

Transmitted signals of any wave length divide into two components: the "ground wave" and the "sky wave". The ground wave follows the earth's surface, providing good reception over short distances only. The sky wave travels into the higher layers of the atmosphere and is reflected back from the "Heaviside Layer" to the earth's surface at an appreciable distance from the transmitting station. With short-wave signals, the sky wave usually does not return within the radius covered by the ground wave, resulting in a "dead spot" area in which reception is impossible or extremely unsatisfactory. The length of the region in which such conditions are effective (called the skip distance) varies greatly from day to night and from summer to winter. In general, the skip-distance increases in the transition from day to night and from summer to winter.

Although short-wave reception is less affected by static or atmospherics and good results may be had even during electrical storms in the summer time, the same is not true of interference from man-made "static".

Electrical machinery such as street-cars, dial telephones, motors, fans, flashing signs, oil burners, electrical appliances, airplanes and automobiles all cause much more interference on the shorter waves than in the regular broadcast band. Interference from automobiles, particularly at the shorter wave end of the short-wave range, is quite noticeable and readily recognized. Cars with ignition suppression equipment put on when receivers are installed in them do not cause this interference.

While the above statements on short-wave reception are valid, there are so many other factors which influence the transmission of short waves that exceptions are probable in certain locations. Experience in the operation of short-wave receivers in a given location is the best guide as to what may be reasonably expected at various times.

When operating a short-wave receiver and attempting to receive distant or foreign stations, the user must consider the time standards in use at various longitudes throughout the world. At 7:00 P. M. Eastern Standard Time in New York it is 6:00 P. M. in Chicago, 5:00 P. M. in Denver, and 4:00 P. M. in San Francisco. Going eastward it is 9:00 P. M. in Eastern Brazil, midnight in London, 1:00 A. M. the next day in most of Europe and 10:00 A. M. in Australia. Therefore, the regular evening broadcasts in Europe will be received in America in the late afternoon, while those from Australia will be received in America in the early morning. More and more special programs are being transmitted from European stations at times suitable for evening reception in America.

7—Services Received on an All-Wave Receiver:

Following is a list of the types of services that can be received on an All-Wave Receiver, together with statements as to their value to the average listener.

(a) **Standard Broadcasts**—The standard broadcast band on the American Continents is between 540 k. c. and 1600 k. c. (Range A). The broadcasts in this range give regularly scheduled, reliable service with valuable entertainment, educational material, news, etc.

(b) **Short-Wave Broadcasts**—Most of the short-wave broadcast stations operate in one or more of five bands known as the 16, 19, 25, 31 and 49 meter bands. Some operate at different frequencies in day and night, using the higher frequency in the daytime. There are many foreign short-wave broadcast stations in operation but the following are in general the most reliable to receive:

Daventry, England — Zeesen, Germany
Pontoise, France — Madrid, Spain
Rome, Italy

In addition to these, there are a number of South American stations which are quite reliable.

Some of the American and Canadian programs of regular broadcast stations are sent out on short-waves and in some locations and at certain hours it may be possible to receive the short waves better than the standard broadcasts. Most of these stations provide a regular scheduled service of programs similar to that of the standard broadcast band.

(c) **Police Radio Stations**—The transmissions from these stations are located in two narrow bands, 1600 to 1700 k. c. and 2300 to 2500 k. c. As these stations, therefore, are crowded together with several operating on the same frequency, more than one may be heard without retuning. A swing to the right of the Visual Tun-

ing Meter pointer indicates when one of these police transmitters is "on the air". This service is confidential in nature and is intended only for authorized police use. Steps are being considered by governing authorities to protect this service.

(d) **Amateur Phone Stations**—These transmissions are heard in three different bands on an all-wave receiver, namely 1800 to 2000 k. c., 3900 to 4000 k. c., and 14.15 to 14.25 mc. Amateur radio is a hobby for many thousands and naturally these bands are overcrowded and there is considerable interference. No entertainment features or regular scheduled programs are heard on these bands.

(e) **Aircraft Radio**—This service is used to maintain contact between planes in flight and the airports and is located in two frequency bands 2300 to 3500 k. c. and 4.1 to 5.7 mc. This is an intermittent commercial service.

(f) **Commercial Phone Stations**—Regular short-wave radio telephone service is maintained between many of the larger countries of the world. One-half of a conversation often can be heard; however, it is customary to render the speech unintelligible by "garbling" electrically for secrecy. Such garbled speech sounds high pitched and with no recognizable sounds.

(g) **Ship and Experimental Phone Stations**—A ship to shore radio telephone service is maintained on some of the larger passenger liners. These stations operate over a wide range of frequency assignments depending on conditions. Occasionally, one-half of a private conversation can be picked up on these channels.

(h) **Code Stations**—These dot-dash transmissions will be heard in many places in the tuning ranges of an All-Wave Receiver and will come in with different types of sounds. This type of transmission should not be confused with interference from electrical systems or automobiles. Code transmission can be tuned-in or out sharply while local electrical interference usually spreads over a large portion of the dial. To those not acquainted with the telegraph code this type of signal has only one value, that of indicating that the short-wave receiver is operating correctly in that particular section of the tuning scale.

(i) **Harmonics of Local Broadcast Stations**—In some cases the higher frequency harmonics (multiples of assigned frequency) of broadcast stations will be picked up and possibly mistaken for short-wave broadcast stations. However, this error will be rectified when the station signs off. In all such cases the spurious reception is the result of actual signals transmitted from broadcast stations, and is not due to defective operation of the short-wave receiver. By listening on the standard broadcast band for the same program material, the station transmitting the "Harmonics" can be ascertained and in the future reception of such programs (harmonics) on those particular divisions of the short-wave dial will be recognized.

8—Short-Wave Log:

A partial list of Short-Wave Broadcast Stations is given in the following table, with a space left for logging the exact dial setting at which these stations are received on your particular No. 70, 72 or 74 Receiver. Most short-wave stations are operating on an experimental basis and as a consequence often change the frequency (megacycles) and time of broadcast to improve transmitting conditions. Information on short-wave broadcasts and exact time of broadcasting can be found in local newspapers or in radio magazines.

PARTIAL LIST OF SHORT-WAVE BROADCAST STATIONS

Consult Newspapers and Radio Magazines for the latest Time Schedules for these Stations.

EUROPE

Location	of Station	Call Letters	Meters	Mega-cycles	Dial
England	Daventry	GSA	49.59	6.05	
	Daventry	GSB	31.55	9.51	
	Daventry	GSC	31.30	9.58	
	Daventry	GSD	25.53	11.75	
	Daventry	GSE	25.28	11.86	
	Daventry	GSF	19.82	15.13	
	Daventry	GSG	16.86	17.79	
France	Pontoise	FYA	25.63	11.71	
	Pontoise	FYA	25.20	11.90	
	Pontoise	FYA	19.68	15.24	
Germany	Zeesen	DJA	31.38	9.56	
	Zeesen	DJB	19.73	15.20	
	Zeesen	DJC	48.83	6.02	
	Zeesen	DJD	25.51	11.76	
Holland	Huizen	PHI	25.57	11.73	
	Huizen	PHI	16.9	17.77	
Italy	Rome	12RO	49.30	6.08	
	Rome	12RO	30.67	9.78	
	Rome	12RO	25.40	11.81	
Portugal	Lisbon	CT1AA	31.25	9.60	
Spain	Madrid	EAQ	30.40	9.87	
Switzerland	Geneva	HBP	38.47	7.80	
	Geneva	HBL	31.27	9.59	
U.S.S.R.(Russia)	Khabarovsk	RW15	70.20	4.27	
	Moscow	RW59	50.00	6.00	
	Moscow	RW50	25.00	12.00	
Vatican State	Vatican City	HVJ	19.84	15.12	

AFRICA

Morocco	Rabat	CNR	37.33	8.03	

AUSTRALIA

Australia	Sydney	VK2ME	31.28	9.59
	Melbourne	VK3ME	31.55	9.51

NORTH AMERICA

Canada	Bowmanville, Ont.	VE9GW	49.22	6.09
	Winnipeg, Man.	VE9JR	25.60	11.72
United States	Boston, Mass.	W1XAL	49.67	6.04
	Chicago, Ill.	W9XAA	49.34	6.08
	Chicago, Ill.	W9XF	49.18	6.10
	Cincinnati, Ohio	W8XAL	49.50	6.06
	New York City	W3XAL	16.87	17.78
	New York City	W3XAL	49.18	6.10
	Philadelphia, Pa.	W3XAV	31.28	9.59
	Philadelphia, Pa.	W3XAV	49.50	6.06
	Pittsburg, Pa.	W8XK	48.86	6.14
	Pittsburg, Pa.	W8XK	25.27	11.87
	Pittsburg, Pa.	W8XK	19.72	15.21
	Schenectady, N. Y.	W2XAD	19.57	15.33
	Schenectady, N. Y.	W2XAF	31.48	9.53
	Springfield, Mass	W1XA2	31.36	9.57

SOUTH AMERICA

Brazil	Rio de Janeiro	PSK	36.65	8.18
Colombia	Barranquilla	HJ1ABB	46.60	6.44
	Bogota	HJ3ABF	48.00	6.25
	Cali	HJ5ABD	46.20	6.49
Ecuador	Guayaquil	HC2RL	45.00	6.66
	Quito	HCJB	73.00	4.10
	Riobamba	PRADO	45.31	6.62
Venezuela	Caracas	YV1BC	49.08	6.11
	Caracas	YV3BC	48.80	6.14
	Maracaibo	YV5BMO	49.42	6.07

Notes—When the above stations are broadcasting, the reception conditions will be approximately as follows:

Good Early Morning: Stations located between 15 and 23 megacycles (including the 14, 16 and 19 meter bands).

Good Late A. M. till Evening: Stations located between 10 and 12 megacycles (including the 25 meter band).

Good Day and Night: Stations located between 8 and 10 megacycles (including the 31 meter band).

Good Late P. M. and Evening: Stations located between 3.7 and 8 megacycles (including the 49 meter band).

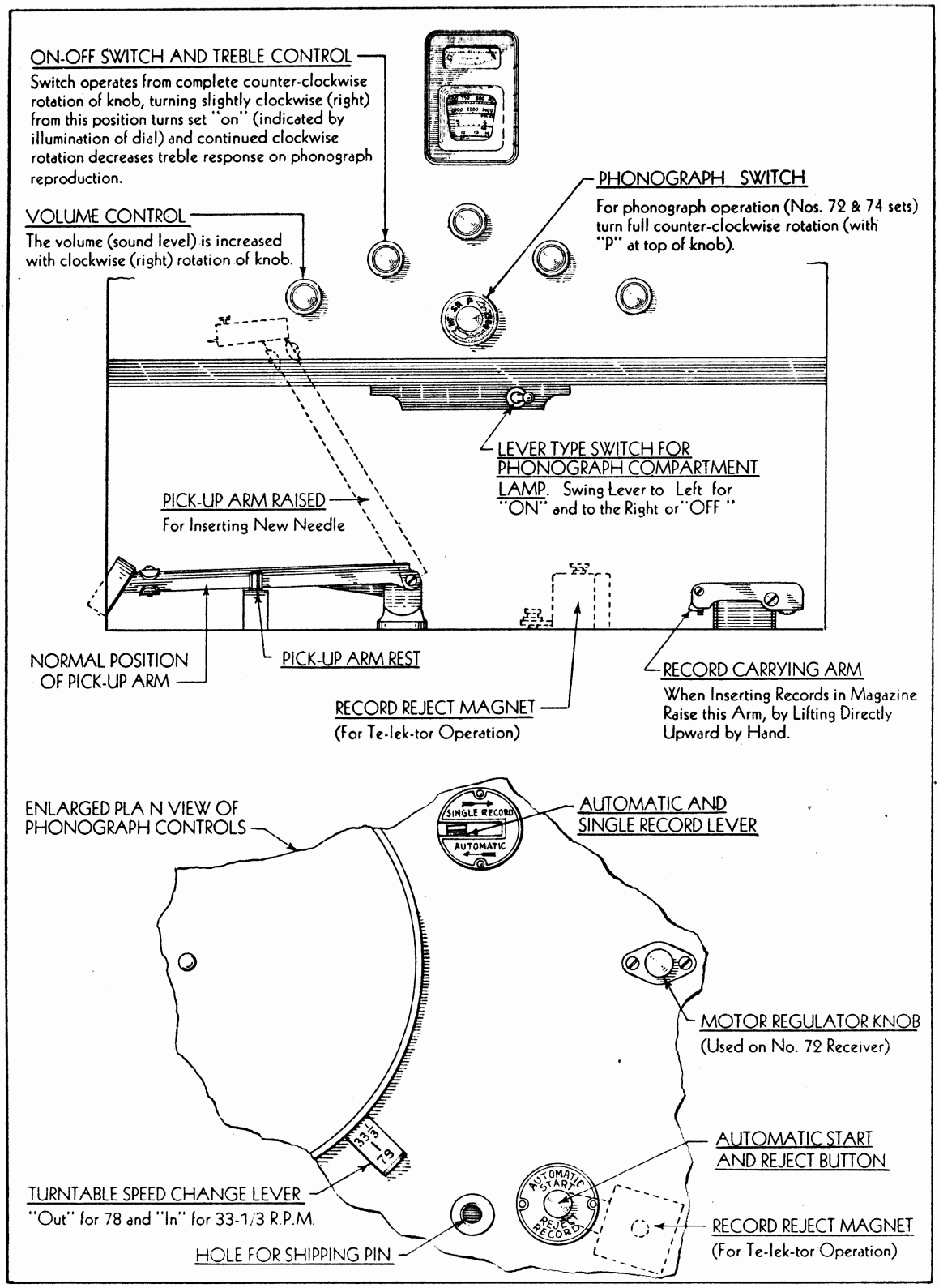


Fig. 10
Location and Operation of the Automatic Phonograph Controls on Nos. 72 and 74 Radio Phonographs.

CHAPTER 2

INSTALLATION AND OPERATION OF THE AUTOMATIC PHONOGRAPH UNITS IN THE NOS. 72 AND 74 RECEIVERS

The Automatic Phonograph Units provided in the Nos. 72 and 74 Receivers are located in the cabinet, directly below the radio chassis, with all of the controls for handling the records, and regulating the phonograph reproduction conveniently arranged in the one compartment, as illustrated in the diagram, Fig. 10. The Radio and the Phonograph Controls are made completely accessible when the two upper doors of the console cabinet are open. This allows the top of the cabinet to be made solid (not hinged as in some designs of radio-phonograph combinations) so that books, and other objects can be left on this top without interfering with the phonograph accessibility and operation.

The No. 72 Receiver is equipped with the Stromberg-Carlson No. 5 Multi-Record Phonograph while the No. 74 Receiver uses the Stromberg-Carlson No. 6 Multi-Record Phonograph. The main difference in these two phonograph units is the use of a governor type of electric motor in the No. 72 Receiver and a constant speed type of electric motor in the No. 74 Receiver. Both phonograph units play fourteen standard lateral-cut records (10 inch or 12 inch records or any mixture of both sizes) without attention. The operating controls are the same on both units. The automatic shifting of records by these units is simple and direct, and due to the smoothness of operation, there is less wear on the record groove than when records are changed by hand in the usual way. Means are provided, however, for playing records singly, the changing of records in this case being by hand. Lateral-cut records, for which these instruments are designed, include those sold under such trade names as Victor, Columbia, Brunswick, etc.

The regular operation of the turntable in these phonographs is 78 revolutions per minute, which is the correct speed for standard lateral cut records. A speed change mechanism (See Fig. 11 for location of speed change lever) is provided for reducing the turntable rotation to 33⅓ revolutions per minute for accommodating the so-called "Long Playing" Records. The 10-inch size of these Long Playing Records (approximately the same thickness of 78 R. P. M. records) can be played automatically on these instruments. The 12-inch Long Playing Records, which are on thin flexible discs, should be played singly as explained elsewhere in these instructions.

It will be noticed that these phonograph mechanisms require very little space in the radio cabinet, allowing all of the radio equipment and sound reproduction apparatus to be designed and constructed for best operation, the same as for the most efficient type of straight radio set (less phonograph).

The only precaution that need be observed in operating these phonograph units is **to always allow the record shifting mechanism to complete its cycle, once it has started, without interference by hand or otherwise.** This applies particularly to the tone arm.

Any number of records, up to the height of the record stops (See Fig. 11 for location), can be placed in the "magazine", about 14 regular thickness records, and all played consecutively on one side, without further attention, the top record in the magazine and the upper side of this record always being the next selection to be played. Thus, the next recording to be automatically brought into playing position, always is in full view. After filling the magazine, the first record to be played is carried to the turntable and the needle properly positioned on the record automatically.

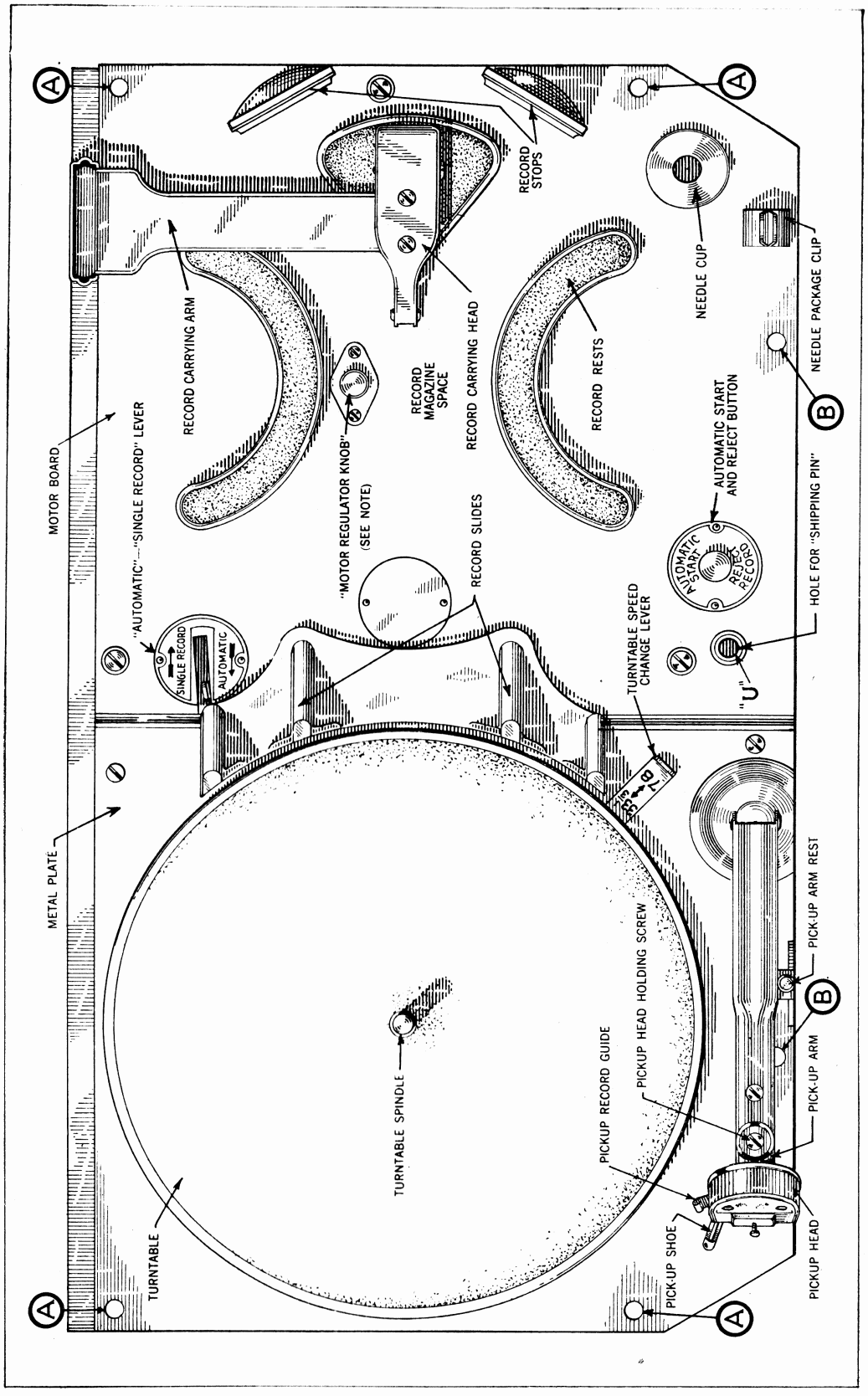


Fig. 11
View Looking Down on the Stromberg-Carlson Automatic Phonograph Unit provided in the Nos. 72 and 74 Radio-Phonographs. (The "Motor Regulator Knob" is not used on the No. 74).

by the mere pressing of the "Automatic Start" button (See Figs. 10 and 11). This avoids any further handling of the records, the pickup arm, or the shifting mechanism, when the phonograph is set for automatic operation.

When the last record from the magazine has been played, the pickup arm is automatically returned to the "Pickup Arm Rest" (Fig. 10) and the phonograph motor stopped. This is a definite and positive indication that a full magazine of records has been played **and that the needle should be changed.** The proper changing of needles is a vital factor where costly records are concerned, as worn needles quickly destroy the delicate tone recordings in the grooves of the records, and at the same time make the reproduction noisy. (See Section 6 of this chapter on "Phonograph Needles".)

In order to provide simplicity, reliability, ease of operation, compactness of mechanism, and visual identity of next selection to be played automatically, these phonograph units are designed to play consecutively the top selections of all records in the magazine. The selections on the other sides of the records are quickly positioned for playing by lifting the complete stack of played records from the turntable, turning it over (rearranging selections as is often desired) and placing this stack of records in the magazine space.

When purchasing what is known as "Victor Albums" of special records, with continued selections, be sure to specify albums with the prefix letters "AM" before the album number. These have Part I, Part II, etc., on one side of the records and remaining parts on the other sides of the same records. This allows the several parts on one side of these records to be played automatically and consecutively, after which the complete group of records can be removed from the turntable, turned over and placed in the magazine, and the remaining selections played consecutively. (Victor albums with the prefix letter "M" have the recordings arranged Part I on one side and Part II on the other side of the same record, etc., requiring the turning over of each record, if the selections are to be played in proper sequence.)

The Phonograph Units employed in the Nos. 72 and 74 Receivers include the following mechanical and electrical operating features:

(a)—Automatic Record Carrying Mechanism for transferring standard records of both 10-inch and 12-inch sizes from a horizontally positioned magazine to the turntable.

(b)—Automatic Pickup Head Positioning Mechanism for correctly locating the pickup needle in the starting groove of 10-inch and 12-inch records as they come from the magazine.

(c)—Automatic Tripping Mechanism for starting the record shifting mechanism at the completion of the playing of standard 10-inch and 12-inch records, having eccentric (Victor) and spiral types of tripping grooves.

(d)—Excess Record Switch, controlled by number of records on turntable, and adjusted to prevent carrying more than 14 or 15 standard thickness records (capacity of turntable spindle) to the turntable automatically.

(e)—"Automatic Start" Button for automatically transferring the top record in the magazine to the turntable, positioning the pickup needle on this record and starting the "playing".

(f) "Reject Record" Button (same as paragraph e) for rejecting any record being played by automatically transferring the next record from the magazine to the turntable.

(g)—Automatic Pickup Arm Restoring Mechanism for returning the Pickup Arm to its Pickup Arm Rest, after the last record from the magazine has been played, making the turntable completely accessible for removing the records which have been played.

(h)—Automatic Motor Stopping Switch, actuated by the mechanism employed in paragraph g, for stopping the phonograph after the last record from the magazine has been played.

(i)—"Single Record" Lever for locking the automatic record shifting mechanism so that the pickup arm can be handled freely and without tripping the automatic record shifting mechanism, when playing "off standard" records singly.

(j)—Pickup Arm Control of Starting and Stopping of Phonograph Motor for Single Record Operation. Placing Pickup needle on record starts turntable rotation. Returning pickup arm to pickup arm rest stops turntable rotation. In order to provide complete freedom in playing odd sizes of records, no automatic tripping mechanism is provided for single record operation.

(k)—Phonograph Motor Starting and Stopping Switch Contacts, controlled by "Phonograph Switch" Knob on the Radio Chassis, to allow going from radio to phonograph and vice versa, by operating one control knob. (See Fig. 10.)

(l)—Volume Control and Treble Control of Phonograph Reproduction by the Volume Control Knob and the Treble Control Knob, respectively, used for radio reproduction. (See Fig. 10).

(m)—Two-Speed Turntable Mechanism for changing from the standard speed of 78 revolutions per minute to 33⅓ revolutions per minute for special "Long Playing Records".

The following detailed instructions on the setting-up and operating of the Phonograph Mechanism in the Nos. 72 and 74 Receivers are divided into twelve sections:

1—Unpacking the Phonograph Unit
2—Checking the Phonograph Connecting Cords
3—General Operating Instructions
4—Playing Records Automatically
5—Playing Records Singly
6—Phonograph Needles
7—Avoiding Mechanical Needle "Noise"
8—Care of Records
9—Adjusting the Phonograph Motor speed
10—Oiling of Phonograph Operating Mechanism
11—Replacing the Phonograph Compartment Lamp
12—Repacking the Phonograph Unit for Shipment

1—Unpacking the Phonograph Unit

Before connecting operating current to the No. 72 or No. 74 Receivers, remove all special packing material from the Phonograph Unit and set up as follows:

First—Remove the Rear Phonograph Panel from the back of the cabinet (See Figs. 5 and 6). This panel is held in place by five wood screws.

Second—Untie (do not cut) the cotton tape used for holding the Pick-up Arm to Pickup Arm Rest for shipment. Also, untie (do not cut) the cotton tape holding the Record Carrier Arm down against Motor Board for shipment. (The knot of this tape is found below the panel and at the rear of the cabinet.

Third—Remove the "Shipping Pin" (colored red) located immediately at left of "AUTOMATIC START" button on the record magazine wooden panel, by turning it counter-clockwise about ten complete turns and then lifting it completely out. (See "E", Fig. 12.)

Fourth—Remove the red finished Metal Spacing Block ("A", Fig. 12) from between the motor bracket and the motor by taking out the two red finished Cap Screws.

Fifth—Loosen the Set Screws locking the universal coupling to main drive shaft. (See "C", Fig. 12.)

Sixth—Slide the Coupling on to the motor shaft about $\frac{7}{16}$ of an inch or until motor shaft shows through one-half of the coupling. (See "D", Fig. 12.)

Seventh—Turn the motor shaft around until the flat side of the shaft is directly under the set screw, then lock this screw tight.

Eighth—Turn the main drive shaft around until the flat side of this shaft is directly under the set screw and lock this screw tight.

Ninth—Completely remove the six red colored Shipping Screws from the Phonograph Chassis (two at each end in holes "A" and two in front edge in holes "B", Fig. 11). This should leave the chassis floating freely on soft rubber cushions. See that the chassis does not touch the wood of the cabinet at either end or at the front.

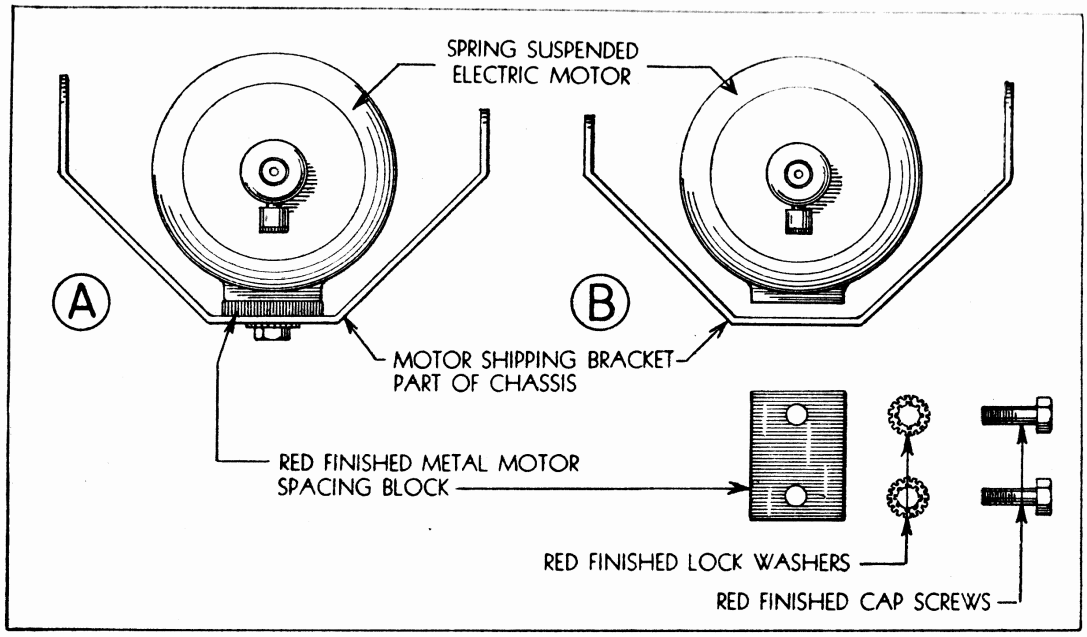
Tenth—Unpack the large carton, found attached to the bracing in the back of the console cabinet, containing the following items:

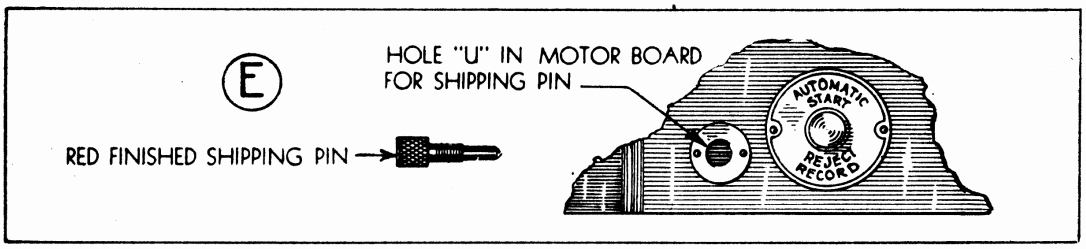
—One Phonograph Turntable
—Six Black Finished Metal Carr Caps
—One Package of Phonograph Needles
—One Motor Regulator Knob (Not required for No. 74 Receiver)
—One Stroboscopic Disc (Not required for No. 74 Receiver).

Place the Turntable on the Phonograph Turntable Spindle; Insert the six metal Carr Caps in the six holes ("A" and "B", Fig. 11), from which the six red finished Shipping Screws were removed; Insert the Motor Regulator Knob through the hole in the motor board of No. 72 Receiver (located between crescent shaped record rests, See Fig. 11) so as to engage speed regulator shaft; Place the Package of Needles in the Spring Clip on motor board (located at extreme right and at front, See Fig. 11).

Eleventh—Place all the special packing material, listed below, in Canvas Pocket found attached to the rear inside of Cabinet, for safe keeping:

—One Metal Motor Spacing Block
—Two Motor Holding Cap Screws and Lock Washers
—One Shipping Pin
—Four Long Shipping Bolts and Washers
—Two Long Shipping Screws and Washers
—Two Pieces of Cotton Tape
—One Red Instruction Card (P-23363)





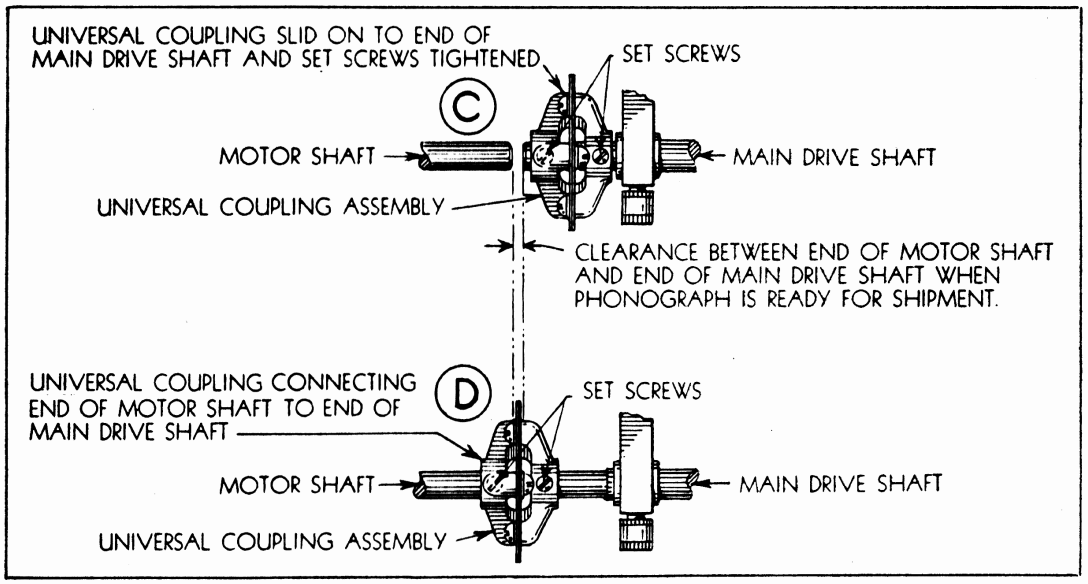


Fig. 12

Shipping Details for the Automatic Phonograph Unit—

A—Spring Suspended Motor Anchored for Shipment

B—Motor freely Suspended on Springs for Operation

C—Motor Shaft Coupling disconnected for Shipping

D—Motor Coupling Connected for Operation

E—Pin for Locking Large Cam Wheel for Shipping

Twelfth—No. 74 Receiver is provided with four Record Albums, which come packed in one of the side record compartments of the cabinet. Two of these albums should be placed in each record compartment. The additional space in each of these record compartments is provided for the storage of special Victor Albums of records.

2—Checking Phonograph Connecting Cords

When setting up the Phonograph for operation, be sure that the pin tips of the pickup are inserted in the pin jacks of the pickup transformer, See Figs. 5 and 6 (located on the top, right hand side of the Labyrinth Box), and that the cord extending from this pickup transformer is connected to the phonograph pin jacks of the radio receiver chassis.

Also check to be sure that the power cord for supplying the operating current for the phonograph motor is connected to the power supply outlet on the back of the radio chassis. See Figs. 5 and 6.

3—General Operating Instructions

The Phonograph in the Nos. 72 and 74 Receivers is operated as follows:

First—Pull out and turn the Large Knob (Fidelity Control) of the radio receiver in a counter-clockwise direction as far as it will go and immediately push in, the letter "P" then being at the top of the knob, as shown in Fig. 10. This connects the pickup of the Phonograph to the audio system of the radio chassis and to the speaker system (See Fig. 21). In addition, it connects the power supply circuit to the phonograph motor circuit.

Second—Turn the On-Off Switch Knob of the radio receiver (See Fig. 10) in a clockwise direction, just far enough to cause the dial light to illuminate the radio dial and no further. This will connect operating current to the radio chassis for the tubes and also make operating current available for driving the phonograph mechanism. Allow a few seconds for the tubes to heat up before attempting to operate the phonograph.

Third—After starting a record playing as described in detail under headings "Playing Records Automatically" and "Playing Records Singly" adjust volume of reproduction of the loud speaker, by turning the regular radio **Volume Control** (left hand knob on radio panel, Fig. 10) in a clockwise direction for increasing volume and in a reverse direction for decreasing volume.

Fourth—If it is desired to reduce the treble response, or to cut down the amount of needle scratch when playing old worn records, turn the combined "On-Off and Treble Control" on the radio panel (Fig. 10) in a clockwise direction as far as desired. Correct reproduction of new phonograph records of the lateral-cut type (which do not have recorded on them, the higher audio frequencies included in these Nos. 72 and 74 Loud Speaker Systems), is obtained when this **knob is set at about ¼ of a turn from the extreme counter-clockwise position.**

4—Playing Records Automatically

The Phonograph Units of the Nos. 72 and 74 Receivers are designed to play automatically a magazine full (about 14) of any standard 78 R. P. M. lateral cut 12-inch or any standard 78 R. P. M. lateral cut 10-inch records, or a mixture of these two sizes. The tripping grooves can be either the "eccentric" or the "Spiral" type.

The so-called "Program Transcription" records of 10-inch size, requiring 33⅓ R. P. M. rotation, can be played automatically by proper setting of the turntable speed change lever. The 12-inch Program Transcription Records are made of thin flexible material that is not suitable for reliable operation in an automatic record shifting phonograph, but these larger records can be played singly on these phonographs as described in Section 5—"Playing Records Singly".

To play records automatically, proceed as follows:

First—Turn the "On-Off" Switch to "On" position (when click occurs). The radio dial will be illuminated when the switch is "On".

Second—Switch "on" the Phonograph Compartment Lamp by moving the switch lever to the left, See Fig. 10. This lamp lights only when the "On-Off" switch is "On".

Third—Set the lever marked "SINGLE RECORD-AUTOMATIC" (located at right and rear of Bakelite record slides, Fig. 11) to the left or automatic playing position.

Fourth—Lift up the Record Carrying Arm (Figs. 10 and 11) to the top of slide or "elevator" bracket where it will be retained by a spring catch, thereby leaving the record magazine clear.

Fifth—Place the records to be played in the record magazine space, located at right, with selected sides (selections to be played) face up. Be sure that the top record is pushed back against the Record Stops, which are located at the extreme right of magazine as shown in Fig. 11.

Sixth—Restore the Record Carrying Arm, allowing it to rest on the upper surface of the record.

Seventh—Observe whether the records to be played are of the 78 R. P. M. type or the 33⅓ R. P. M. type and set the Speed Change Lever (found projecting from under right side of turntable, See Fig. 11) "in" for 33⅓ R. P. M. and "out" for 78 R. P. M.

Eighth—Place the proper phonograph needle in the pickup head. (See "Phonograph Needles"). This operation is facilitated by raising the pickup arm as shown in the dotted lines of Fig. 10.

Ninth—Pull out and turn the large knob on the front panel of radio receiver to the complete counter-clockwise position and immediately push in, with "P" at the top of the knob (phonograph "on" position). See Fig. 10.

Tenth—To start the phonograph, push down the "AUTOMATIC START" button, Fig. 10, holding down for about two seconds or until the Record Carrying Arm starts moving. This will transfer the top record in magazine to the turntable and start playing.

Eleventh—To stop the phonograph at any time, pull out and turn the large knob ("Phonograph Switch", Fig. 10) on the front panel of the radio receiver in a clockwise direction, and immediately push in, so that "SR" will be at the top of the knob.

Twelfth—If the phonograph has played through a record and automatically tripped itself or has been tripped in any way, the **Record Carrying Arm should be allowed to complete its cycle of movement before the middle large knob on the front panel of radio receiver is turned to the "SR" (phonograph off) position.**

Thirteenth—If the phonograph has been left to play through all the records in the magazine, it will automatically shut itself off, and restore the pickup arm to the pickup rest bracket.

Fourteenth—If it is desired to play the next record in the magazine before the record on the turntable has completed its playing, press the "Reject Record" button (See Fig. 10).

Fifteenth—The Phonograph Compartment Lamp can be turned "off" at any time by moving the Switch Lever to the "right".

Sixteenth—Be sure to turn the "On-Off" switch to "Off" when through (See Fig. 10) playing the phonograph or through operating the radio, the dial lamp going out when this is done.

5—Playing Records Singly

Any lateral cut record of 12 inches or less in diameter can be played singly on the Phonograph Units of the Nos. 72 and 74 Receivers. This includes home recordings, mailing card discs and other odd sizes of records that are not designed for use in automatic record shifting mechanisms. When it is desired to play records singly and without the bother of having the record shifting mechanism operate at the end of each record, proceed as follows:

First—Turn the "On-Off" switch to the "On" position (when click occurs). The radio dial will be illuminated when the switch is "On".

Second—Switch on the Phonograph Compartment Lamp by moving the switch lever to the "left", Fig. 10. This lamp lights only when the "On-Off" switch is "On".

Third—Set the lever marked "SINGLE RECORD-AUTOMATIC" (locatet at right and rear of Bakelite record slides) to "right" or single record playing position. (See Fig. 11.)

Fourth—Place the single record to be played on the turntable (desired side up).

Fifth—Observe whether the record to be played is the 78 R. P. M. type or 33⅓ R. P. M. type and set the speed change lever (found projecting from under turntable) "in" for 33⅓ R. P. M. and "out" for 78 R. P. M. (See Fig. 11).

Sixth—Place the proper phonograph needle in pickup head. (See "Phonograph Needles"). Raise the Pickup Arm as shown in the dotted lines of Fig. 10 to facilitate changing of the needles.

Seventh—Pull out and turn the large knob on the front panel of the radio receiver to the complete counter-clockwise position and immediately push in (phonograph "on" position). (See Fig. 10.)

Eighth—To start the Phonograph, lift the pickup from its Rest Bracket and move the arm in toward the record (motor will now start when the needle is lowered to the record surface), and carefully place the needle in the first groove of the record.

Ninth—Remember the phonograph is not designed to stop automatically when set for single record operation. No automatic stop can be employed satisfactorily as the "Single Record" setting is designed for miscellaneous sizes and different types of recordings which have no standardized "Stopping Groove" on the records.

Tenth—To stop the Phonograph after the record has played, restore the pickup arm to its rest. When through using the Phonograph, pull out and turn the large knob on the front panel of the radio receiver in a clockwise direction, and immediately push in, so that "SR" will be at the top of the knob.

Eleventh—When playing home recorded records or records smaller than 10 inches in diameter, always set the control lever to the "SINGLE RECORD" position. If the playing grooves run in so close to center that the pickup record guide strikes the turntable spindle, it may be necessary to place 14 or more regular records on the turntable first, so as to raise this pickup record guide above the top of the turntable spindle.

Twelfth—The Phonograph Compartment Lamp can be turned "off" at any time by moving the Switch Lever to the right.

Thirteenth—Be sure to turn the On-Off switch to "Off" when through (See Fig. 10) "playing" the phonograph or through operating the radio, the dial lamp going out when this is done.

6—Phonograph Needles

The Phonograph Units used in the Nos. 72 and 74 Receivers are designed to employ either the **GREEN CHROMIUM** or the **FULL VOLUME TUNGSTONE** needles when playing standard 78 R. P. M. records. On Program Transcription 33⅓ R. P. M. records, use only the **ORANGE CHROMIUM** needle and observe instructions on the needle package. These **ORANGE CHROMIUM** needles can be used, also, on standard 78 R. P. M. records. On Home Recordings use the needles supplied for the particular type of disc to be played.

The pickup arm of these Phonograph Units is correctly counterweighted for the 33⅓ R. P. M. Program Transcription Records, as well as for the regular 78 R. P. M. records. This pickup arm also is hinged to allow raising to a vertical position (See dotted lines in Fig. 10) for ease in inserting new needles.

A metal "Needle Package Clip" is provided on the motor board of the Phonograph Unit (See Fig. 11) for holding a package of new needles. A Needle Cup is supplied for safe disposal of worn-out needles. (See Fig. 11.)

A loose needle in the pickup head will cause noisy or imperfect reproduction, and worn needles will damage the delicate recordings in the record grooves. Every minute recording on the record is reproduced electrically and is necessary for best audio quality, especially on the high quality reproducing systems of the Nos. 72 and 74 Receivers. When in doubt as to the condition of wear on a needle, replace with a new one. **It is always a safe plan to replace the needle every time the phonograph stops playing, after a magazine full of records have been played, as this insures against damaging valuable records which might be the case if the phonograph was of the continuous playing type with no definite stopping point to serve as a positive reminder that the worn needle required replacing.**

If the pickup shoe drags on the surface of the first record being played, the needle has been inserted too far in the pickup head.

7—Avoiding Mechanical Needle "Noise"

When a phonograph record is reproduced at the correct volume level for which it was designed, the music or speech is sufficiently loud to mask any mechanical "buzzing" noise caused by the needle in following the

record groove. Thus, records having high level recordings should be reproduced at comparatively high sound levels if mechanical needle noise is to be avoided. Records having low level recordings can be reproduced at very low sound levels without noticeable mechanical needle noise.

Special precautions are taken in the design of this phonograph to keep the mechanical noise of the needle to a minimum. A light weight (low inertia) pickup armature with very flexible mounting allows the needle to follow the recording groove accurately and with much less wear and "noise" than other types of lateral pickups.

Needle noise can be further reduced by keeping the cabinet doors and the top Fall Board closed at all times when records are being played.

Due to the wide frequency range of the audio systems of these Nos. 72 and 74 Receivers, overloads of the amplifier tubes, caused by abnormally high volumes, may produce "raspy" or rattling sounds which fall principally in the range reproduced by the high frequency (treble) loud speaker only. This may appear to be a mechanical rattle of the speaker diaphragm or the reproduction of "needle" noise, whereas it is not a fault or defect in the system but rather a result of overloading in the attempt to operate at volume levels above that for which the receiver is designed.

8—Care of Records

Care must be taken with new records to keep the surface as free from dust as possible, otherwise the records will wear out quickly and the reproduction will be harsh and unpleasant. Clean the dust from records by dusting only with a velvet or plush pad. Cracked or scratched records should not be played, as this may result in damage to the Electrical pick-up. It is best to destroy such records.

Keep all records away from heat, which will cause warping. A warped record will give an uneven "wavy" reproduction which is very disagreeable.

Old worn-out phonograph records will not give good reproduction with high quality electric pickups, high quality audio amplifiers, and high quality loud speakers.

9—Adjusting the Phonograph Motor Speed

The Phonograph Unit furnished in the No. 72 Receiver is provided with a Motor Regulator Knob, located in the center of the magazine compartment, as shown in Fig. 11 (concealed under any records that may be in the magazine) for accurately adjusting the speed of the governor type of electric turntable motor. To check the turntable speed, place the Stroboscopic Disc, furnished with the No. 72 Receiver, on top of a record, set for playing at 78 R. P. M. Adjust the turntable speed by use of the motor regulator knob, viewing the disc in the rays of the Phonograph Compartment Lamp (See Fig. 10). When the lines on the disc appear to be stationary the speed is properly adjusted. The stroboscopic disc can be used only when viewed with light from an incandescent lamp operating on an A. C. current of the frequency (cycles) marked on the disc and when the turntable is set for 78 R. P. M. rotation.

It is not necessary to adjust the motor speed for the 33⅓ R. P. M. turntable rotation, as this lower speed is obtained by positive mechanical speed reduction mechanism in the turntable, and a correct adjustment of speed for the 78 R. P. M. setting will insure correct speed for the 33⅓ R. P. M. setting.

The No. 74 Receiver is provided with a constant speed electric phonograph motor which always operates correctly when the receiver is connected directly to a Central Station alternating current supply. Voltage changes in this supply do not affect the correct speed of the phonograph turntable of the No. 74 Receiver, but sudden or large changes in the frequency of the alternating current supply will result in corresponding changes in the phonograph turntable speed and cause defective reproduction. Thus, in direct current areas, where individual motor-generator sets are employed to change the direct current to alternating current, these motor-generator sets must be of the constant speed or governor type to insure steady and correct A. C. frequency. When using alternating current, directly from the outside power circuits of modern Power Systems, the frequency is uniformly constant, thereby giving accurate turntable speed for the No. 74 Receivers.

10—Oiling of Phonograph Operating Mechanism

These Phonograph Units should operate without any care, excepting an occasional oiling. This should be done at least once in six months. Use a good quality of sewing machine oil on all shaft bearings not supplied with grease cups. Apply a few drops of this oil to each governor friction pad (No. 72 Receiver only) to insure steady operation of the turntable. At least once each year fill all grease cups with high quality "Soft" cup grease and place a small quantity of this grease on the teeth of the worm gears.

11—Replacing the Phonograph Compartment Lamp

If at any time the Phonograph Compartment Lamp burns out, it can be quickly replaced by reaching behind the wooden bracket that holds the switch for this lamp (See Fig. 10) and unscrewing the old lamp from its socket and replacing with a new P-18630 Lamp (6-volt, ¼ ampere Miniature Base Radio Dial Lamp) screwing the latter tightly into this socket. This is the same size and type of lamp employed for the radio chassis dial and tuning meter illumination.

12—Repacking the Phonograph Unit for Shipment

Before transporting the Nos. 72 or No. 74 Receiver by truck or by rail, be sure to protect the operating mechanism of Phonograph Unit by using the special packing material (stored in the Canvas Pocket and located on the inside of the cabinet) proceeding as follows:

First—Remove the rear phonograph panel from the back of the cabinet (See Figs. 5 and 6). This panel is held in place by five wood screws.

Second—Run the Phonograph Motor through its complete record changing cycle, without any records in magazine, and immediately remove the A. C. plug from house outlet.

Third—Insert the red finished "Shipping Pin" in hole provided for it, immediately at left of "AUTOMATIC START" button on the record magazine wooden panel (shown at "U" in Figs. 11 and 12). Force this pin into place, screwing the threaded portion in a clockwise rotation until it is securely held against dropping out in shipment. The Red Instruction Card (P-23363) should be held in place for shipment on top of Motor Board by this Shipping Pin.

Fourth—Remove the Turntable from Turntable Spindle by lifting up. (See Twelfth Paragraph of this Section.)

Fifth—Remove the Motor Regulator Knob from the motor speed control shaft by lifting up. (See Twelfth Paragraph of this Section.) Not used on No. 74 Receiver.

Sixth—Be sure that the Thumb Screw in the pickup head is tightened to prevent loss in shipment.

Seventh—Loosen the Set Screws which lock the universal coupling to the motor shaft and to the main drive shaft (See "C", Fig. 12). Slide this coupling off the motor shaft and on to the drive shaft until clear of motor shaft at least $\frac{1}{16}$ of an inch (See "D", Fig. 12) then lock the set screws to prevent the coupling from sliding off drive shaft.

Eighth—Slide the Metal Motor Spacing Block (colored red, See "B", Fig. 12) in between the bottom of the motor and the motor bracket. Line up the holes in the bracket, the motor, the plate and the bottom of the motor and screw in the two cap screws, with one lock washer on each screw, and fasten tight as shown at "A" in Fig. 12.

Ninth—With all records out of the magazine, force the Record Carrying Arm down on the record rests. Take one piece of the Cotton Tape and wind once around this arm, in close to upright bracket. Equalize the lengths of the free ends of this tape. Pull both ends down and pass over, back and under the block to the motor bracket. Pass left side of the tape through the inside of the motor bracket and the right side end of the tape through the bracket to left side. Inspect the position of tape on the top of record shifting arm before drawing tight. Fasten with a secure knot.

Tenth—With the Pickup Arm on the pickup arm rest, take the second piece of cotton tape and wind once around the pickup arm, close to the bracket, then criss-cross the tape around the pickup rest bracket, back over arm again and tie tight.

Eleventh—Remove the six Black Finished Metal Carr Caps from the screw holes "A" and "B", Fig. 11, in two ends and the front edge of the Phonograph Chassis (See Twelfth Paragraph). Insert the six phonograph shipping screws into these holes and tighten securely, using two long bolts on each end holes "A", Fig. 11, and two wood screws on the front edge, holes "B", Fig. 11. The metal washers should be between the heads of these screws and the felt washers.

Twelfth—Wrap the Turntable separately and carefully (See Fourth Paragraph), Motor Regulator Knob (See Fifth Paragraph), six metal Carr Caps (See Eleventh Paragraph), Package of Needles, and Stroboscopic Disc (not required for No. 74 Receiver) and enclose all of these items in a package or carton. If the receiver is to be repacked in its original factory shipping box, this carton of phonograph parts can be safely transported by securely fastening it by heavy wrapping cord to the Bracing in the back of the Console Cabinet, in the same manner used for the factory shipment.

Thirteenth—Empty Record Albums of the No. 74 Receiver should be carefully wrapped and tightly packed in the album pockets of the cabinet, care being taken to place soft paper packing between the backs of the albums and the inside of cabinet doors.

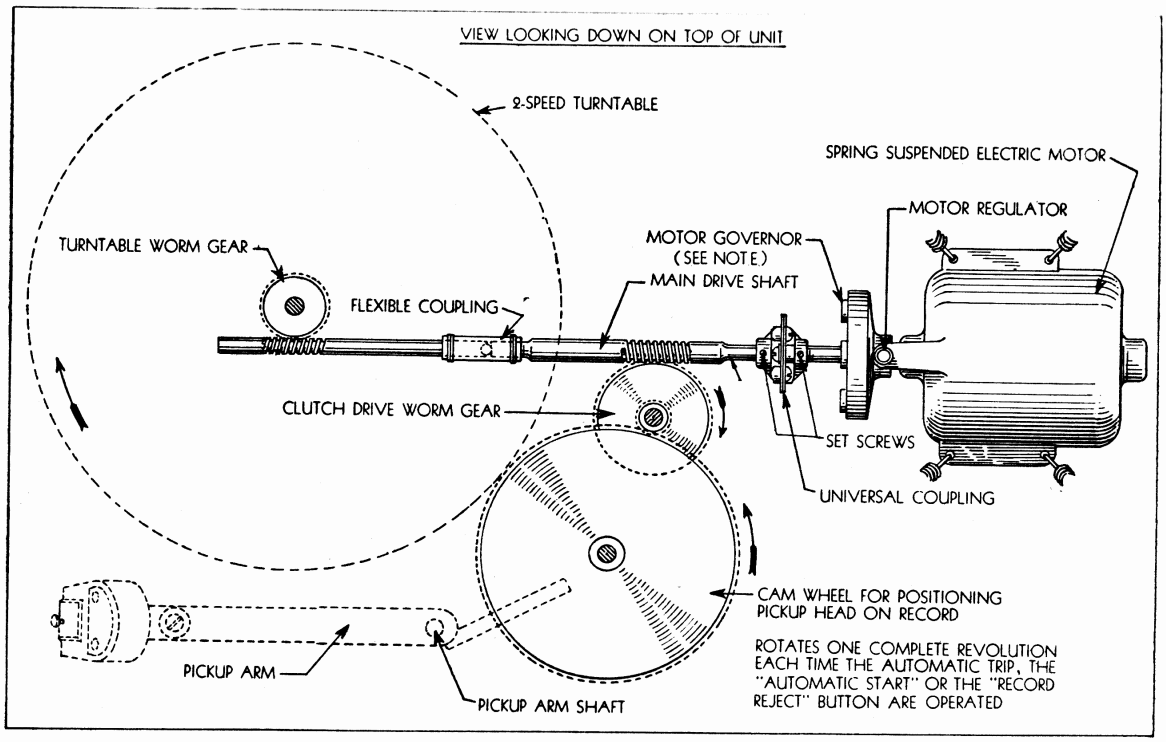


Fig. 13
Rotating Mechanism of the Automatic Phonograph Unit, showing Great Simplicity. (Motor Governor not used on the No. 74.)

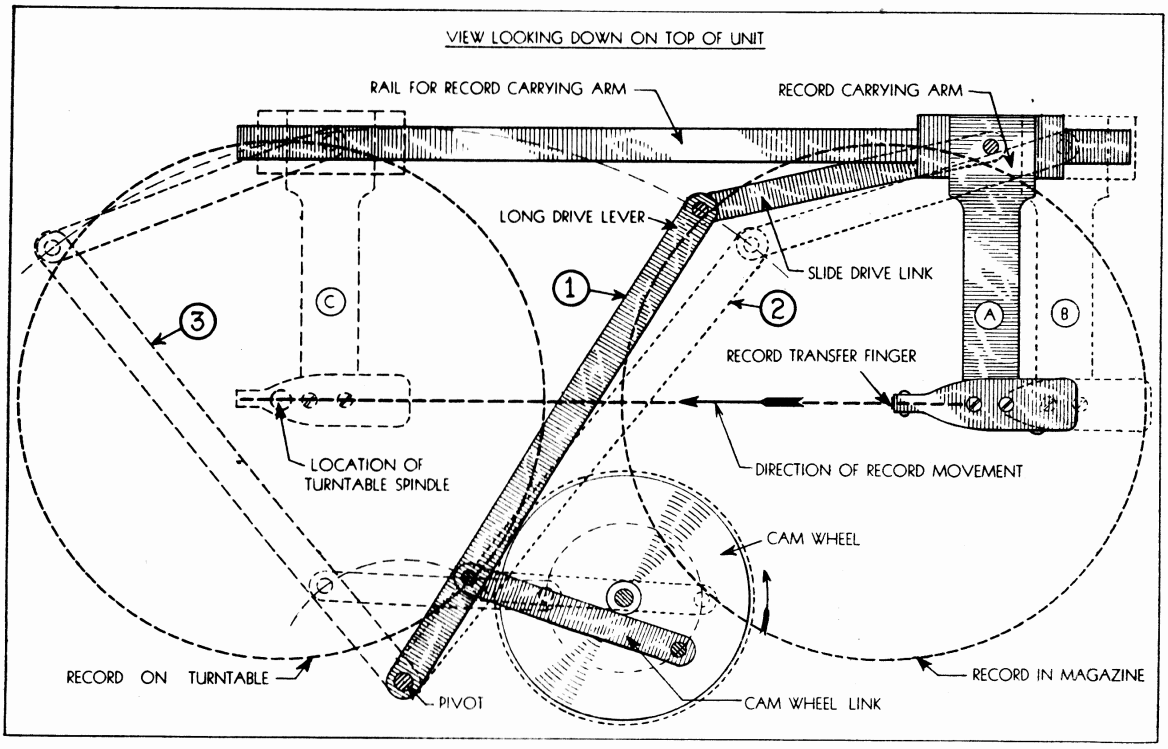


Fig. 14
Record Carrying Mechanism of the Automatic Phonograph Unit. One revolution of the Cam Wheel Transfers a Record from the Magazine to the Turntable.
"1" and "A"—Normal Position of Mechanism
"2" and "B" —Initial Movement to the Right for Positioning the Record in the Magazine.
"3" and "C" —Full movement to the left for Depositing the Record on the Turntable.

CHAPTER 3

DESCRIPTION OF THE OPERATING MECHANISM OF THE PHONOGRAPH UNITS OF THE NOS. 72 AND 74 RECEIVERS

The operating mechanism of the Phonograph Units supplied in the Nos. 72 and 74 Receivers is comparatively simple and easily understood, when each element is considered separately. Thus, this chapter is divided into the following eight sections, each describing a separate element of the complete phonograph unit:

1—Turntable Rotating Mechanism
2—Record Changing Mechanism
3—Pickup Arm Operating Mechanism
4—Automatic Tripping Mechanism
5—Automatic Start and Record Reject Mechanism
6—Single Record Mechanism
7—Two-Speed Turntable Mechanism
8—Cushioning of the Phonograph Chassis

In brief, a single electric motor drives all of the Phonograph mechanisms, including the automatic shifting of records. See Fig. 13. With the exception of a large cam wheel, which makes one complete revolution in changing a record on the turntable, all other rotating mechanism, including the turntable, operates continuously when the instrument is turned "on" and the mechanism is started.

The rotation of the large cam wheel is controlled by a mechanical dog type clutch, which is held out of engagement at all times, excepting immediately following the automatic tripping operation at the end of a record selection (or the pressing of the "Automatic Start and Reject Button". See Fig. 11.)

In making a complete revolution, this large cam wheel (Fig. 13) performs all the operations of transferring a phonograph record (Fig. 14) from the magazine to the turntable, setting the pickup needle for entering the first groove of either a 10-inch or a 12-inch record (whichever may be brought over from the magazine) and starting the playing of the record.

In case no record comes over from the magazine (last record having been played, or no record picked up in magazine due to improper positioning) the single rotation of the large cam wheel restores the pickup arm to its arm rest and operates a switch for stopping the phonograph motor.

These and other operations of the Phonograph Unit are described in more detail in the following sections:

1—Turntable Rotating Mechanism

Fig. 13 shows in diagramatic form the rotating mechanism of the Phonograph Unit. A spring suspended electric motor operates through flexible couplings a horizontal main drive shaft. At the left hand end of this drive shaft is the worm gearing for rotating the vertical spindle at 78 R. P. M.

A ball type speed reduction mechanism for 33⅓ R. P. M. operation is contained in the turntable hub and is described in detail in Section 7 under the heading "Two Speed Turntable Mechanism".

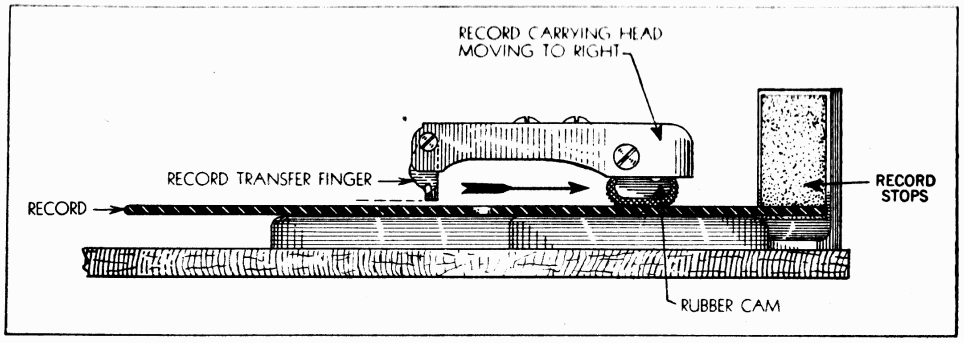


Fig. 15
Mechanism for Positioning the top Phonograph Record in the Magazine, preparatory to Shifting this Record to the Turntable.

By mounting the motor on a combination of eight spiral springs and eight soft rubber bushings, and driving the main shaft through a fabric type of universal coupling, mechanical motor "noise" is prevented from reaching the phonograph chassis and the enclosing cabinet. This insures quiet operation. (See Section 8—Cushioning of the Phonograph Chassis.)

2—Record Changing Mechanism

The mechanical movement for carrying a record from the magazine to the turntable is shown in diagrammatic form in Fig. 14. One rotation of the large cam wheel swings the "Long Drive Lever" by means of the "Cam Wheel Link" from the normal position, marked "1" (shown in full lines) to a right hand position, marked "2" (shown in dotted lines) and then to an extreme left hand position, marked "3" (shown in dashed lines).

The free end of this long drive lever, acting through the "Slide Drive Link", moves the "Record Carrying Arm" a short distance to the right ("B", Fig. 14) over the record magazine, and immediately reverses its motion and travels to the extreme left "C" so as to be over the turntable. After this, it reverses the motion and returns to its normal (stopped) position "A" over the magazine.

The "Record Carrying Arm", Fig. 11, is free to be lifted by hand to the top of the vertical track and is held in the raised position by a spring catch. This allows complete freedom of both hands in filling the magazine space with records or in re-arranging the order of records to be played. It is to be noted that the top selection (in full view) is the one to be played next on the turntable. The Record Carrying Arm must be lowered by hand after placing the records in the magazine, in order that the transfer fingers may be in proper position to engage the top record when a record shifting operation occurs.

When the record carrying arm starts its short movement to the right (Position 2, Fig. 14), the soft rubber cam, Fig. 15, engages the top record, forcing it back against the two "Record Stops", Fig. 11, so that this record will become "centered" and properly lined up for the "Record Transfer Finger". This movement of the arm to the right also causes the rubber cam to rotate just enough to raise the "Record Carrying Head" so that the "Record Transfer Finger" will drop straight down and clear the surface of the top record as shown in Fig. 15.

Now, when the Record Carrying Arm starts its movement to the left, the rubber cam swings back to its normal position, allowing the record transfer finger to rest on the surface of the top record. This finger slides a short distance on the center surface portion of the record (not on the

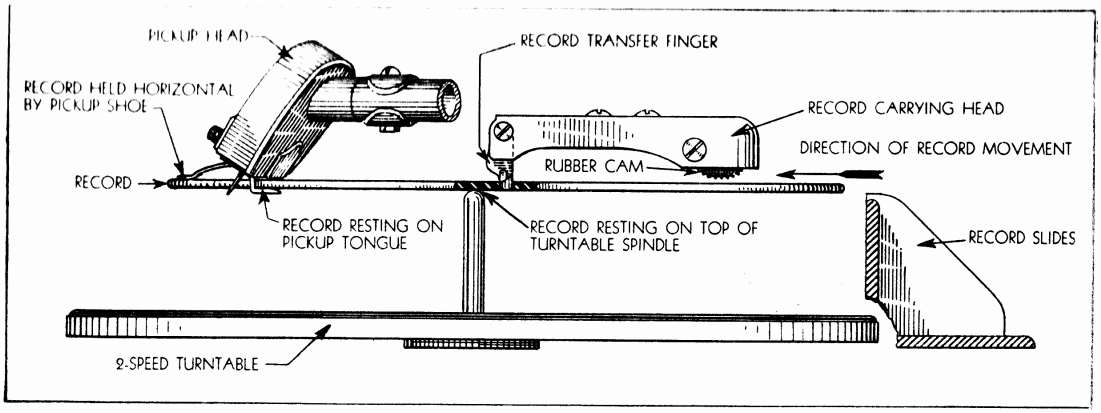


Fig. 16
Positioning of Pickup Head to Accommodate the size of Phonograph Record (10-inch or 12-inch diameter) being Delivered from the Magazine.

record groove portion) until it drops into the center hole in the record. The top record is now moved positively to the left, raising on the inclined record slides so as to pass over the top end of the turntable spindle as shown in Fig. 16.

Just prior to the carrying of the record to the top of the "Record Slides" the Pickup Arm has been raised and moved to a position over the turntable as described in Section 3, entitled "Pickup Arm Operating Mechanism". This makes it possible for the front edge of the record coming from the magazine to engage the Pickup Head Tongue, Fig. 16, forcing the pickup arm ahead of the record. The record is held in a horizontal position by the top of the turntable spindle, the hooked portion of the pickup tongue and the extending arm of the pickup "shoe" (shown in Fig. 16) until it comes directly over the top of the turntable spindle, when it drops down of its own weight to the turntable.

The record carrying arm continues its movement to the left for a short distance, after depositing a record on the turntable, then reverses its movement and travels back to its normal position ("A", Fig. 14) over the record magazine. Just before coming to a stop the rubber cam of the record carrying arm engages the surface of the top record in the magazine, forcing this record back against the record stops (Fig. 11) for centering purposes, preparatory for the next record change.

3—Pickup Arm Operating Mechanism

All of the automatic movements of the pickup arm are obtained by one complete revolution of the Large Cam Wheel shown in Fig. 13. This is the same wheel that provides the record carrying arm movement, described in Section 2.

Normally this Cam Wheel remains stationary, making one complete revolution following a tripping action at the completion of the playing of a record. See Section 4, covering "Automatic Tripping Mechanism" for details regarding the rotation of this cam wheel. The large cam wheel also makes a complete revolution following the pressing of the "Automatic Start" and "Record Reject" Button as described in Section 3, entitled "Automatic Start and Record Reject Mechanism".

One complete revolution of the large cam wheel provides the following sequence of movements of the pickup arm:

First—Pickup Arm is raised by a cam surface on the Large Cam Wheel, so as to bring the lower edge of the pickup head just high enough

to clear the top edge of a record coming from the magazine and to allow the pickup tongue (Fig. 16) to be engaged by the edge of this record.

Second—If the Pickup Arm happens to be on the Pickup Arm Rest as shown in Fig. 11, when the Large Cam Wheel starts to rotate (condition at start of playing a magazine full of records), a cam surface on this wheel forces the Pickup Arm towards the center of the turntable, so that the pickup head will be in position to meet a record coming from the magazine. This movement does not take place if the pickup arm is already near the center of the turntable, which is the condition immediately following the playing of a record.

Third—Further rotation of the Large Cam Wheel accurately positions the Pickup Arm with respect to the outer edge of the record (10-inch or 12-inch, to accommodate the particular size brought over from the magazine).

Fourth—Continued movement of the Large Cam Wheel causes the Pickup Head to be lowered gently so that the needle engages the outer clear surface of the record, between the edge and first playing groove.

Fifth—Quickly following the lowering of the needle on to the record surface, the Pickup Head is gently forced towards the center of the turntable so that the needle will enter the first playing groove of the record. This side pressure is immediately removed before the record starts playing.

The completion of a single rotation of the cam wheel does not cause any further movements of the Pickup Arm. The Pickup Arm, however, does not always follow the sequence of operations just enumerated, the exception being as follows:

After the last record from the magazine has been played or when (for any accidental reason) the Record Carrying Arm does not carry a record to the turntable, the Pickup Head remains near the center of the turntable (not being forced over by a 10-inch or 12-inch record to the edge of the turntable), allowing a mechanism to operate, when the Large Cam Wheel rotates. This causes the Pickup Arm to swing back to the Pickup Arm Rest (to the position shown in Fig. 11). Incidentally this movement of the Pickup Arm operates a switch to open the electric motor circuit and turn off the motor

In order to prevent bringing over more records from the magazine than the height of the turntable spindle will accommodate, a "Record Limiting Switch" is provided. The contacts of this switch are so adjusted that when the surface of a top record on the turntable comes within ¼ inch of the top of the turntable spindle, these contacts open and prevent rotation of the phonograph motor. Thus, if at any time the pickup arm is raised by hand to a position above the top of the turntable spindle, the phonograph motor is stopped and the turntable rotation ceases.

4—Automatic Tripping Mechanism

The rotation of the Large Cam Wheel (Fig. 13) is controlled by an Automatic Record Tripping Mechanism.

When the pickup arm is carried towards the center of the turntable by the action of the needle in following the playing grooves of the record, and the motion of the Pickup Arm is reversed, as when the needle enters an eccentric (Victor) type tripping groove in a record, the automatic tripping action takes place.

In case the motion of the Pickup Arm is continued towards the center of a record by a spiral type of tripping groove (instead of an eccentric type of tripping groove), the automatic tripping action takes place when the needle reaches the position of a 3¼ inch diameter circle ("standard" tripping groove diameter for this type of record).

When the automatic tripping action takes place, a clutch is operated so that the Phonograph Motor (Fig. 13) positively rotates the Large Cam Wheel for one complete revolution, after which the clutch is automatically released. This means that the Record Carrying Arm (Fig. 14) will complete its cycle of record changing operations, once it has started.

5—Automatic Start and Record Reject Mechanism

A push button, marked "Automatic Start" and "Reject Record", See Fig. 11, is provided on the Phonograph Unit, and operates as follows:

For Automatic Start Operation—After placing the records to be played automatically in the magazine space, and lowering the record carrying arm so as to rest on the top record, the "Automatic Start" button is pressed and held down for about two seconds. The first part of the movement of the button closes an electrical circuit for starting the phonograph motor. Further movement of the button operates the Large Cam Wheel operating clutch, the same as when automatically tripped at the completion of the playing of a record.

The holding down of this button for two seconds allows time for the clutch to actuate and the large cam wheel to rotate far enough to close an auxiliary circuit for the Phonograph Motor operation. From this point of rotation of the cam wheel, the phonograph motor circuit will remain closed until the record shifting cycle is completed.

For Record Reject Operation—If at any time it is desired to operate the record shifting mechanism, for example, to reject a record being played on the turntable in favor of the next record in the magazine, or to demonstrate the operation of the instrument, the pressing of the "Reject Record" Button will instantly start the large cam wheel rotating without waiting two seconds as for the "Automatic Start" operation. In this case, the phonograph motor is already rotating so that the pressure on the button need trip the clutch only.

6—Single Record Mechanism

Briefly this mechanism consists of a latch, actuated by the "Automatic-Single Record" Lever (See Fig. 11) for engaging the "Automatic Tripping" mechanism and preventing the operation of the Large Cam Wheel clutch when the end of this lever is moved to the "right" or "single record" position. This allows complete freedom of movement of the Pickup Arm in playing records singly on the turntable, without any possibility of tripping the record shifting mechanism. When the end of this shifting lever is set to the "left" or "Automatic" position, the "Automatic Tripping" mechanism is restored to its normal or operating conditions, and in this case the Pickup Arm should be allowed to complete its automatic record shifting cycle, once it has started to operate, before disturbing or moving by hand.

7—Two-Speed Turntable Mechanism

These Phonograph Units provide for 33⅓ speed by a Ball Speed Reducing Mechanism contained in the hub of the turntable. The turntable shaft rotates at 78 R. P. M. regardless of the speed of the turntable. A sliding type of speed change lever (Fig. 11) is mounted on the framework of the phonograph and so designed that its inner end engages the

ball speed reducing mechanism when this lever is pushed "in", causing the turntable to rotate at 33⅓ revolutions per minute. When this lever is pulled "out", the Ball Speed Reducing Mechanism is released and the turntable is driven at 78 revolutions per minute.

8—Cushioning of the Phonograph Chassis

In addition to a spiral spring and rubber suspension of the Phonograph Motor, the complete Phonograph Chassis floats on large soft rubber cushions. Also, the Pickup Arm Base is mechanically insulated from the metal framework of the Phonograph Chassis by rubber. These several cushionings are provided to insure quiet mechanical operation of the phonograph mechanism, and quiet electrical operation of the reproducing apparatus.

Six packing screws are provided for holding this Phonograph Chassis securely in the cabinet for shipping purposes. These screws must be used at all times, when transporting the Nos. 72 or 74 Receivers, and also must be removed before operating the phonograph. (See Instructions for Packing and Unpacking the Phonograph Unit in Sections 12 and 1 of Chapter 2.)

The complete Phonograph Unit can be removed from the Nos. 72 or 74 Radio Cabinets, by first removing the Rear Phonograph Cover (See Figs. 5 and 6) which latter is held in place with five wood screws. Now, disconnect the Phonograph Pickup Cord from the Pickup Transformer by pulling out the pin tips from the pin jacks in this transformer; Disconnect the Phonograph Power Supply Cord Plug from the socket in the back of the Radio Chassis; Disconnect the Phonograph Chassis Ground Wire from the Screw "GC" (Figs. 5 and 6) at the back of the radio chassis; Disconnect the Pickup Transformer Ground Wire from the Screw Terminal "GP" on the Transformer Casing.

The Phonograph Chassis rests on two Wooden Slides (one at each end) and each of these slides is fastened to the cabinet by two large bolts. Removing these four bolts allows the Phonograph Chassis to be pulled directly out of the cabinet, the same as a bureau drawer, care being taken to hold the chassis from falling when the ends of the Wooden Slides leave the cabinet. Reverse all of these operations when installing the Phonograph Unit in the cabinet.

CHAPTER 4

DESCRIPTION OF THE TE-LEK-TOR REMOTE CONTROL SYSTEM FOR USE WITH THE NOS. 70, 72 AND 74 RECEIVERS

All Nos. 70, 72 and 74 Receivers are provided with mechanical and electrical fittings for the Stromberg-Carlson Te-lek-tor System of Remote Control as shown in Figs. 4, 5 and 6. Thus, any of these receivers can be equipped for remote control operation without requiring any special work on the part of the installer. In fact, the Te-lek-tor Motor Unit for operating the Radio Chassis (See Fig. 17) can be installed at any time and made ready for operation in less than 15 minutes. The only tool required for this job is a screwdriver.

The Stromberg-Carlson Te-lek-tor System is the most simple, efficient and reliable type of Remote Control yet devised for Radio Receiver operation. The first of these controls was made in 1930 and through gradual improvements in details of design, this unit has been brought to a high state of perfection.

From the standpoint of operation, the Te-lek-tor System is extremely simple and direct, as it is completely push-button controlled, with one button for each operation and a plainly printed designation adjacent to each button indicating its function. Thus, strangers can operate the system at once, with little or no instructions.

Te-lek-tor Systems are very flexible in design, the most simple being a Motor Unit with one or two key boxes to control the operation of the radio chassis at any remote location in the same room in which the No. 70, 72 or 74 Receiver is installed (See Fig. 17). In this case no permanent house wiring is required as the circuits between the Receiver and the Te-lek-tor Key Box are made through a flexible flat (ribbon shaped) cord which can be concealed under the edges of rugs or other floor coverings. The standard lengths of this flat cord regularly furnished with the key boxes, are 10 feet and 30 feet.

There are two key box outlets in the back of the Te-lek-tor Motor Unit, allowing two of the key boxes to be used in this simple installation. In this case one of the key boxes can have a short connecting cord (10 ft.) for operating the Receiver from a chair or couch, located close to the instrument, and the other key box with a long cord (30 ft.) for operating from a more distant location.

A more complete Te-lek-tor System can be provided for operating the phonograph as well as the radio system in the Nos. 72 and 74 Receivers (See Fig. 18.) The Phonograph control, however, requires the installation of a Phonograph Switching Relay in the radio chassis circuits. This can be done at the factory on special order. Authorized Stromberg-Carlson Te-lek-tor System Dealers are in position to make this Phonograph Relay installation and to install permanent (concealed) wiring in the home to accommodate extension speakers and Te-lek-tor Key Boxes in other rooms, remote from the room containing the Radio Receiver Cabinet.

1—Services Provided by the Te-lek-tor System

For practical reasons, the Te-lek-tor System is limited to performing those functions which are involved in normal, every-day service. Thus, tuning is confined to standard broadcast-station reception without attempting to accomplish the extremely fine hair-breadth tuning required for short wave reception. Remote control of the Fidelity and Tone Controls is not attempted, it being assumed that these will normally be left in "SR" fidelity position and for any desired tone quality.

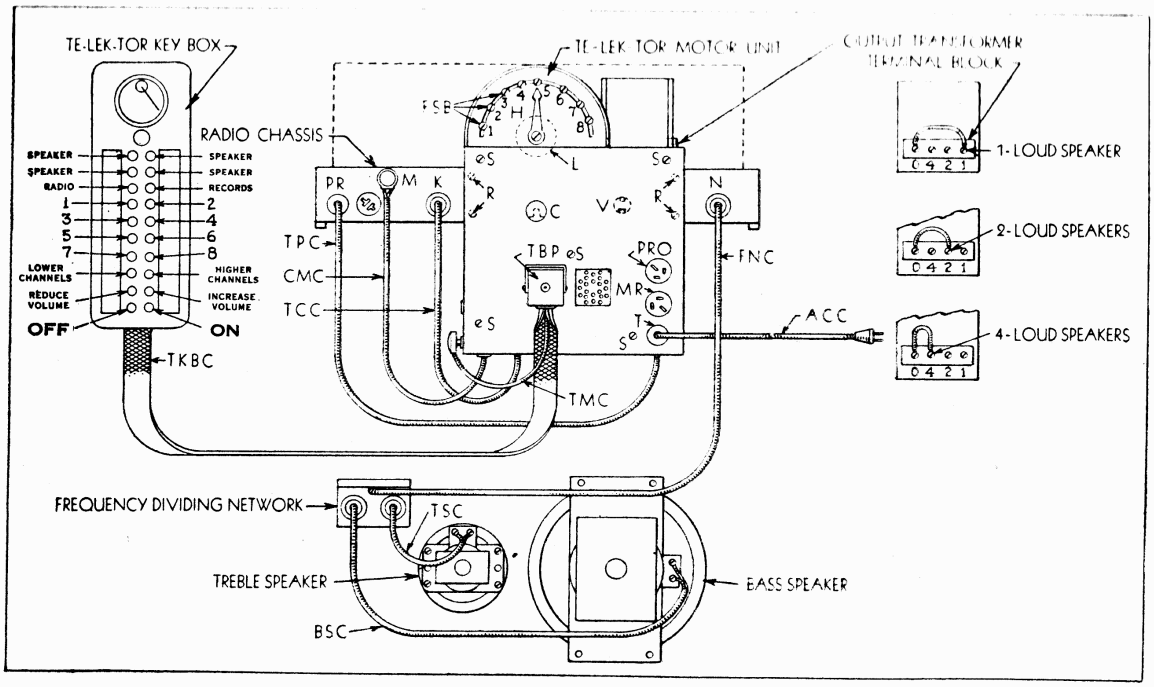


Fig. 17

Te-lek-tor Motor Unit Mounted on the Back of the Radio Chassis of a No. 70, 72 or 74 Receiver for Performing the following Remote Control Operations:

1—Turning the Receiver "On" and "Off"

2—Selecting any one of Eight "Favorite" (Pre-Set) Standard Broadcast Stations

3—Rotating the Dial in Either Direction for "Sharpening" Tuning or for Tuning Stations not Pre-Set

4—Tuning Accurately by Meter (Visual Tuning)

5—Setting Volume Level of Radio Reproduction

This equipment can be installed in a few minutes by a service man, without any Changes in the Radio Circuits or Extra Wiring.

An electrical inter-lock is provided so that the manual on-off switch (combined with the tone control) is not effective when the receiver is set for Te-lek-tor operation, so that the Tone Control may be left in any desired setting. Going to the receiver, an operator may adjust the Fidelity, Tone or Volume Controls without affecting the Te-lek-tor; or the operator may "take manual control", in which case this operator alone can tune the instrument, adjust its volume and other controls, change to phonograph operation or turn the instrument on and off, although listeners at remote Te-lek-tor control positions are still free to turn their loud speakers on or off to "listen in".

The following remote control operations are provided by the Stromberg-Carlson Te-lek-tor System when installed on the Nos. 70, 72 and 74 Receivers.

(a) Simple Te-lek-tor Radio Remote Control System (See Fig. 17)

This simple system of Radio Chassis Remote Control can be used on the No. 70, 72 or 74 Receiver and provides push buttons on each Key Box for the following operations:

—One Button for Turning the Radio "On"
—One Button for Turning the Radio "Off"
—One Button for Increasing the Volume Level
—One Button for Decreasing the Volume Level
—One Button for Turning the Dial clockwise for tuning "DX"

stations or for "sharpening the tuning" of pre-set stations, by meter indication.

—One Button for Turning the Dial counter-clockwise for tuning "DX" stations or for "sharpening the tuning" of pre-set stations, by meter indication.

—Eight Buttons for Turning the Dial Directly to any of eight "Favorite Stations" that are set up previously on the Te-lek-tor Motor Unit

In this simple system, there will be left on the key box six push buttons, which are not used. These are reserved for extension speakers, etc., which may be added to the system at some later date. Each Te-lek-tor Key Box contains an accurate Visual Tuning Meter for use in sharpening the tuning of stations selected by any of the eight favorite station buttons or by the "DX" buttons. A combined Pilot and Meter Lamp is supplied on each Key Box to provide illumination for the meter and keys and to serve as a visual indication (when this lamp is lighted) that the Radio is operating, and that control of the Radio is switched to the Te-lek-tor System.

(b) Complete Te-lek-tor Radio and Phonograph Remote Control System (See Fig. 18)

This complete system of Radio and Phonograph Remote Control can be used on the No. 72 or No. 74 Radio and Automatic Phonographs and provides push buttons on each key box for the following operations:

—One Button for Turning the Radio or Phonograph "On"

—One Button for Turning the Radio or Phonograph (and any connected Extension Speakers) "Off"

—One Button for Increasing the Volume Level of Radio or Phonograph

—One Button for Decreasing the Volume Level of Radio or Phonograph

—One Button for Turning the Dial clockwise for Tuning "DX" Stations, or for "Sharpening the Tuning" of pre-set stations by means of Meter Indication.

—One Button for Turning the Dial Counter-Clockwise for Tuning "DX" Stations, or for sharpening the tuning of pre-set Stations by means of Meter Indication.

—Eight Buttons for Turning the Dial Directly to any of eight "Favorite Stations" that are set-up previously on the Te-lek-tor Motor Unit.

—One Button for Turning on the Phonograph and Transferring a Record from the Magazine to the Turntable and Starting Playing. Pressing this Button when a Record is playing, immediately transfers the next Record from the Magazine to the Turntable and starts playing (acting as a "Record Reject")

—One Button for Turning off the Phonograph and connecting the radio into circuit.

—One Button for Disconnecting the Loud Speaker System in the Receiver Cabinet (For use when reproduction is desired only from one or more Extension Speakers, and not from the Radio Set).

—Three Buttons for Connecting or otherwise Controlling Several Extension Speakers, located in other rooms.

In this system all twenty push buttons of each Key Box are used, and as many Key Boxes as desired can be installed (usually one Key Box in each room in which an Extension Loud Speaker is located). Tuning Meters on each Key Box give accurate tuning control for best audio quality. A combined Pilot and Meter Light also is provided on each Key Box.

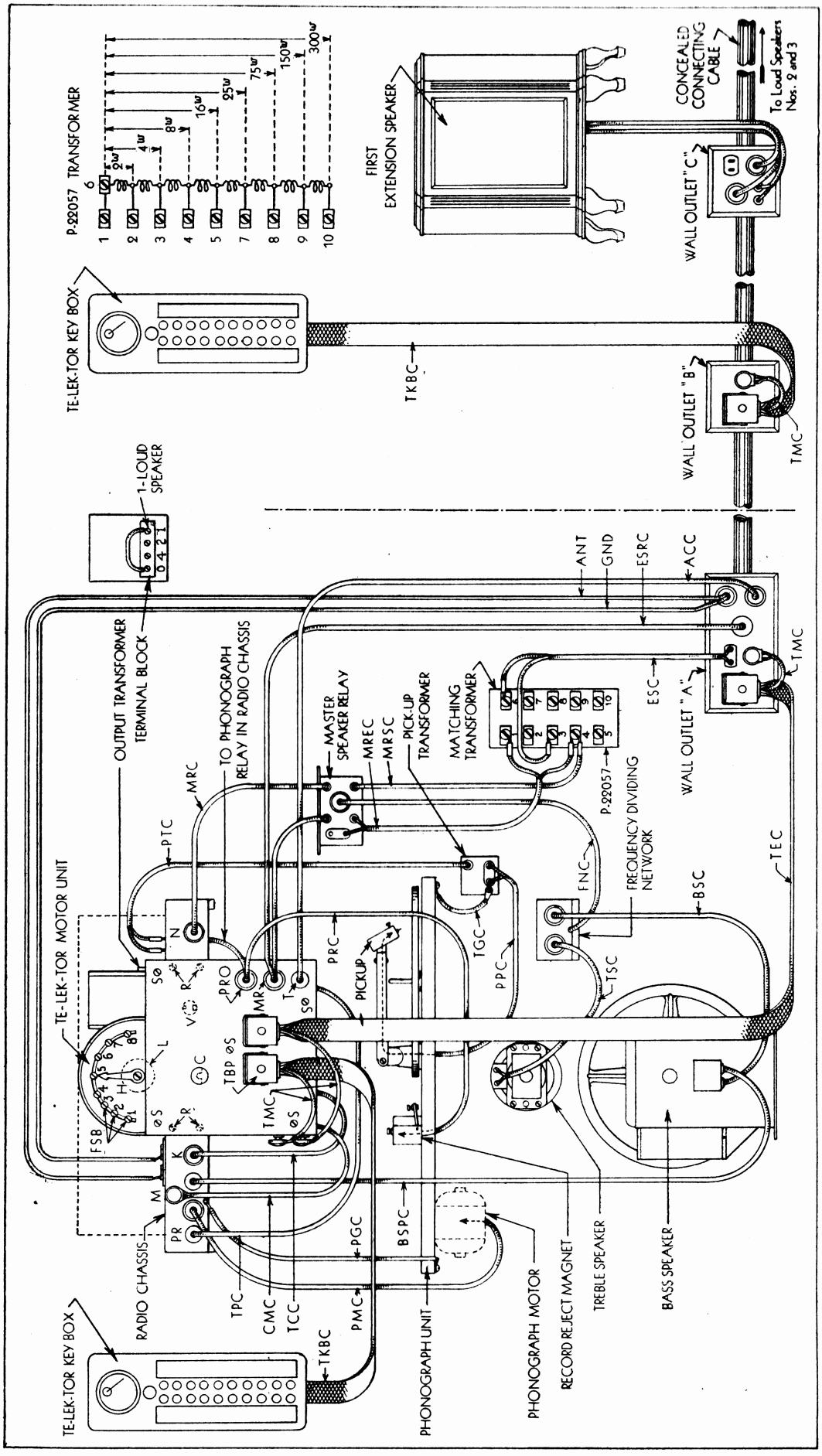


Fig. 18 Complete Te-lek-tor Radio and Phonograph Remote Control System on Nos. 72 and 74 Receivers (See page 48)

2—Installing the Te-lek-tor Motor Unit

This is a simple operation, if the following sequence of instructions is observed. (This work should be done by the Dealer's Service Man).

First—Remove the Dust Cover from the Te-lek-tor Motor Unit by first taking out the five screws "S" and pulling off the Tuning Knob "C", Figs. 17 and 18.

Second—Turn the Volume Control Knob of the Radio Chassis (Fig. 7) to complete Counter-Clockwise Rotation, so as to bring the wide slot in the Coupling Disc "V" (Located at the back of the Radio Chassis as shown in Figs. 4, 5 and 6) to the bottom.

Third—Turn the Volume Control Drive Coupling Arm located on the motor side of the Te-lek-tor Motor Unit, to the bottom so as to be in position to engage the wide slot in Coupling Disc (mentioned in the previous paragraph) when the installation is made.

Fourth—See that the Large Radio Chassis Knob (marked "Fidelity Control" in Fig. 7) is pushed "In".

Fifth—With four Te-lek-tor Unit Mounting Screws within reach, take the Te-lek-tor Motor Unit in the two hands and insert the gear shift stud (located on the motor side of the unit) into the lower half of the opening "C" (Figs. 4, 5 and 6) at the back of the radio chassis.

Sixth—Now, raise the Te-lek-tor Motor Unit so as to cause the slot in the end of the Fidelity Control Shaft Lug to engage or hook into the "necked" portion of the Te-lek-tor Unit Gear Shift Stud. This engagement can be checked by pulling the complete Te-lek-tor Motor Unit back (holding up so as to insure engagement) and away from the Radio Chassis. If it can move only a small distance, then the proper engagement is made.

Seventh—With this engagement made, hold the Te-lek-tor Motor Unit against the back of the Radio Chassis with one hand and with the other hand, insert the four mounting screws "R", Figs. 17 and 18, into the threaded holes in the back of the radio chassis. Turn these screws into the holes just far enough to hold the Motor Unit loosely in place.

Eighth—Check the proper engagement of the Volume Control Drive to the Te-lek-tor Unit by turning the Volume Control Knob on the front of the Radio Chassis and observe whether the Volume Control gears of the Te-lek-tor Unit are rotated.

Ninth—Check the engagement of the Large Radio Chassis Knob (Fidelity Knob, Fig. 7) Shaft to the Te-lek-tor Gear Shift Mechanism by observing whether the Tuning Gears of the Te-lek-tor Motor Unit are engaged and disengaged when this large knob is pulled "out" and pushed "in".

Tenth—If both of these controls are properly engaged, proceed to line up the pin on the end of the Tuning Crank Shaft of the Te-lek-tor Motor Unit with the hole in the end of the Tuning Shaft of the Radio Chassis. This can be done by lifting up or moving to either the right or left the complete Te-lek-tor Motor Unit until a position is reached where the Tuning Shaft Disc "L" (Figs. 17 and 18) can be moved freely towards and away from the back of the Te-lek-tor Motor Unit. Before this test can be made, the Round Stud on the End of the Te-lek-tor Tuning Crank must be lined up with the notch in the Radio Chassis Tuning Drive Disc "L" (Figs. 17 and 18).

Eleventh—Now, tighten all four Te-lek-tor Mounting Screws "R" (Figs. 17 and 18) and check for proper and free operation of the Volume Control Drive, and of the Te-lek-tor Tuning Drive and

Gear Shift. (See Section 5 of this Chapter on "Operating the Te-lek-tor System".)

Twelfth—Before replacing the Dust Cover on the Te-lek-tor Motor Unit, check the electrical and mechanical operation of the installation, by temporarily making electrical connections between the Te-lek-tor Motor Unit and Radio Chassis as shown in Fig. 17, for a simple radio installation on a No. 70, 72 or 74 Receiver or as shown in Fig. 18, for a Radio and Phonograph Installation on a No. 72 or 74 Radio and Automatic Phonograph. It will be noted that the Power Supply Cord, marked "A. C. Plug" in Figs. 4, 5 and 6, is removed from the socket in the back of the Radio Chassis and inserted in a similar socket, marked "T" in the lower right hand corner of the Te-lek-tor Motor Unit (Figs. 17 and 18). Now, the Te-lek-tor Power Cord, marked "TPC" in Figs. 17 and 18, can be inserted in the socket "PR", just vacated in the back of the Radio Chassis. Follow the Operating Instructions in Section 5 of this Chapter when checking the various electrical operations of the Te-lek-tor Motor Unit.

Thirteenth—If the system employs a No. 72 or 74 Receiver equipped with both a Phonograph Switching Relay and Record Reject Magnet, it will be necessary to "short circuit" the lower protective resistor in the lower left-hand corner of the Motor Unit. This resistor is provided to protect the Phonograph Relay against excessive voltage where the lighting circuit voltage is high and no Reject Magnet is used.

Fourteenth—After checking the installation and finding that it works correctly, the Dust Cover can be replaced on the Te-lek-tor Motor Unit and fastened by the five screws "S" (Figs. 17 and 18). In order to do this, it is necessary to temporarily remove the several circuit connecting plugs and Tuning Knobs (TBP, P, T, C, etc., Figs. 17 and 18) from the face of the Te-lek-tor Motor Unit. Be sure to install the Motor Unit Tuning Knob "C", Figs. 17 and 18, on its shaft.

The various connecting cords and mechanical details of the Te-lek-tor equipped No. 70 series Receivers are identified by the following letters in Figs. 17 and 18:

ACC	A. C. Current Supply Cord (Connecting Te-lek-tor Unit to House A. C. Current Supply)
ANT	Antenna Connection to Chassis
BSC	Bass Speaker Cord
BSPC	Bass Speaker Power Supply Cord
CMC	Chassis (Radio) Meter Cord (from Te-lek-tor Unit)
ESC	Extension Speaker Cord (Connecting Matching Transformer to Special House Wiring Circuits)
ESRC	Extension Speaker Relay Cord (Connecting Te-lek-tor Unit to Special House Wiring Circuits)
FNC	Frequency Dividing Network Cord (to Master Speaker Relay)
GND	Ground Connection to Chassis
MRC	Master Relay Cord (to Radio Chassis)
MREC	Master Relay Extension Cord (Two Conductors Connecting Master Relay to Matching Transformer)
MRSC	Master Relay Single Cord (Connecting Master Relay to Matching Transformer)
PGC	Phonograph Ground Cord (to Radio Chassis)
PMC	Phonograph Motor Current Supply Cord
PPC	Phonograph Pickup Transformer Connecting Cord
PRC	Phonograph Reject Magnet Cord
PTC	Phonograph Transformer Cord (to Radio Chassis)
TCC	Te-lek-tor Circuit Connecting Cord (to Radio Chassis)
TEC	Te-lek-tor Extension Cord (to Special House Wiring Circuits)
TGC	Transformer (Pickup) Ground Cord (to Phonograph Chassis)

TKBC	Te-lek-tor Key Box Cord
TMC	Te-lek-tor Key Box Tuning Meter Cord
TPC	Te-lek-tor Power Cord (to Radio Chassis)
TSC	Treble Speaker Cord
C	Notched Lug on End of Radio Chassis Te-lek-tor Control Shaft
FSB	Favorite Station Brushes on Te-lek-tor Motor Unit
H	Favorite Station Brush Indicating Pointer on Te-lek-tor Unit
K	Te-lek-tor Motor Unit Circuit Outlet on Radio Chassis
L	Clutch Disc on Tuning Shaft of Radio Chassis
M	Tuning Meter Jack on Radio Chassis
MR	Master Relay Outlet on Te-lek-tor Motor Unit
N	Audio Output Circuit Outlet on Radio Chassis
PR	Power Outlet on Radio Chassis
PRO	Phonograph Relay Outlet on Te-lek-tor Motor Unit
R	Te-lek-tor Motor Unit Mounting Screws (4)
S	Te-lek-tor Motor Unit Cover Holding Screws (5)
T	Power Outlet on Te-lek-tor Unit
TBP	Te-lek-tor Box Plug on End of Cord
V	Notched Disc on Volume Control Shaft of Radio Chassis

3—Setting of Favorite Station Brushes on the Te-lek-tor Motor Unit

There are eight Push Buttons provided on each Te-lek-tor Key Box for the automatic selecting of eight "Favorite Stations" on a Te-lek-tor equipped No. 70, 72 or 74 Receiver. The Te-lek-tor Motor Unit is provided with eight Adjustable Brushes for setting up these eight Favorite Stations, this operation being as follows:

First—Decide on the eight best local or nearby stations which are regularly heard (night and day) in your locality, and arrange these stations in a list, in the order of their channel assignment (kilocycle markings on the Radio Dial). For example, if the receiver is installed in a locality in or near New York City, the following list of stations might be selected, and arranged in this order:

Station No.	Kilocycle	Station Letters
1	660	WEAF
2	710	WOR
3	760	WJZ
4	860	WABC
5	1010	WHN
6	1100	WLWL
7	1180	WINS
8	1300	WBBR—WFAB—WEVD

When selecting this list, it is necessary to see that the separation of these stations on the dial is sufficient to allow adjacent Te-lek-tor Motor Brushes to be properly located in the adjusting slot. On the higher channel end of the No. 70 type Tuning Dial, the brushes cannot be placed closer than 60 kilocycles. On the middle and lower channel end of the Dial, the tuning scale is more open, allowing for less than 40 kilocycles setting of adjacent brushes.

Second—With the Large Knob (Fidelity Knob, Fig. 7) of the Radio chassis, turned to the "SR" position and pulled out for Te-lek-tor Operation (See Section 5 of this Chapter) and the Tuning Dial turned by hand by the Station Selector Knob to the position where the Te-lek-tor Tuning Clutch has snapped into engagement (Station Selector Knob will not turn the Dial in this engaged position), proceed to rotate the dial by the Te-lek-tor Motor Unit (pressing the "Lower Channel" button on the Te-lek-tor Key Box) until Station No. 1 of your list of "Favorite Stations" is reached.

Now, tune this station as accurately as possible by momentarily pressing, either the lower channel button or the higher channel button, until the station is heard with good quality and the pointer on the Tuning Meter gives the maximum swing to the right.

Third—Loosen, about one-half a turn, the knurled metal nut holding the Favorite Station Brush (Brushes marked "FSB" in Figs. 17 and 18) in the extreme left hand end of the adjusting slot and marked "1" in the diagram. Slide this brush in the slot until it is directly in line with the end of the pointer "H" and tighten the knurled nut tightly with the fingers. Now, turn the Knob "C" on the motor Unit, clockwise about one-half a turn and press the Te-lek-tor Key Box Button No. 1 (See Key marked "1" on Fig. 17) and hold down until the Te-lek-tor Hand "H" comes to rest. If the setting of Bush No. 1 was accurate, Station No. 1 of your list should be correctly tuned. Look at the dial on the front of the receiver to check the station tuned-in, to see that it corresponds to the No. 1 Station of your list. Correct the setting of Brush No. 1 by moving it in the slot a very small amount in the desired direction and checking the new setting by turning Knob "C" clockwise one-half turn and pressing Push Button No. 1 on the Key Box to rotate the dial until Hand "H" comes to rest.

It is to be noted that the Brush No. 1 for the first station in the list of Favorite Stations, need be adjusted for accuracy of setting in one direction only as the Te-lek-tor Motor will always rotate in that one direction when automatically tuning from any station of higher channel numbering to this lowest pre-set station.

Fourth—Proceed to set up the second, and the other remaining stations in your Selected list of Favorite Stations, in the same manner described in the "Second" and "Third" operations of these instructions, the second station using Brush "2" on the Te-lek-tor Motor Unit and Push Button "2" on the Te-lek-tor Key Box, etc. (See Figs. 17 and 18.) There is one important exception on this operation, as Brushes 2, 3, 4, 5, 6 and 7 must be set so that fairly accurate tuning of these six intermediate pre-set stations will be obtained when the dial is rotating in either direction in the automatic selecting of these stations. The best setting of these six stations can be obtained by checking the accuracy of each of these Te-lek-tor Brushes as follows: Turn the Te-lek-tor Knob "C" one-half turn clockwise and rotate the Tuning Dial back to rest by pressing the corresponding Button on the Key Box, and immediately turn this Knob "C" one-half turn counter-clockwise and again rotate the Tuning Dial back to rest by pressing the same Key Box Button as before. Compare the extent of the movement of the pointer of the Te-lek-tor Box Tuning Meter, and readjust the position of the Te-lek-tor Brush until the Meter Pointer swings the same amount for both directions of tuning. This may not be the exact position of the dial for sharpest tuning of the receiver, required for best audio quality on the Nos. 70, 72 and 74 Receivers, but it gives a positive selection of these pre-set Favorite Stations by the mere pressure on one push button of the Te-lek-tor Key Box.

For best audio quality on any of these eight automatically selected stations, the tuning can be sharpened by momentarily pressing the Higher Channel Button or the Lower Channel Button to give maximum swing to the right of the pointer of the Key Box Tuning Meter. When the tuning is correctly sharpened, the audio reproduction will give maximum low frequency response and be free from any raspy or high pitched effects.

Fifth—Adjust Favorite Station Brush No. 8 the same as for Brush No. 1, excepting turn the Knob "C" (Fig. 17) on the back of the Te-

lek-tor Motor Unit in one direction only (counter-clockwise one-half turn), for checking the accuracy of brush setting. This is the direction that the tuning dial always rotates when automatically selecting this eighth station.

Sixth—Write the Station Call Letters of the eight Favorite Stations of your list on the designation strips of the Key Box, so as to correspond to the keys used in setting up the stations on the Te-lek-tor Motor Unit. These push button strips are printed on both sides so as to allow for another list of Favorite Stations, if at any time in the future another choice of stations is made.

4—Te-lek-tor Extension Speakers

Each No. 70, 72 and 74 Receiver Chassis has a special Terminal Block on the Output Transformer to allow for adjusting the impedance of the Audio Output Circuits to accommodate several extension loud speakers as shown in the right hand section of Fig. 17.

(a) Connection with No Extension Speakers

The correct connection of the Output Transformer adjusting cord for regular operation of the receiver (with no extension loud speaker) is between Terminal marked "0" and Terminal marked "1", as shown in Fig. 17 for "1—Loud Speaker". When only one speaker is to be connected to the output of the Radio Chassis at any one time, that is the speaker system in the receiver being disconnected when an extension speaker is connected, then the Output Transformer adjusting cord should be left connected between Terminal marked "0" and Terminal marked "1", as shown for "1—Loud Speaker" in Fig. 17.

(b) Permanent Connection with One Extension Speaker

If one Extension Speaker is likely to be connected at the same time that the loud speaker system in the receiver is operating, making a total of two speakers operating from the radio chassis, the adjusting cord should be connected between Terminal "0" and Terminal "2", as shown for "2—Loud Speakers" in Fig. 17.

(c) Permanent Connection with Two or Three Extension Speakers

When two or three Extension Speakers are likely to be connected to the radio set, making a total of three or four speakers operating from the radio chassis, then the Output Transformer adjusting cord should be connected between Terminal "0" and Terminal "4", as shown for "4—Loud Speakers" in Fig. 17.

(d) Correct Impedances of Extension Speakers

The Loud Speaker System employed in the Nos. 70 and 72 Receivers has a different impedance to that used in the No. 74 Receiver, requiring that the Extension Speakers also have different voice coil impedance, as follows:

—For the Nos. 70 and 72 Receivers the Extension Speakers should preferably have voice coil impedances of approximately 24 ohms each. Otherwise, special impedance matching precautions, such as the use of a P-22057 Matching Transformer may be required in addition to the matching facilities provided by the tapped output transformer on the chassis.

—For the No. 74 Receiver the Extension Speakers should preferably have voice coil impedances of approximately 8 ohms each. Otherwise special impedance matching precautions, such as the use of a P-22057 Matching Transformer may be required, in addition to the taps on the output transformer of the chassis.

(e) Connecting an Extension Speaker Impedance Matching Transformer to the Receiver

When a Te-lek-tor System employs extension speakers of different voice coil impedances from those specified above, or it is desirable to keep the volume level of reproduction from the several extension speakers somewhat below that of the speaker system in the Receiver Cabinet, then a Stromberg-Carlson P-22057 Matching Transformer can be employed to advantage as shown in the Te-lek-tor Installation, Fig. 18. This P-22057 Matching Transformer has its winding and taps arranged as shown in the upper right hand diagram of Fig. 18. This diagram shows also the impedance between the various taps of the transformer.

The P-22057 Matching Transformer is an "Auto-Transformer" having an excellent frequency characteristic and power-handling capacity sufficient to drive one Stromberg-Carlson No. 1 High Fidelity Loud Speaker or three or four ordinary Dynamic Loud Speakers.

When the P-22057 Matching Transformer is used, a section of its winding is placed in parallel with the Receiver Loud Speaker system, the same as if it were another loud speaker of similar impedance to that employed in the receiver. Thus, in order to obtain correctly balanced results, the impedance of this portion of the Matching Transformer winding should equal the impedance of the Loud Speaker System in the receiver. The Matching Transformer should also be treated as one loud speaker when determining which tap to employ on the chassis output transformer. The impedance of the Speaker System in the Nos. 70 and 72 Receivers is 24 ohms, so that the connections from the receiver to the Matching Transformer should be made to taps Nos. 1 and 7, which provides a Transformer Impedance of 25 ohms. The No. 74 Receiver Speaker System has an impedance of 8 ohms, so that connections to the Matching Transformer for this receiver should be made to taps Nos. 1 and 4, which provide a transformer impedance of 8 ohms. This connection for a Te-lek-tor equipped No. 74 Receiver is shown in the main diagram of Fig. 18.

(f) Connecting Extension Speakers to an Impedance Matching Transformer

The P-22057 Matching Transformer provides a sufficient number of taps to allow for correct impedance matching for various arrangements of Extension Speakers of either Dynamic or Magnetic types. Special instructions are supplied with each of these Transformers for correct installation of speakers. For example, with three Dynamic Extension Speakers having voice coil impedance of about 15 ohms each, the Extension Speaker Circuit should be connected to taps Nos. 3 and 6 of the P-22057 Matching Transformer (4 ohms impedance) as shown in the main diagram of Fig. 18.

In general, the connection of Extension Loud Speakers to the P-22057 Matching Transformer should be made as follows:

1 (only)	Dynamic Speaker	-	Use Taps No. 1 and No. 5
1 to 2	Dynamic Speakers	-	Use Taps No. 1 and No. 4
1 to 4	Dynamic Speakers	-	Use Taps No. 1 and No. 3
1 to 5	Magnetic Speakers	-	Use Taps No. 6 and No. 10
1 to 10	Magnetic Speakers	-	Use Taps No. 6 and No. 9
1 to 60	Magnetic Speakers	-	Use Taps No. 6 and No. 8

5—Operating the Te-lek-tor System

A Te-lek-tor equipped No. 70, 72 or 74 Receiver can be operated either as a Remote Control instrument or as a Manual Control set, the switching from one method of operation to the other, being accomplished by the pulling out or pushing in of the Large Knob (Fidelity Control Knob, Fig. 7).

(a) Manual Operation

Complete hand (manual) control of a Te-lek-tor equipped No. 70 series Receiver is obtained by merely pushing in the Large (Fidelity Control) Knob and following the instructions given in Article 4 of Chapter 2, covering "Operating Procedure for the Radio Receiver". **The only precaution is to be sure that the Te-lek-tor Control is set for Radio Operation (not Phonograph Operation) before this Large (Fidelity Control) Knob is pushed in for Manual Control.**

When the Large (Fidelity Control) Knob is pushed in for Manual Control, the Te-lek-tor Tuning Mechanism is completely disconnected so that the Tuning Dial is as free to turn by hand as a receiver not equipped with a Te-lek-tor Motor Unit. This is necessary for accurate hand tuning of short-wave stations.

The Te-lek-tor System is not designed or intended to be used for tuning short-wave stations, as this service requires that the operator be stationed at the Receiver for manipulating the special controls necessary for switching from one Range to another, the hand operation of the Vernier Tuning Knob, etc.

(b) Te-lek-tor Operation

Te-lek-tor Remote Control of a No. 70 series Receiver has been made simple by providing individual push buttons on the Key Boxes for each separate operation, there being twenty buttons as shown in the upper left hand section of Fig. 17. Each button has a plainly printed designation to clearly indicate its operation. The following sequence of operations should be followed when operating a No. 70 series Receiver by Te-lek-tor Control:

First—Pull out the Large (Fidelity Control) Knob (Fig. 7), to connect the Radio Chassis to the Te-lek-tor Motor Unit for Remote Control operation, and immediately rotate the Station Selector Knob (Fig. 7) until a position is reached where the Te-lek-tor Clutch engages the Tuning Dial Drive. When this engagement is made a slight click will be heard, and the Tuning Dial will be locked against any further motion in either direction. **The Fidelity Control Knob (Fig. 7) should be set with the letters "SR" at the top, for Standard Radio Selectivity, when operating the Radio by Te-lek-tor Control, in order to insure against adjacent channel interference, etc.**

Second—Press momentarily the Key Box Button marked "On", Fig. 17, to operate a relay for switching the operating current to the Receiver Chassis. The Pilot Lamp on the Te-lek-tor Key Box will light to indicate that this operation has been accomplished.

Third—Press the Key Box Button associated with the particular Favorite Radio Station desired (Station Call Letters marked on the Designation Strip adjacent to the button) and hold this button down until the radio set tuning dial

is automatically rotated to the correct position for that station. The pilot light will be dimmed while the dial is being rotated, but will come to full brilliancy when the dial stops rotating. Also, no sound will come from the loud speaker while the radio dial is being rotated but sound will be heard as soon as the dial stops. The Tuning Meter on the Te-lek-tor Key Box shows by the movement of its pointer when the receiver tuning dial is being rotated, as this pointer gives a distinct swing for each radio station signal passed over and comes to rest when the dial stops its movement.

Fourth—To raise the Volume Level of Reproduction, press the Key Box Button marked "Increase Volume". To reduce the Volume Level of Reproduction, press the Key Box Button marked "Decrease Volume". A separate electric motor is provided on the Te-lek-tor Motor Unit to operate the Volume Control of the Radio Chassis. This motor is operated in one direction by the "Increase Volume" Push Button and in the other direction by the "Decrease Volume" Push Button. Thus, the length of time the Push Button is pressed determines the amount of volume increase. A momentary pressure on a Volume Control Button, therefore, will give a noticeable change in the Loud Speaker volume. A longer pressure, a greater change of volume, etc.

Fifth—Now, if necessary, sharpen the tuning of the radio station just selected automatically, for best audio quality, by momentarily pressing the "Higher Channel" Button or the "Lower Channel" Button **so as to obtain maximum low frequency response and freedom from high pitched tone effects or raspy reproduction.**

This method of sharpening of tuning requires that the Fidelity Control Knob on the Receiver is previously set with the letters "SR" at the top.

This position of the Radio Tuning Dial for best reproduction, also will be indicated by a maximum swing to the right of the pointer of the Key Box Tuning Meter.

The fine audio quality incorporated in the design of the No. 70 series Receivers, depends on accuracy of tuning, so that these two methods of sharpening of tuning by Remote Control are provided on the Te-lek-tor System and should be used as required.

Sixth—To select another Favorite Station, press the Key Box Button associated with the desired station call letters, following the instructions contained in the previous operations "Third" and "Fifth".

Seventh—The two buttons, marked "Higher Channels" and "Lower Channels" used to sharpen tuning in the fifth operation (above), can be employed for locating other stations which are not set up on the eight Favorite Station Buttons. In this case, the maximum swing of the pointer on the Key Box Tuning Meter to the right will serve as a visual indication when one of these other station signals is being passed over by the rotating of the Tuning Dial of the Receiver. Immediately removing the pressure on the button and reversing the direction of the dial by the other Channel Push Button will allow this particular station to be

tuned in. Sharpen the tuning by maximum swing to the right of the Tuning Meter or by maximum low frequency audio response from the speaker.

Eighth—Press Key Box Button marked "Off" to turn the receiver off. The Pilot Lamp of the Key Box will go out to indicate that this is done.

Ninth—When the Te-lek-tor System is installed on a No. 72 or 74 Receiver, with Phonograph Switching Relay and Record Reject Magnet, as shown in Fig. 18, the momentary pressing of the Te-lek-tor Key Box Button marked "Records" will automatically switch the circuits in the radio cabinet from radio operation to phonograph operation and transfer automatically the top record in the Phonograph Magazine space to the Turntable and start playing. The volume level of the record reproduction can be regulated with the same Te-lek-tor Key Box Buttons used for regulating the volume of radio reproduction. (See "Fourth" operation of these instructions.) If at any time, when a record is being played, it is desired to substitute another record without waiting for the completion of the selection, the momentary pressing of the button marked "Record" will cause the next record in the Phonograph Magazine to be transferred immediately to the turntable and played.

Tenth—With the Te-lek-tor controlled Phonograph operating as just described, the momentary pushing of the Selector Key Box Button marked "Radio" will immediately stop the phonograph operation and connect the radio. The next time the "Record" button is pressed, the phonograph is started and a new record is carried from the Record Magazine to the Turntable. Thus, any unfinished record on the Turntable is not played. This avoids confusion as each switching to phonograph operation (by pressing the "Record" button) starts playing a record at its beginning, regardless of whether the previous record on the phonograph turntable has completed its playing when the last switch from Phonograph to Radio operation was made.

Eleventh—If the Te-lek-tor installation includes Extension Loud Speakers (See Section 4 of this Chapter) as shown in Fig. 18, up to three extension speakers can be assigned to three of the buttons, marked "Speaker" on the Te-lek-tor Key Box (Fig. 17) and the fourth button used to control a Master Speaker Relay. The circuits for controlling these Speakers can be arranged in several ways (See special instructions furnished with each Te-lek-tor System), one of the most convenient being a separate button for turning on each Extension Speaker and one button for turning off the Speaker System in the Radio Cabinet (Master Speaker). With this arrangement, all Extension Speakers are turned off when the "Off" button is pressed on the Te-lek-tor Box, and the Master Speaker is turned on when the "on" button is pressed. Thus, the next time the "on" button of the Key Box is pressed (after the "off" button is operated), the receiver will be turned on with only the Master Speaker connected, all Extension Speakers being disconnected. This avoids any errors in operation and allows the desired arrangement of speakers to be selected each time the radio set is turned on.

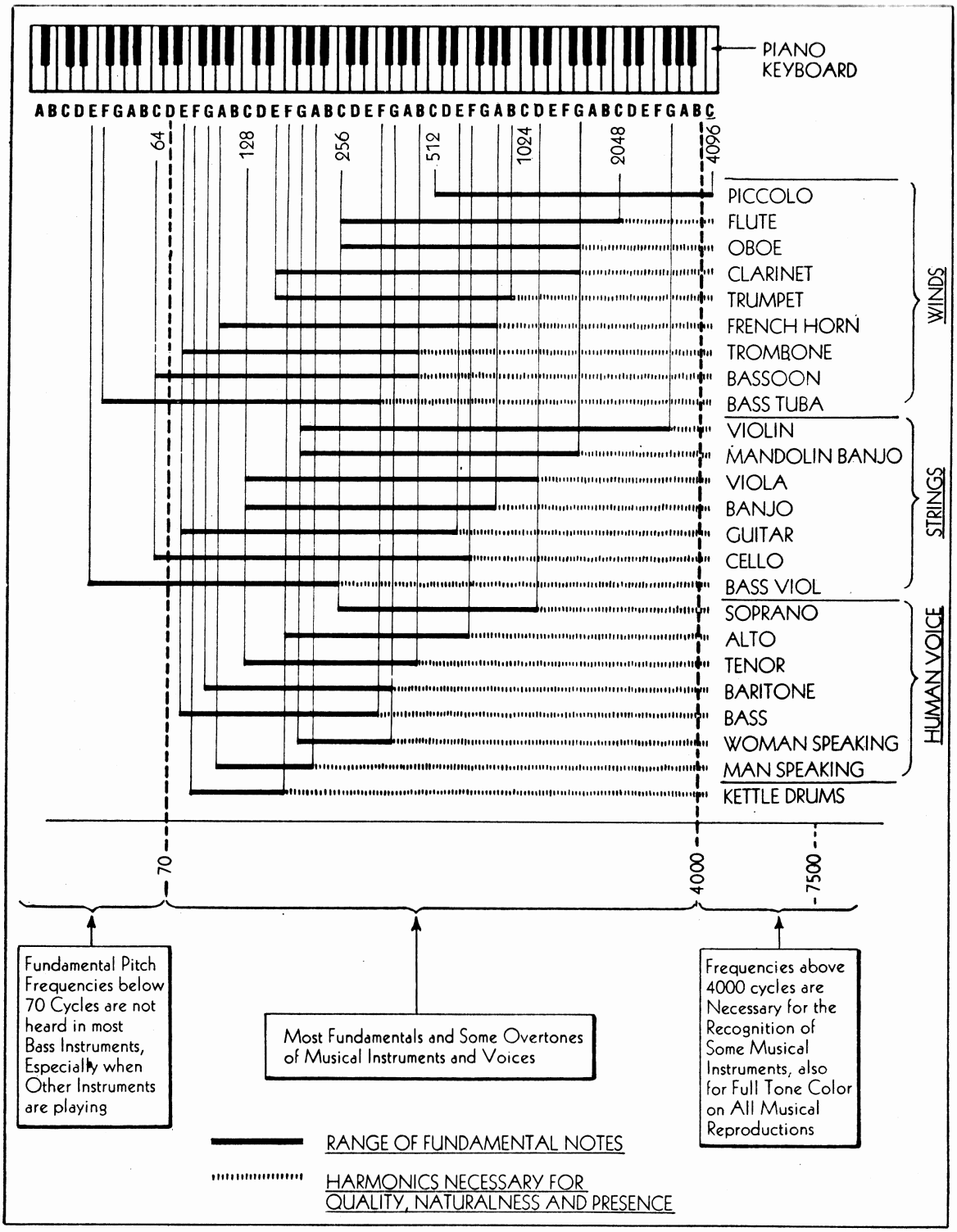


Fig. 19

Frequency Ranges of Human Voices and Musical Instruments. Solid Lines show the Audio Frequency Ranges of the Fundamental Tones of Musical Instruments and Fundamental Tones of the Human Voice. Dotted Lines (extending up to above "7500" cycles) Show the Overtones or Useful Harmonics of the Fundamental Tones which are Necessary for Recognition of Different Kinds of Musical Instruments and the Different Qualities of the Human Voice. Without these Overtones, all Musical Instruments (as far as Tones are Concerned) would Sound Alike. The Overtones above 4000 Cycles are Necessary for Recognition of High Pitched Musical Sounds, such as the Jingles on the Tambourine, also for Richness in Tonal Color of the Majority of Musical Reproductions.

CHAPTER 5

DESCRIPTION OF THE NEW AUDIO FEATURES INCORPORATED IN THE NOS. 70, 72 AND 74 RECEIVERS

When you listen to the reproduction of a good radio program through Stromberg-Carlson No. 70 series Receivers, the following qualities are noted:

(a) A true tonal balance (as regards low, middle and high register) on all kinds of reproductions.

(b) Brilliance of high frequency (treble) tones that bring out qualities in instrumental reproduction that you have not heard before in radio, without sounding high pitched.

(c) A wealth of low frequency (bass) tones that do not sound tubby or boomy, as in other console radio receivers.

(d) Crystal clearness of tones that make individual voices and musical instruments stand out as clearly as when listening directly.

(e) Startling distinctness and naturalness in the reproduction of all kinds and types of speaking voices, devoid of the artificial cabinet boom and harshness of peaked treble response that usually are present in ordinary radio reproduction.

(f) Ample undistorted volume that gives vivid dynamic color to the reproduction without sounding too loud.

(g) Better sound distribution to listeners in all parts of the room.

While most programs from local broadcast stations will be reproduced by the No. 70 series Receiver with the marked tonal improvements listed above, it must be understood that these receivers will reproduce defects in the transmitted program, as well as its fine qualities, more distinctly than receivers of limited audio range. This applies to hum and low rumbles as well as high-frequency distortions. In some cases the broadcasting stations are not yet operating up to high fidelity standards, though most of them have been or will soon be improved. In some cases, the broadcast transmitting station does not yet employ high fidelity listening or test equipment to "monitor" its own transmissions and may not be aware of defects in its programs not perceptible on receivers of poor tone quality.

Due to the fact that different circuits and different apparatus may be employed in transmitting the various programs from any one station, the audio quality of the different programs may vary in accordance with the capabilities of the equipment used. Thus, some programs from a particular station may be of excellent tone quality, while others may show defects which require that the receiver be adjusted for Standard rather than High Fidelity operation.

Knowledge of the features that provide for good reproduction, also knowledge of the factors that limit or prevent obtaining satisfactory quality on some stations, will allow the listener to make selections of programs that will give the greatest satisfaction. Therefore, this chapter is devoted to a semi-technical discussion of some of the most important factors involved in high quality radio reproduction.

1—Audio Frequency Range Required for Good Radio Quality

The most important sounds transmitted and reproduced by radio are from the human voice and from musical instruments. These sounds are very complex in character, consisting of fundamental or pitch tones with various overtones (harmonics of the fundamental tones) combined in various patterns to give the distinctive tones that characterize the different types of musical instruments and different kinds of voices.

If we removed the overtones (harmonics) all musical instruments would sound alike. Thus, middle "C" on a trumpet would sound like middle "C" on a violin or on a flute. These overtones or harmonics have simple ratios of vibrations (frequencies or cycles) to the fundamental tone. For every single vibration of the fundamental tone, the first overtone (second harmonic) has two vibrations, the third harmonic three vibrations, the fourth harmonic four vibrations, etc. It is the relative loudness of the harmonics with respect to each other and to the fundamental that produces the quality or tone-color of a musical sound.

For example, middle "C", which has a fundamental pitch of 256 vibrations per second, when sounded on a particular instrument, might have a second harmonic (512 cycles) of about the same loudness as the fundamental, a third harmonic (768 cycles) of less loudness, a fourth harmonic (1024 cycles) of very much less loudness, a fifth harmonic (1280 cycles) of about the same loudness as the second harmonic, etc. The combination of the fundamental tone of a certain intensity, with the various intensities of sounds of the harmonics gives a distinctive tone color that characterizes this particular instrument. Middle "C" on another type of instrument would have the same 256 vibrations per second, combined with a similar series of harmonics, but with a different arrangement of the intensities or loudness of the fundamental and the various harmonics.

These differences in tone color might be likened to the differences in the raised portions on the keys of a "Yale" lock, a large number of different keys being made possible by varying the relative heights of a comparatively few elements (raised portions). Musical sounds, however, usually have a comparatively large number of elements (the fundamental or "pitch" tone and its harmonic "overtones") and while the absence of some of these higher harmonics may not prevent recognition of particular types of instruments, the loss of these higher harmonics detract materially from the fine tone values.

It is of interest at this point to note the range of fundamental frequencies of various musical instruments and the human voice as shown diagramatically in Fig. 19.

At the top of this diagram is shown the keyboard of a standard piano and under it black lines are drawn to indicate the range of fundamental notes of other musical instruments. For example, the flute has a range of fundamental tones from 256 cycles to 2048 cycles, inclusive. The harmonics of these instruments, shown by broken lines, extend well beyond the 7500 cycle mark on this diagram. The ranges of the fundamental tones of human voices, shown in this diagram, are for average persons and are included for comparison purposes only.

A study of Fig. 19 will show that musical frequencies are arranged in a logarithmic progression, that is, the fundamental pitch of each higher octave has twice the frequency (cycles) of the next lower octave. This is an important factor when considering the audio response diagrams given in this chapter.

2—Importance of High Frequencies in Audio Quality

While some kinds of sounds require frequencies of over 12,000 cycles to give complete recognition, it has been found through extensive listen-

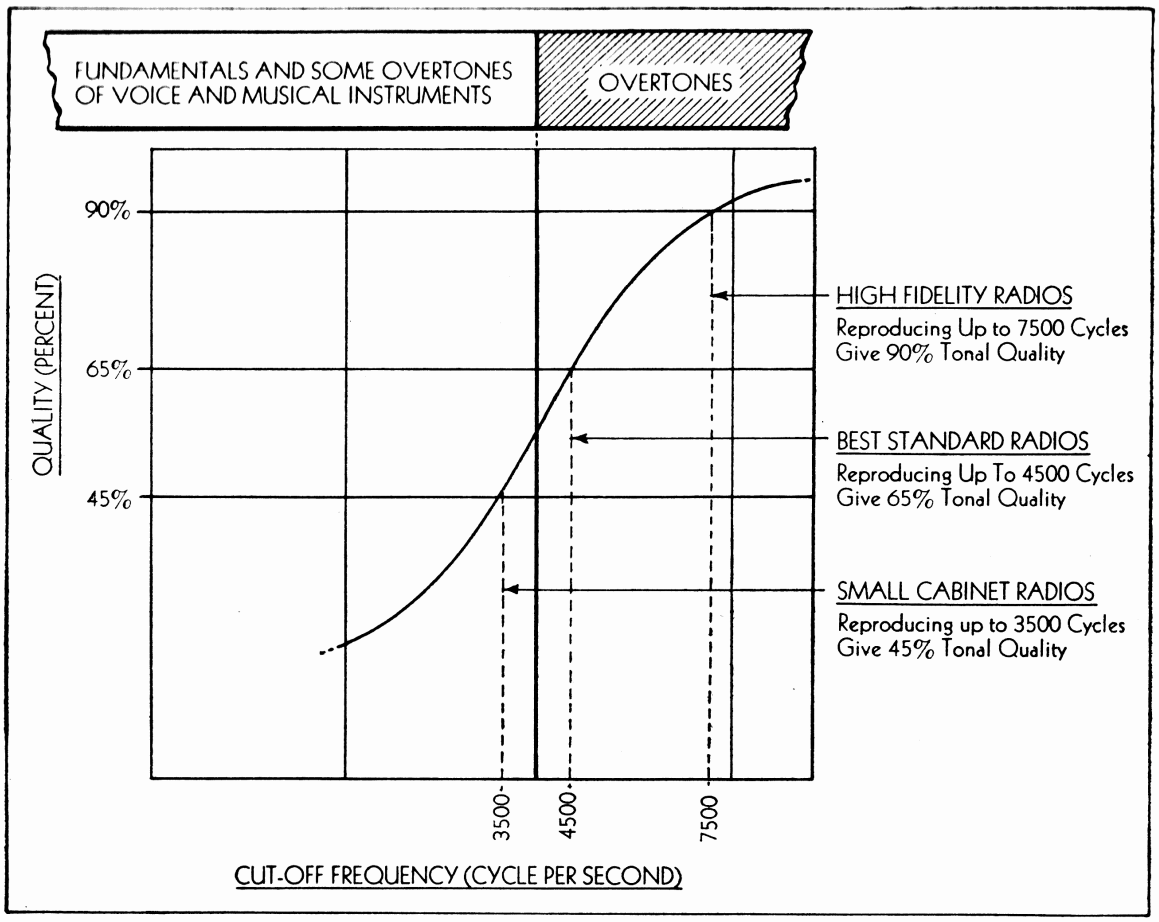


Fig. 20
Diagram Showing Importance of High Audio Frequencies in Obtaining Quality of Reproduction in Radio Receivers. An Extension of the Audio Frequency Band to over 7500 Cycles is Provided in the No. 70 series of Receivers. However, this is only One of Eight Important Tonal Quality Improvements Provided in these Instruments, all of which are Necessary for Real High Fidelity Reproduction. (See Section 14 of this Chapter.)

ing tests that frequencies above approximately 7500 cycles are not necessary for high quality of reproduction. Fig. 20 shows a curve obtained through listening tests of trained observers on orchestral music. As the higher frequencies were reduced by filters, the observers judged the percentage of audio quality remaining as compared to a reproduction with all frequencies present. From this curve, it was shown that 90% of the quality of the orchestral music was reproduced when all audio frequencies above 7500 cycles were cut off, that 65% of the quality was obtained when frequencies above 4500 cycles were omitted and that only 45% of the quality remained when the cut-off was 3500 cycles.

From the shape of the upper portion of the curve, it is noted that a considerable increase in frequency is required to produce a worth-while increase in Quality Percentage, so that a 7500 cycle cut-off can be considered a practical limit for musical reproduction.

Radio reproduction presents two additional limitations, as follows:

(a) The allocation of all standard broadcast channels with 10,000 cycle separation, limits the carrier side bands (which carry program) to less than 5000 cycles, excepting for powerful local stations, which may use a band width up to 7500 cycles without interference from weak distant stations in adjacent channels. This limitation is discussed more fully in Section 16 of this Chapter.

(b) Atmospheric and other disturbing electrical noises are mostly high frequency in character, so that a radio receiver capable of reproducing frequencies much higher than 7500 cycles may include proportionately more noise frequencies than useful higher audio frequencies.

These factors, together with other important considerations, have resulted in the selection by Radio Engineering Groups of 7500 cycles as the practical upper limit of audio reproduction for a high fidelity radio system.

Before leaving this subject, it is necessary to add that a 7500 cycle cut-off in a correctly designed receiver, with a wide range speaker system, such as is provided in the Stromberg-Carlson No. 70 series Receivers (capable of reproducing up to 10,000 cycles), actually reproduces 7500 cycles without noticeable attenuation (loss of volume) at that frequency. Thus, these receivers are capable of reproducing some frequencies above 7500 cycles on radio programs.

Claims for radio reproduction of over 7500 cycles are usually based on special methods of laboratory measurement which show higher instrument readings for the high frequency response than is actually heard by a listener to the receiver, or are based on the consideration that any weak response (regardless of how insignificant) is the upper limit of reproduction.

3—Useful and Distortion Harmonics

In the previous discussions, the term "Harmonic" has been used to describe the overtones which are created along with the fundamental pitch tones in both voice and music, and which contribute to the tone quality. These are useful harmonics and belong in the reproduction.

The term "Harmonic" also is used by Radio Engineers to describe the distortion frequencies usually resulting from overload somewhere in the radio system (not necessarily in the receiver) and which are reproduced along with the useful harmonic frequencies. Naturally these harmonics do not belong in the reproduction, as they were not present in the original voice or music, and, therefore, constitute a type of distortion.

Fig. 44 shows one form of these distortion harmonics, resulting from over-modulation at the radio broadcast station. In this case, the distortion harmonics, when reproduced on a wide range receiver, such as the No. 70 series, will give a raspy or rattling sound which is often mistaken for a mechanical rattling of the loud speaker cone.

All broadcasting stations have controls for adjusting the per cent of modulation and usually the presence of over-modulation distortions indicates either careless operating at the station, or use of inadequate monitoring equipment.

4—Obtaining of High Frequency Reproduction Without High Pitched Effects

It must be understood that the presence of the higher audio frequencies in the reproduced speech and music merely corresponds to the natural brilliance and tonal color of the original performance before the studio microphone and if correctly handled in the radio system, including the receiver, will not sound high pitched or shrill.

This can be explained by comparing an accurate radio reproduction of a musical composition to the accurate portraying of the face of a familiar person by photography, and the comparing of a distorted high pitched radio reproduction of the same musical composition to a cartoonist's distorted drawing of the face of the same familiar person. In the first case, both the music and photograph are life-like and natural, while in the second case the high pitched reproduction is just as much of a radio distortion as a long nose drawn on the caricatured face of the familiar person is a cartoonist's distorted view.

In radio this high pitched type of distortion usually is produced in the loud speaker, a short range of frequencies in the neighborhood of 3000 cycles being greatly accentuated with respect to other frequencies above and below that range. Any musical tones coming within this distortion range, therefore, are greatly exaggerated in the radio reproduction, and as this range (in the neighborhood of 3000 cycles) is at the upper or high frequency end of most musical instruments (See Fig. 19), the result is a high pitched distortion. It gives, in fact, a caricature of the original musical composition that is untruthful as well as irritating to the listeners' ears.

Now, it is obvious that a loud speaker system that is capable of reproducing a wide range of audio frequencies, without any peaks in the higher frequency range, will give truthful (natural) reproduction with the brilliancy and tonal color of the original, and **with no high pitched distortion tones.**

The speaker system employed in the No. 70 series Receivers provides this wide range, smooth response by the use of two speakers and a frequency dividing network, as shown in Fig. 21. One of these speakers has a comparatively large and wide-angle cone of stiff material, for handling the lower frequencies, up to 2500 cycles, without any distortion peaks, while the second speaker has a small light weight cone for the handling of all frequencies above 2500 cycles, also without distortion peaks. An electrical network is used to divide the audio frequencies from the radio chassis between these two speakers, so that the response is smooth from the low end of the audio range to the high end. Most of the audio power output from the receiver is required for the low audio frequencies, therefore, the Bass Speaker (Fig. 21) is made with a large diameter, stiff cone and a massive magnetic system, so as to be capable of handling this heavy load efficiently and without distortion. On the other hand the higher audio frequencies require very little power, so that the Treble Speaker (Fig. 21) is made comparatively small in size, yet of high efficiency so as to allow for correct operation with a simple frequency dividing network and without extra amplification.

When a single speaker is employed for reproducing a wide range of audio frequencies (to over 7,500 cycles) the cone structure must be made light enough to respond efficiently to the higher frequencies and yet stiff enough to act as a piston in the correct reproduction of the lower frequencies. These conflicting requirements (and several others of equal importance) usually force the designer to use a compromise cone structure and sacrifice smoothness of response for frequency range (See Figs. 37 and 38). In addition to irregularities in response (high frequency peaks) that give high pitched reproduction, these compromise cones usually have paper rattle distortions (produced similar to the snapping effect of the metal bottom of an oil can when pressed with the fingers) at comparatively low volume levels.

5—Importance of Low Frequencies in Audio Quality

While high audio frequencies contribute to the tonal color of music and are necessary for recognition of various kinds of musical instruments and for different voices, these frequencies must be accompanied by the middle range frequencies and low range (bass) frequencies, otherwise the reproduction will sound thin and very unnatural. These low frequencies give depth or body to the music or voice and when present in their proper proportion of intensity to the intensities of the middle and high frequencies, give a tone balance to the reproduction that is natural and life like.

It has been found by listening tests, made with a large number of trained observers, that low frequencies below 70 cycles, do not contribute

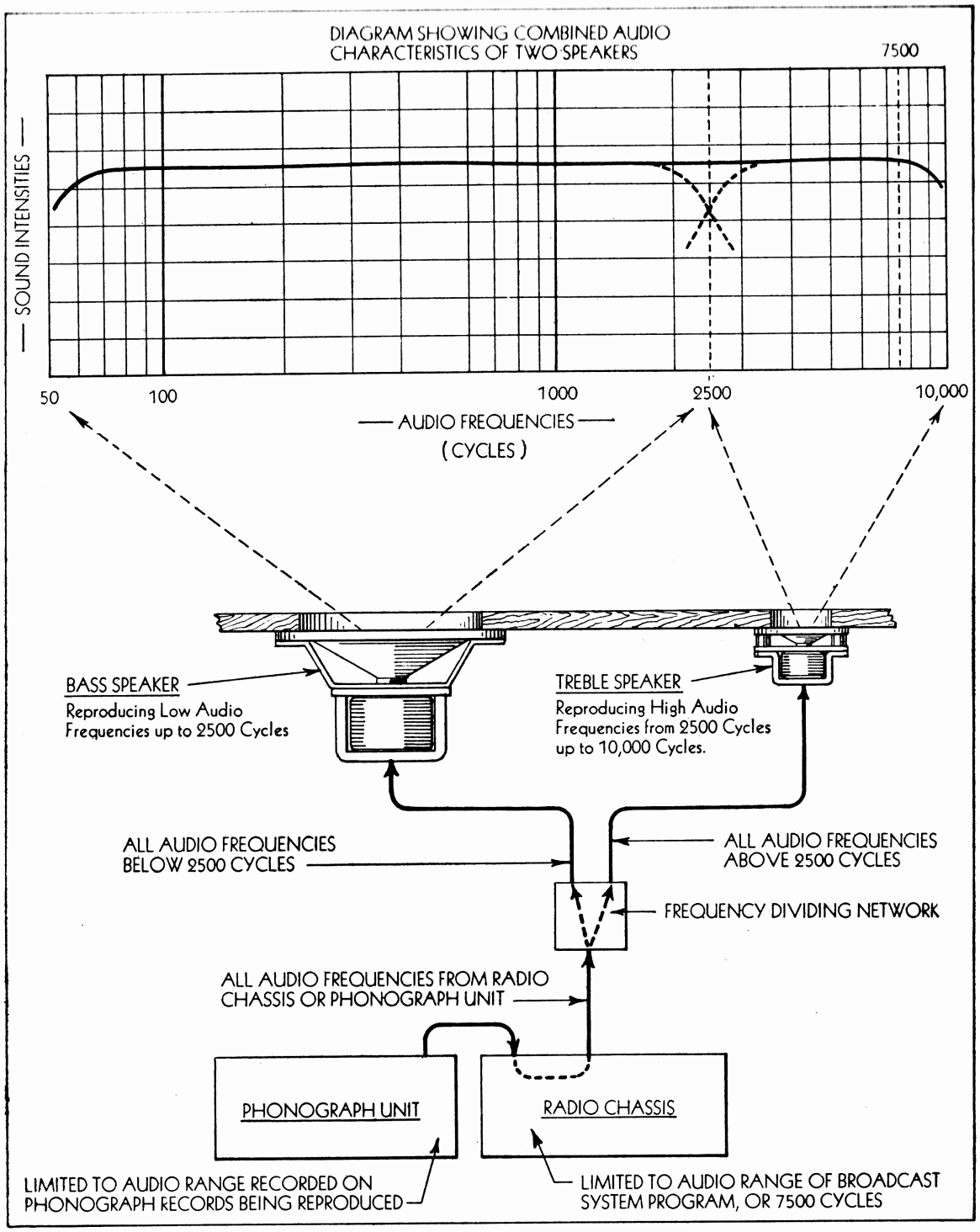


Fig. 21

Diagram Showing the Extremely Wide, Smooth Response of the Two Speaker System Employed in Stromberg-Carlson No. 70 series of Receivers. This Excellent Performance is Possible Only Through the Use of the Special Double Speaker System.

materially to the quality of musical reproduction and in fact, their omission is rarely noticed when listening to music or speech reproductions. This is partially due to the fact that the human ear has a peculiarity of being able to recognize a fundamental pitch frequency by the harmonics or overtones of that frequency, even though the fundamental frequency and some of the lower harmonics are absent. Thus, in the case of a piano (which has an abundance of harmonics), the lower fundamental

bass tones appear to be reproduced by a small size radio that does not reproduce any frequencies below 150 cycles (Fig. 22). The ear is called upon to fill in the frequencies below 150 cycles (See Fig. 19) and does a good job as far as the recognition of the fundamental pitch tones are concerned. The richness and fullness of bass tones, however, are absent in this case, so that frequencies down to at least 70 cycles are necessary for high fidelity of radio reproduction. Usually the radio receiver does not have a sharp low frequency cut-off so that frequencies below the 70 cycles are reproduced but in a gradually diminishing intensity, the complete cut-off being 10 to 20 cycles lower than the technical rating.

Unfortunately, radio receivers capable of reproducing low frequencies, below 70 cycles, will show up low frequency noise defects in the broadcast system which are not heard when listening to the same reproduction with a receiver of more limited low frequency (bass) response. These low frequency defects include continuous low pitched hum, rumbling noises and low beating tones, that are heard occasionally on some particular program or are confined to one or more broadcast stations. Thus, at the low frequency end of the musical scale, there are noise disturbances that limit the practical cut-off of a high fidelity radio to approximately 70 cycles.

6—Effect of Cabinet Size on Low Frequency Reproduction

The low frequency (bass) reproduction of a standard radio receiver is dependent on the baffle area presented by the front of the cabinet in which the loud speaker is housed. Roughly speaking, if the radio chassis and loud speaker are both capable of low frequency reproduction, then the larger the front of the cabinet the greater will be the low frequency response.

It is well known that the Dynamic type of Loud Speaker, without a baffle surrounding its front opening, is incapable of setting up low frequency (long) sound waves, even though the cone be vibrated violently at these low frequencies. This is due to the fact that at the lower frequencies the cone moves as a complete unit, similar to a piston, and that with a forward movement, the air is compressed in front and rarefied at the back. Now, without any obstruction (baffle) around the rim of the speaker, the compressed air in the front will circulate freely to the space back of the cone, where the air pressure is reduced. On the return motion of the cone, a reverse action of the air occurs. This low frequency churning of the air, from front to back of the speaker, does not set up low frequency sound waves, which are comparatively long from crest to crest. The providing of an obstruction to the free circulation of air from front to back of the cone (called a baffle) permits the cone to "get a grip on the air" and thus to generate sound waves.

This relation of cabinet size to low frequency response for various sizes of radio cabinets is shown diagramatically in Figs. 22, 23, 24 and 25. It will be noted the high frequency response of the small cabinet receivers is limited along with the low frequency response. This is necessary in order to keep a pleasing tonal balance of high frequencies with respect to low frequencies, and avoid high pitched or thin sounding reproduction.

From the foregoing, it will be appreciated that small cabinet receivers, from size limitations alone, are not capable of reproducing a sufficient range of fundamental low frequency (bass) notes to qualify for high fidelity radio reproduction.

7—Effect of Cabinet Shape and Enclosure on Quality of Reproduction

While the size (baffle area) of a radio cabinet plays an important part in the reproduction of low (bass) audio frequencies, it also introduces a

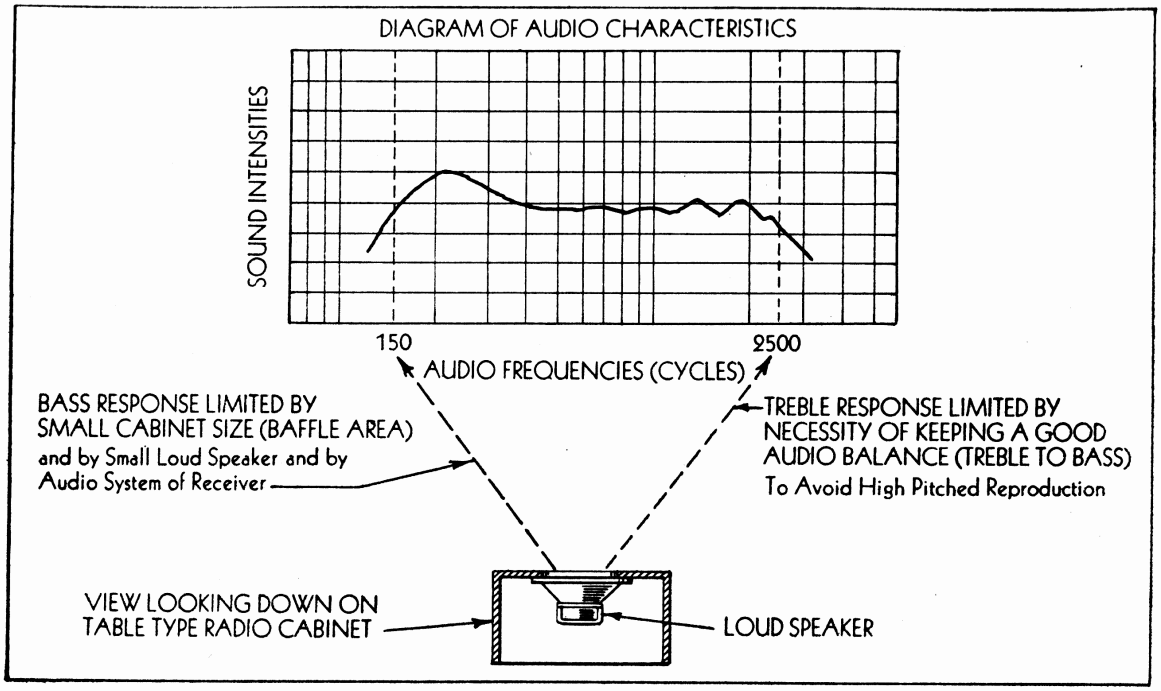


Fig. 22

Diagram Showing the Very Limited Audio Range of a Table Model Receiving Set (Due Primarily to Small Cabinet).

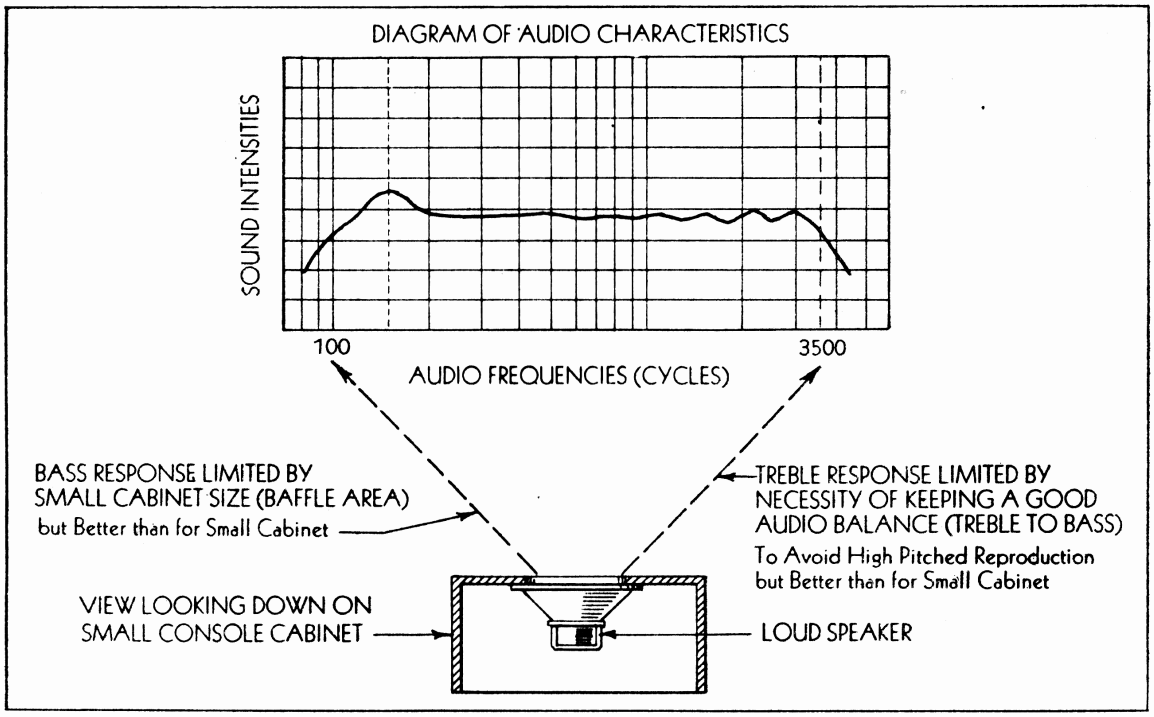


Fig. 23

Diagram Showing that a Wider Audio Range than for Table Models is Possible when Small Console Cabinets are Used.

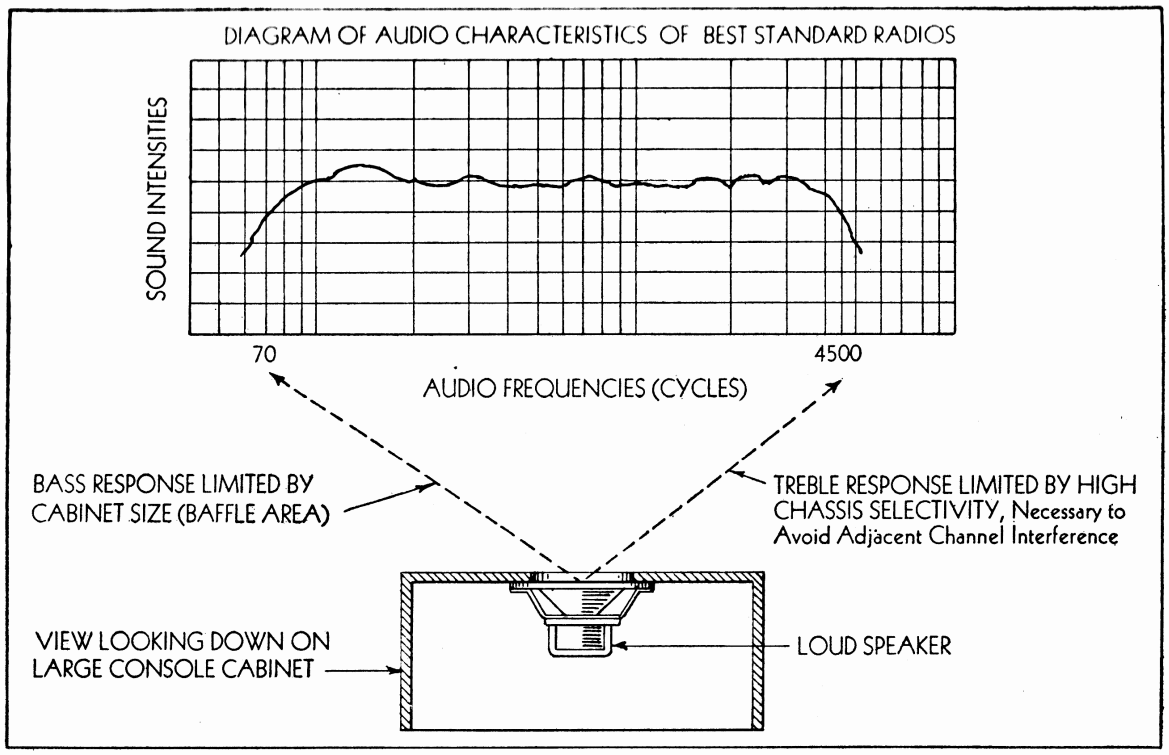


Fig. 24

Diagram Showing That a Good Audio Range for American Broadcast Conditions is Possible when the Largest Standard Radio Consoles are employed.

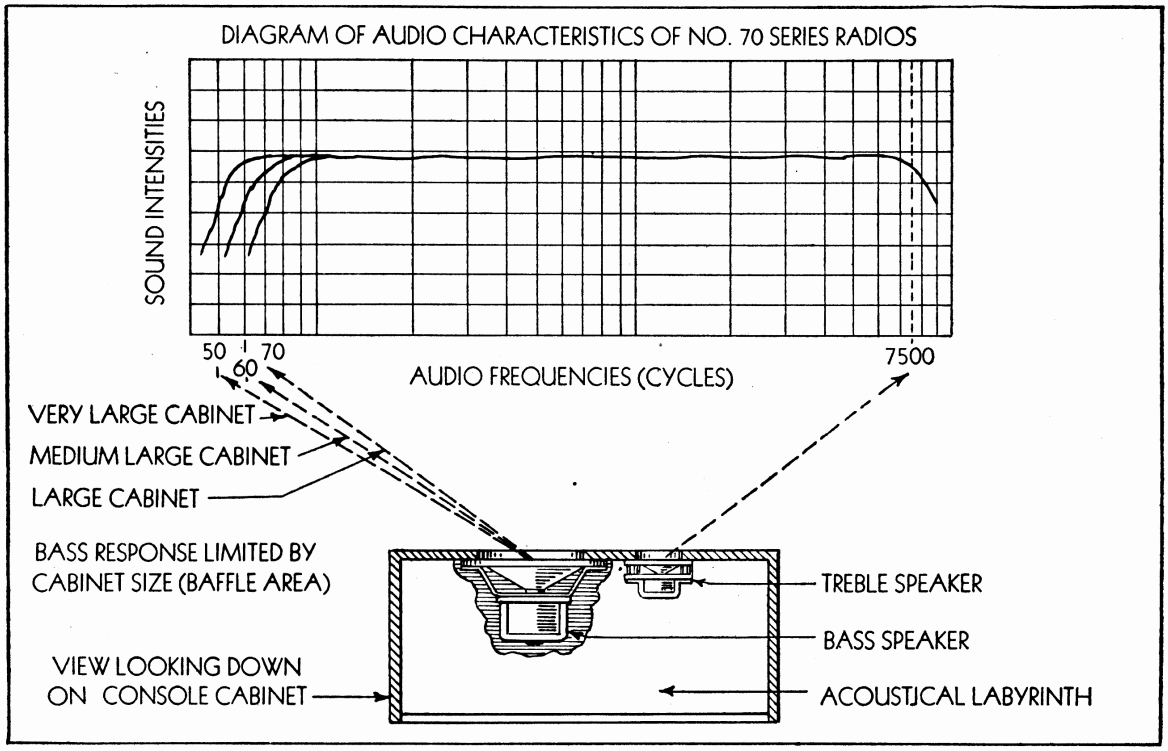


Fig. 25

Diagram Showing the Maximum Useful Audio Range with Smooth Flat Response that is Provided by the No. 70 series of Receivers, employing Double Speakers and Acoustical Labyrinths.

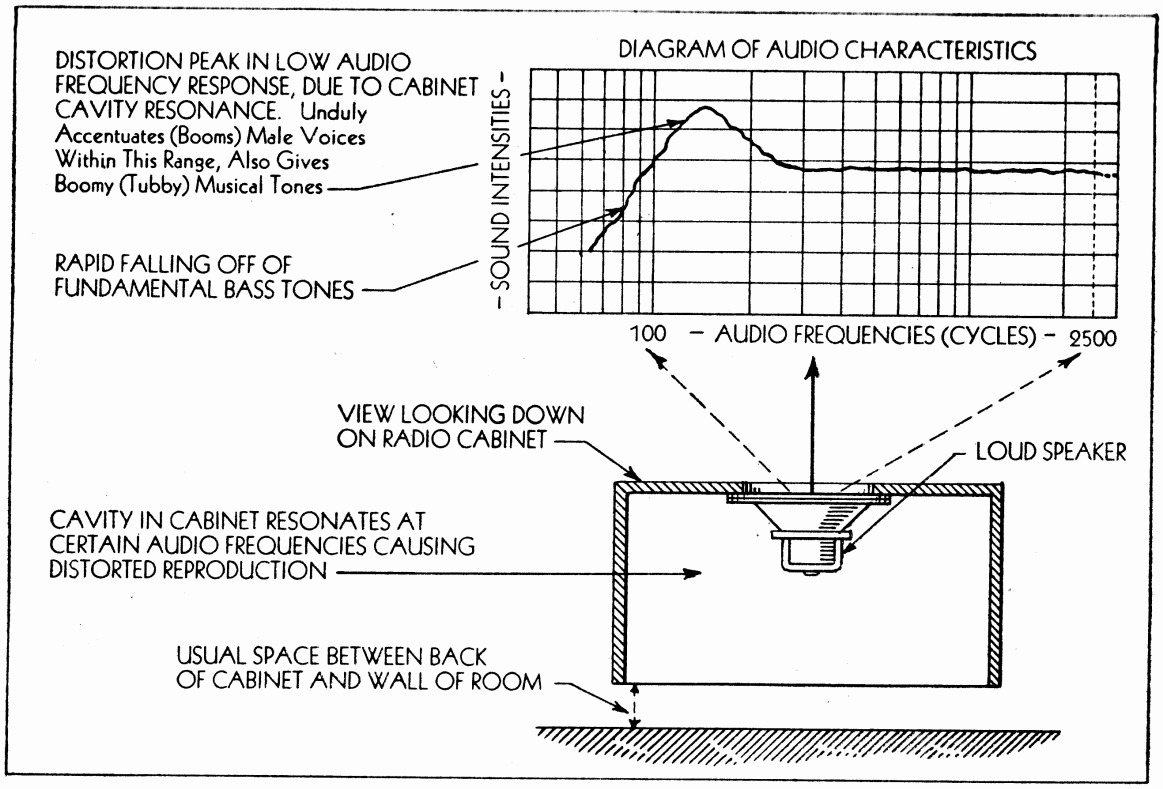


Fig. 26

Diagram Showing Distortion in the Bass Range Due to Cabinet Cavity Resonance in an Ordinary Radio Set, giving Boomy Reproduction to Speech and Music. This "Boom" is very Noticeable When Comparing with the No. 70 series of Receivers which have no "Boom."

disturbing type of distortion known as "Air Cavity Resonance". This is nothing more than the familiar "Rain Barrel" effect of reinforcing the sound of a speaker's voice, providing the pitch of the voice is altered to the point where the sound frequencies match the resonance of the air in the barrel.

In the standard cabinet type receiver, the rear of the Dynamic Speaker Cone is in the radio cabinet enclosure so that when the frequency of the sound vibrations come within the resonant period of the air included in the particular cabinet, these frequencies are greatly amplified in comparison to the frequencies above and below and constitute a low frequency distorion peak in the reproduction.

This distortion peak for a console type cabinet occurs in the neighborhood of 150 cycles as shown in Fig. 26. Unfortunately, this is the region of the fundamental tones of the male speaking voice (See Fig. 19) so that cabinet cavity resonance peaks distort male voices to a greater extent than female voices (also See Fig. 19). In the case of a male voice, the effect of the cabinet distortion is a boomy and unnatural tone with decreased intelligibility.

In music, this cabinet resonance distortion often is mistaken by some listeners for true low bass response. It has the disagreeable effect, however, of over-accentuating musical notes that come in a very short range of frequencies, giving a boomy reproduction instead of the full rich bass response of the original composition. It also unnaturally prolongs certain tones, causing them to overlap succeeding ones, giving a confused effect.

While it is possible to reduce the effect of cabinet cavity resonance by venting the rear and bottom of the cabinet, and by placing the cabinet

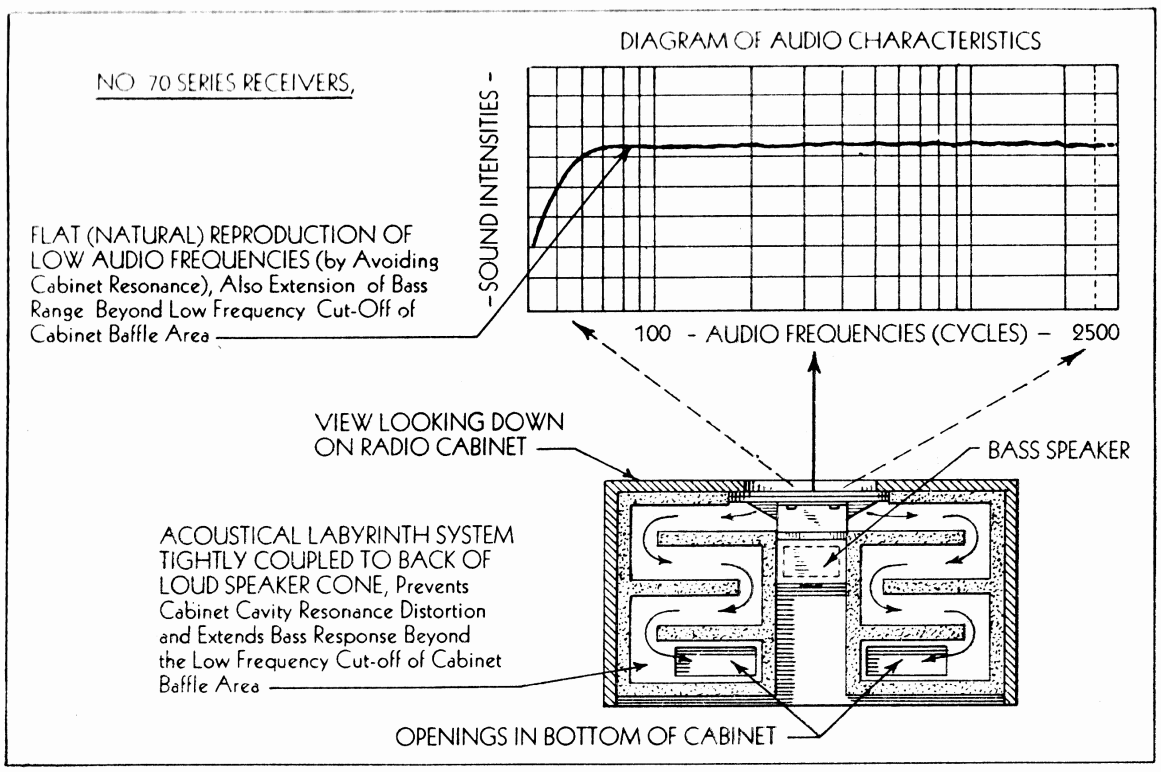


Fig. 27

Diagram Showing Smooth Flat (Natural) Reproduction in the Bass Range Provided by Stromberg-Carlson Acoustical Labyrinth System. This is a New and Exclusive Feature in the No. 70 series of Receivers. (Patent Applied For.)

away from the wall, as shown in Fig. 28, the complete elimination of this type of distortion is not within the province of cabinet design and the placement of the cabinet in the room, but necessitates the employment of an entirely new Sound Reproducing System as described in the next section of this chapter.

8—Avoiding Cabinet Cavity Resonance by the Acoustical Labyrinth

It was found early in the development of a high fidelity type of radio receiver in the Stromberg-Carlson Laboratories that smooth over-all response could not be obtained when the loud speakers were enclosed in the usual way in a radio cabinet.

After a long period of research by Stromberg-Carlson Engineers, a complete remedy for this cabinet cavity resonance distortion (boominess in reproduction) was found in what is known as an **"Acoustical Labyrinth"** which by the way is an exclusive Stromberg-Carlson development.

The essential feature of the Acoustical Labyrinth System consists of the prevention of the sound coming from the back of the loud speaker from being discharged into the interior of the cabinet.

This is accomplished by the application of a housing around the rear of the low frequency (Bass) Speaker; this housing communicating with free air through a conduit lined with a material having a high value of acoustic absorption. Due to the fact that this conduit must have considerable length and ample (rectangular) cross sectional area, and at the same time fit into a limited space in the radio cabinet, it is made in the form of a labyrinth as shown in Fig. 27.

The diagram in Fig. 27 shows a type of Labyrinth used in the No. 74 Receiver, it consisting of two separate units symmetrically connected to

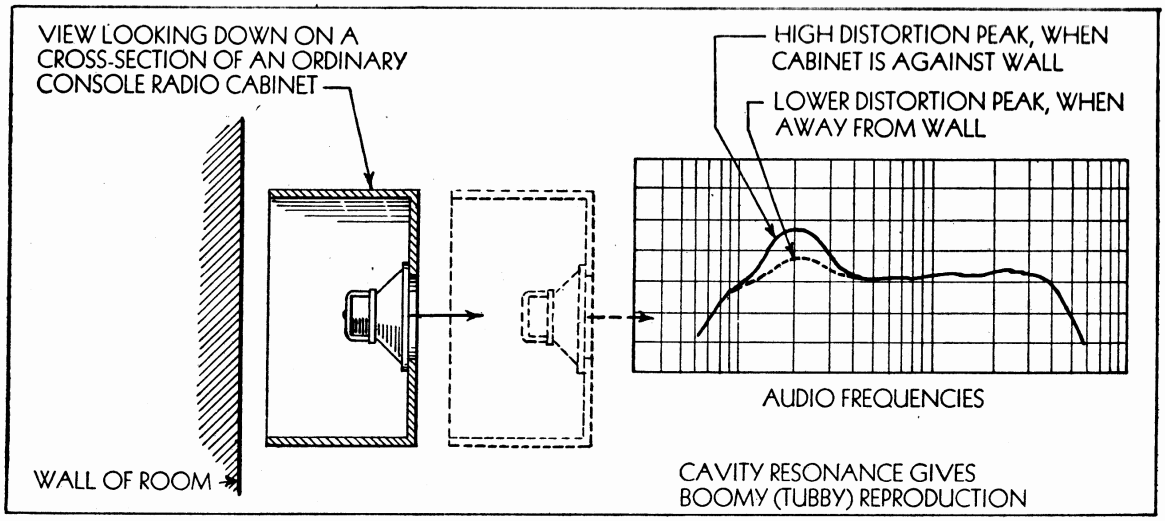


Fig. 28

Diagram Showing that Cabinet Cavity Resonance Distortions are Present in a Standard Radio Console when Located Against a Room Wall or Away from the Wall, the Best Location for Minimum Distortion Being a Separation of at Least 4 Inches from the Wall.

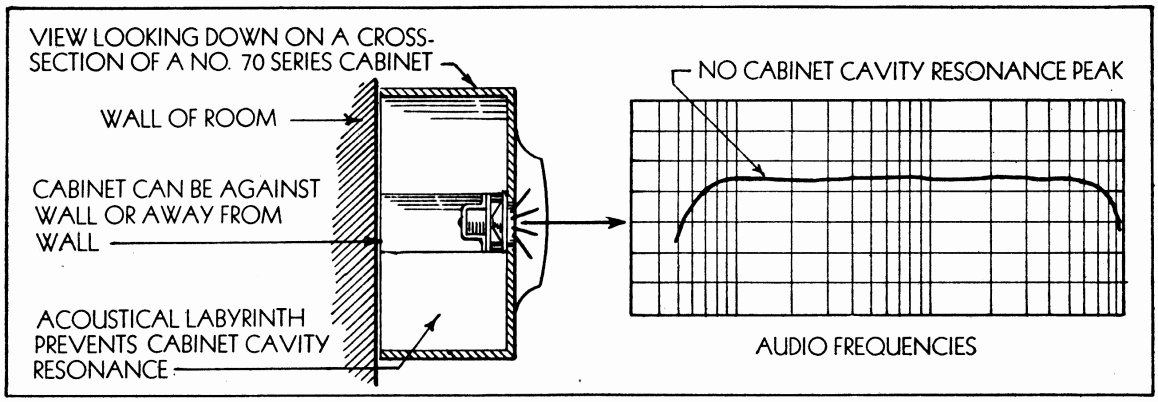


Fig. 29

Diagram Showing that Smooth Distortion-Free Reproduction is Provided by the Stromberg-Carlson No. 70 series of Receivers, Regardless as to Whether the Cabinets are Located Closely Against a Room Wall or Any Distance Away from the Wall. This Direct Radiation of Sound from the Front of Cabinet Only, is an Entirely New Feature in Radio Receivers and Exclusive to Stromberg-Carlson.

the openings at the rear of the loud speaker, with the other ends of the conduits discharging through openings located in the bottom and at the rear of the cabinet. This provides a balanced acoustical load to the back of the speaker cone, preventing any uneven action that might drive it out of line. The Labyrinth employed in the Nos. 70 and 72 Receivers is similar in principle of operation and effectiveness to the one just described for the No. 74 Receiver, but has a different shape in order to fit the type of low frequency (Bass) Speaker employed.

Besides completely doing away with the boomy type of reproduction, produced by cabinet cavity resonance in the ordinary receiver, the Acoustical Labyrinth makes it possible for the first time in radio, to place a radio cabinet tightly against a wall without change in its acoustical operating characteristics (See Fig. 29). Also, corner of room locations, such as shown in Fig. 30, or any other desirable position of the Nos. 70, 72 or

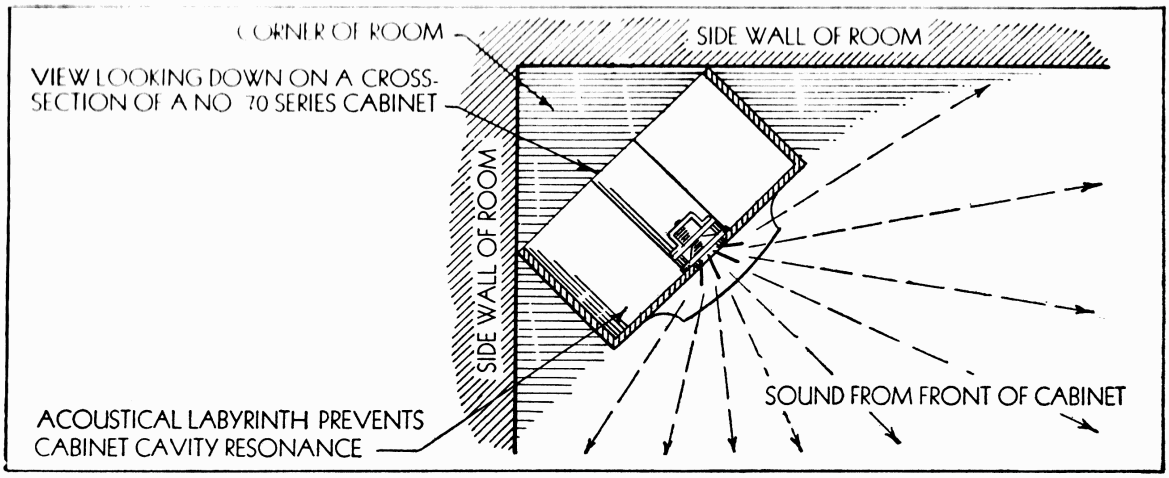


Fig. 30

Diagram Showing an Advantage in Reproduction, Due to Side Wall Reflections, when a No. 70 series Receiver is Placed in the Corner of a Room.

74 Receivers can be selected to suit the listeners without experiencing the usual difficulties of sound wave interference that occurs with all other radio receivers (not using the Acoustical Labyrinth) that radiate freely from both front and back of the loud speaker.

9—Increasing the Low Frequency Range by the Acoustical Labyrinth

Up to the time of the introduction of the Acoustical Labyrinth, the only method for effectively extending the low frequency range in a radio receiver using a Dynamic type of Speaker, was to increase the baffle area of the cabinet as described in Section 6 of this Chapter. For a given size (baffle area) of cabinet, the Acoustical Labyrinth can be so proportioned as to reinforce the low frequency (bass) response just below the natural cut-off due to baffle limitation.

This extension of bass frequencies is obtained by making the air column in the Labyrinth resonate at a frequency just below the baffle cut-off of the cabinet, and to broaden the tuning of this Labyrinth air column by scientific design of the shape of conduit, the orifice of the conduit, and the absorbing materials employed, so that the resulting low frequency response is smooth and completely free from distortion peaks as shown in Fig. 25.

The application of the above feature of the Acoustical Labyrinth in the Nos. 70, 72 and 74 Receivers gives a more extended low frequency (bass) range, than would be otherwise possible for these cabinets. This is clearly shown by comparing the flat and extended low frequency (bass) audio characteristics of the speaker system employed in the No. 70 series Receivers, as shown in Fig. 27, with the limited and sharply sloping low frequency (bass) audio characteristics of a regular speaker system (employed in other receivers), as shown in Fig. 26. The cabinets employed in both of these examples are of the same size and shape so that the excellent performance shown in Fig. 27 is due to the beneficial effect of the Acoustical Labyrinth and Speaker Systems used in the No. 70 series Receivers.

10—Increasing the Power Handling Ability of the Loud Speaker by the Acoustical Labyrinth

In addition to the two important improvements in reproduction already ascribed to the Acoustical Labyrinth in Sections 8 and 9 of this Chapter, it has been found that the power handling ability of the loud speaker at

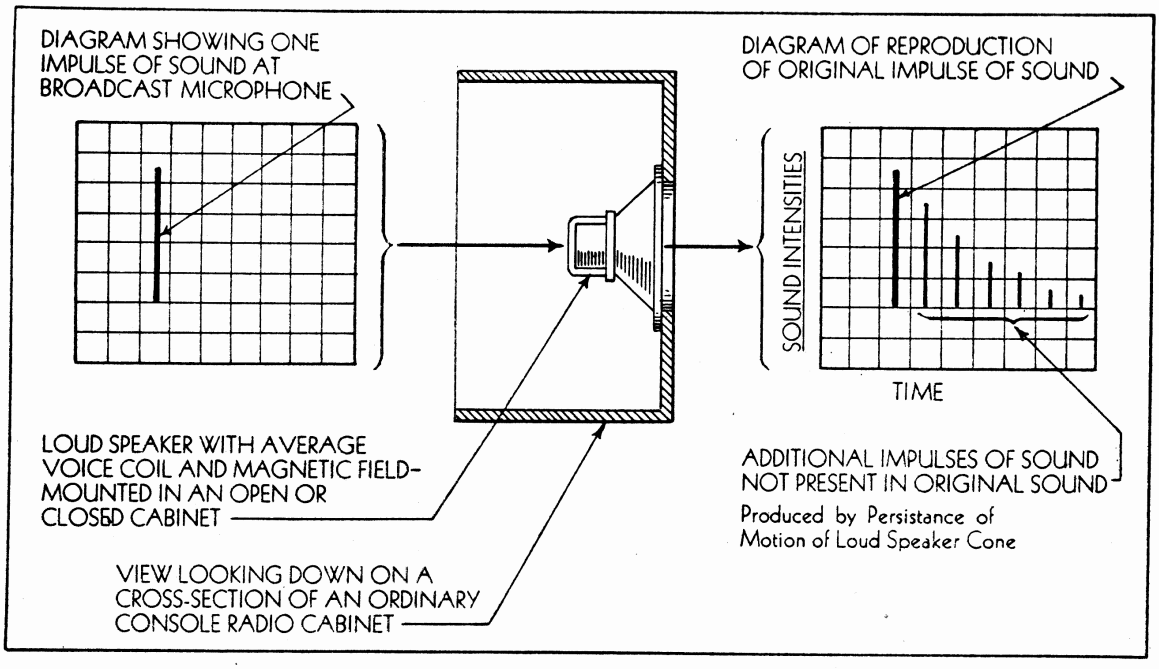


Fig. 31

This Diagram Shows the Type of Distortion Due to Persistence of Motion of a Loud Speaker Cone in an Ordinary Radio Receiver. This Distortion Gives a "Blurred" or Indistinct Reproduction.

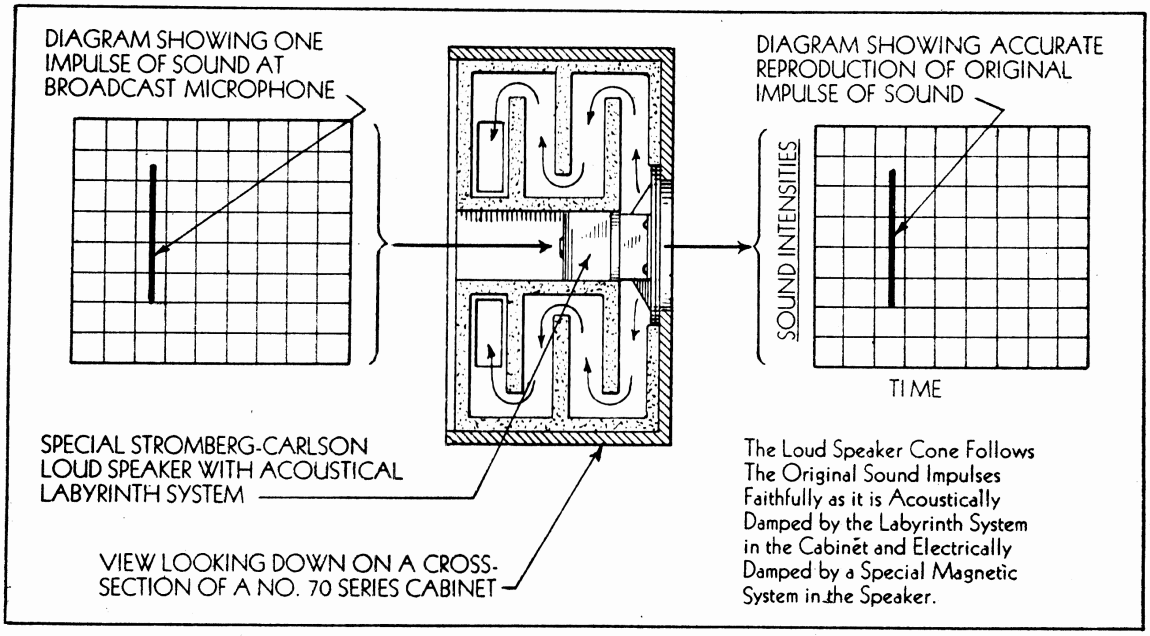


Fig. 32

Diagram Showing Clear Cut (Natural) Reproduction of a Loud Speaker Cone in the Stromberg-Carlson No. 70 series of Receivers. Persistence of Motion of the Cone is Overcome by Means of the Acoustical Labyrinth System and by the Special Electrical Design of the Speaker. This is an Important New Feature in These Radios.

low frequencies (bass response) has been greatly increased over that of a regular cabinet installation. This is due to the augmented acoustic load afforded by the conduit of the Labyrinth Unit. Thus, the low frequency (bass) speakers employed in the No. 70 series Receivers are capable of greater undistorted sound outputs than would be the case if these speakers were operated in console cabinets, less the Labyrinth.

11—Accuracy of Loud Speaker Cone Action Provided by the Acoustical Labyrinth

In the ordinary design of Dynamic Speaker, mounted in a cabinet with both sides open to the air, there is a tendency for the cone to continue to vibrate after the actuating impulse is stopped, especially for the low frequency sounds. This persistence of motion of the cone is shown in Fig. 31 in which a single impulse of sound at the broadcast station microphone, is shown in diagram at the left, causes the loud-speaker cone to send out an impulse of sound corresponding to the original, and through the continued vibration of the cone assembly (which, however, soon comes to rest) there are set up additional sound components shown at the right hand diagram of Fig. 31, which were not in the original sound. In ordinary speech and musical reproduction, these extra sound impulses that are the result of persistence of cone motion, tend to produce "blurred" or "fuzzy" reproduction, which a musician might characterize as lacking in "firmness".

In the No. 70 series Receivers, the enclosing of the rear low frequency (Bass) Speaker by the Acoustical Labyrinth makes it possible to employ the "damping" effect of the column of air in the Labyrinth conduits to overcome persistence of motion of the speaker cone. Thus, a single impulse of sound at the broadcast station microphone will be reproduced by these No. 70 series Receivers as a single impulse of sound as shown in Fig. 32. A "thump" sounds like a "thump" and not like a "buzz" in these receivers.

To make this correction of persistence of loud speaker cone motion completely effective, the Auditorium Type Bass Speakers used in the No. 70 series Receivers, have exceptionally strong magnetic fields, which, combined with a very low impedance audio output circuit in the radio chassis and correct voice coil design provides a very efficient electro-acoustic damping for the cone assembly.

The final result of these two corrective measures from the standpoint of the listener is a more natural or "firm" quality of musical reproduction and a startling accuracy of reproduction of impulsive sounds. This is another high fidelity feature that is exclusive to these Stromberg-Carlson receivers.

The four important advancements in fidelity of reproduction, made possible by the Acoustical Labyrinth (just described in Sections 8, 9, 10 and 11 of this Chapter) assure better reproduction of all radio programs, regardless of whether the Fidelity Control is operated to increase the high frequency range, or not. In other words, with the No. 70 series Receivers, it is not necessary to have a so-called "high fidelity broadcast" in order to obtain a very noticeable improvement in reproduction, over that of receivers not provided with the Acoustical Labyrinth.

12—Uniform Sound Distribution from Front of Radio Cabinet

Sound waves produced by a Dynamic Speaker located in a radio cabinet, vary as to their directional characteristics, with the frequency (wave lengths), the high frequency sounds being very directional and the low frequency sounds practically non-directional. Thus, the high frequency sounds (treble tones) are projected in a narrow cone shaped

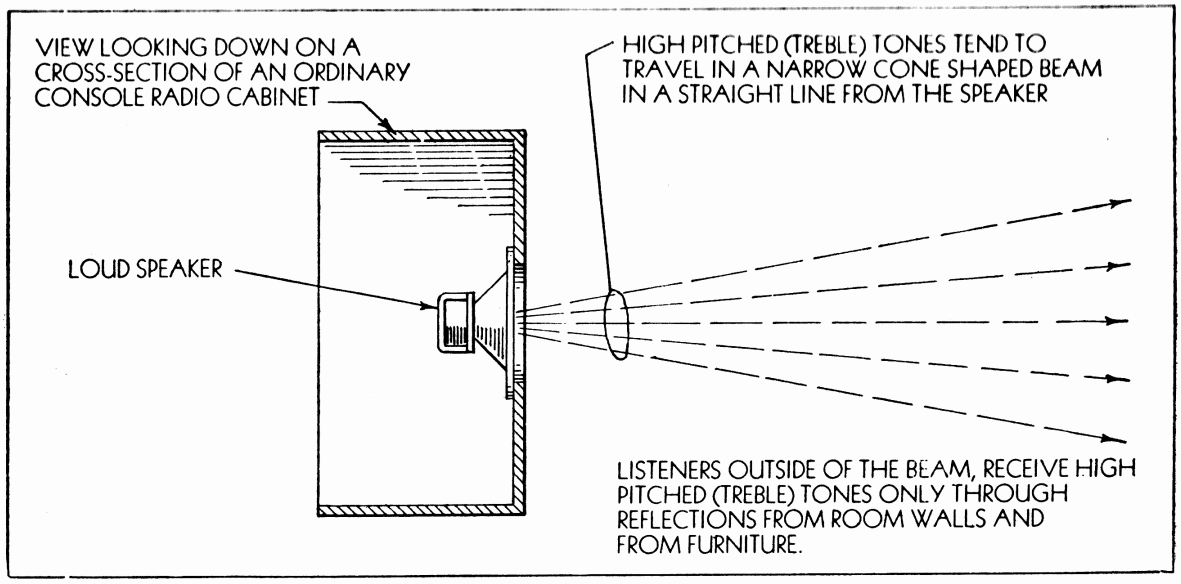


Fig. 33

Diagram Showing the Very Directional (Beam Effect) of the High Pitched (Treble) Tones in an Ordinary Radio Receiver. Listeners in the Direct Beam of Sound Receive an Exaggerated High Pitched Reproduction.

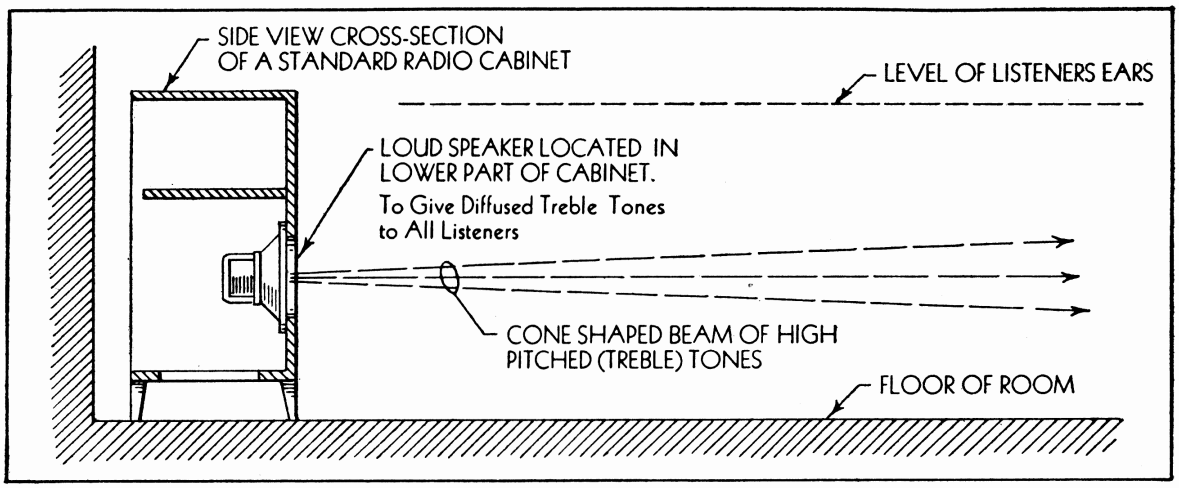


Fig. 34

Preferred Location of a Loud Speaker in a Radio Console Cabinet (Below the Level of All Listeners Ears) to Avoid the Beam Effect of the High Audio Sound Frequencies. High Pitched Tones Reach All Listeners in the Room by Wall and Furniture Reflections, Therefore are Fairly Uniformly Diffused.

beam in a straight line on the axis of the center of the speakers as shown in Fig. 33. If the listener's ears are located somewhere in this cone of high frequency sounds, the treble tones will be greatly exaggerated as compared to the lower frequencies. Also, if the listener's ears are above, or at either side of the high frequency beam of sound, the treble tones will sound less intense and probably will reach the listener through reflections from walls and furniture.

In the standard design of console cabinet radio receiver, it is customary to place the loud speaker in the lower part of the cabinet, so that the cone shaped beam of high frequency (treble) tones will be projected in a line below the level of all listeners' ears (when listeners are seated), and in this way provide diffused high frequency (treble) tones to all listeners (See Fig. 34).

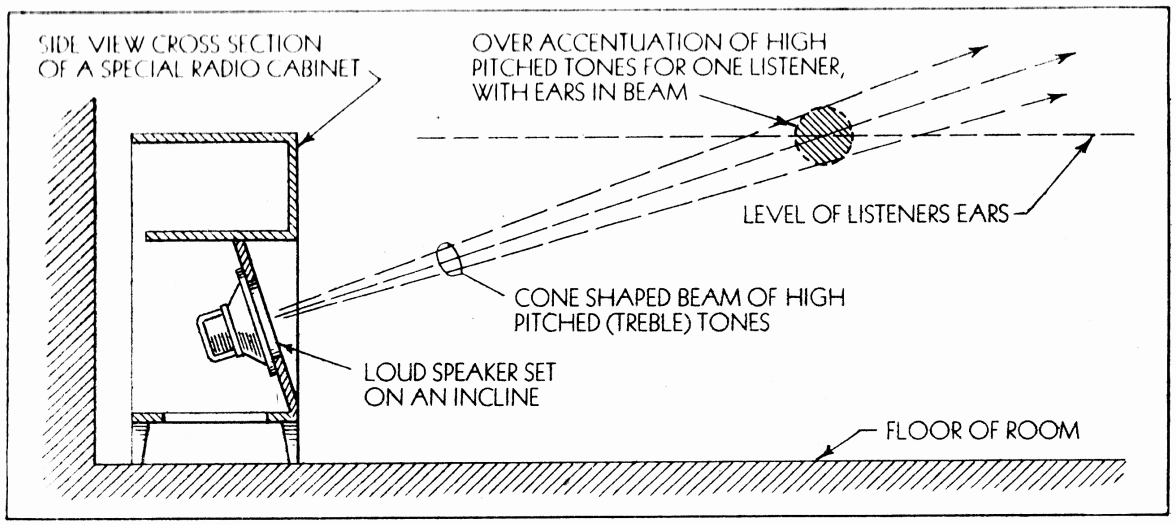


Fig. 35

Other locations of the Loud Speaker in a Radio Cabinet, such as Inclined Upward (Shown in this Diagram) Have the Disadvantage of Intense High Frequency Reproduction for One Particular Listener in the Room (With Ears Located in the "Beam"). All Other Listeners Must Receive High Pitched Tones by Wall and Furniture Reflections.

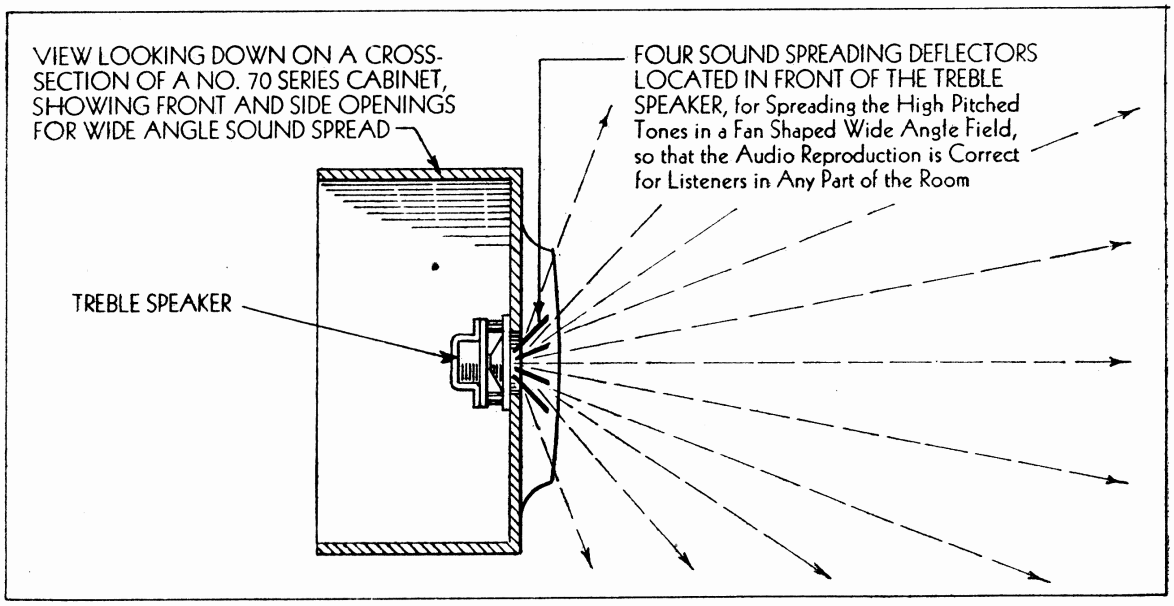


Fig. 36

Diagram Showing the Wide Angle Spread of the High Pitched Tones (Otherwise Very Directional as Shown in Diagram Below) in the Stromberg-Carlson No. 70 Series of Receivers. This Feature is Provided by Sound Spreading Deflectors for the Treble Speaker and by Side Openings in the Radio Cabinet. It gives a More Uniform Reproduction for all Listeners in the Room.

Another plan of placing the loud speaker in the cabinet is shown in Fig. 35. In this case the loud speaker is on an angle so as to project the cone shaped beam of high frequencies (treble tones) upward. It has the disadvantage that to one or more persons, who might have their ears directly in the beam, the treble tones will be over-accentuated as compared to the lower frequencies. All other listeners in the room must depend upon wall and furniture reflections for the high frequency sounds, the same as when the loud speaker is located in the regular way (Fig. 34).

The directional effects of the high frequency sounds can be overcome by using sound spreading deflectors located in front of the loud speaker cone as shown in Fig. 36. When properly designed these deflectors give a wide angle or fan shaped distribution of the high frequency (treble) sounds.

In the No. 70 series Receivers, high frequency sound spreading deflectors are placed in front of the Treble Speaker only, where all of the higher frequency sounds are reproduced. Front and side openings are provided in the Nos. 70, 72 and 74 Receiver Cabinets to permit wide angle sound spread, so that the audio reproduction is correct for listeners in any part of the room (See Fig. 36).

Thus these No. 70 series Receivers introduce a new style in radio cabinet design, having a pleasing curved front effect so as to provide side openings as well as front openings for the loud speaker. Like the stream lining of motor cars, this new style is dictated by functional requirements as well as decorative design, hence it introduces a new trend which is destined to be used on all high quality radio cabinets in the future.

13—Reasons for Two Dynamic Speakers in No. 70 series Receivers

As explained in Section 4 of this Chapter, the two speaker system employed in the No. 70 series Receivers is necessary for providing the extremely wide, smooth response required for real High Fidelity reproduction. Another important reason, is the providing of higher undistorted sound output capacity than for a single unit wide range speaker. This advantage is clearly shown by comparing the smooth and high level of the Audio Characteristic Curve of the wide range two speaker system shown in Fig. 37, with the uneven and lower level of the Audio Characteristic Curve of the wide range single speaker system shown in Fig. 38.

14—Factors Necessary for Real High Fidelity Radio Reproduction

Following is a brief summary of the most important factors, discussed in the preceding sections of this Chapter, that are necessary for real high fidelity radio reproduction:

(a) Reproduction of high frequencies up to at least 7500 cycles, in order to obtain full tone color on all musical instruments and for the recognition of some special musical instruments.

(b) Reproduction of low frequencies down to at least 70 cycles for depth or body to the music or speech and to provide natural tonal balance.

(c) Smoothness of response over the complete audio range, so as to avoid high pitched or shrill effects and low frequency boom or rain barrel tones.

(d) High power handling ability of the Loud Speaker System, to take care of the maximum demands of orchestral music, without distortions.

(e) Accuracy of motion of the Loud Speaker Cone in following the electrical sound impulses, so as to give clear, firm reproduction without "blurred" effects.

(f) Uniform sound distribution from the front of the radio cabinet, so that the high frequency tones as well as the middle and low tones will be heard correctly by all listeners in the room.

(g) Avoidance of the sound wave interferences that occur when the loud speaker radiates from the back of the cabinet as well as from the cabinet front. (Not present when the Acoustical Labyrinth is used).

(h) Complete elimination of the varying acoustical conditions presented when the receiver cabinet is placed against the wall or away from the wall of a room. (Not present when the Acoustical Labyrinth is used).

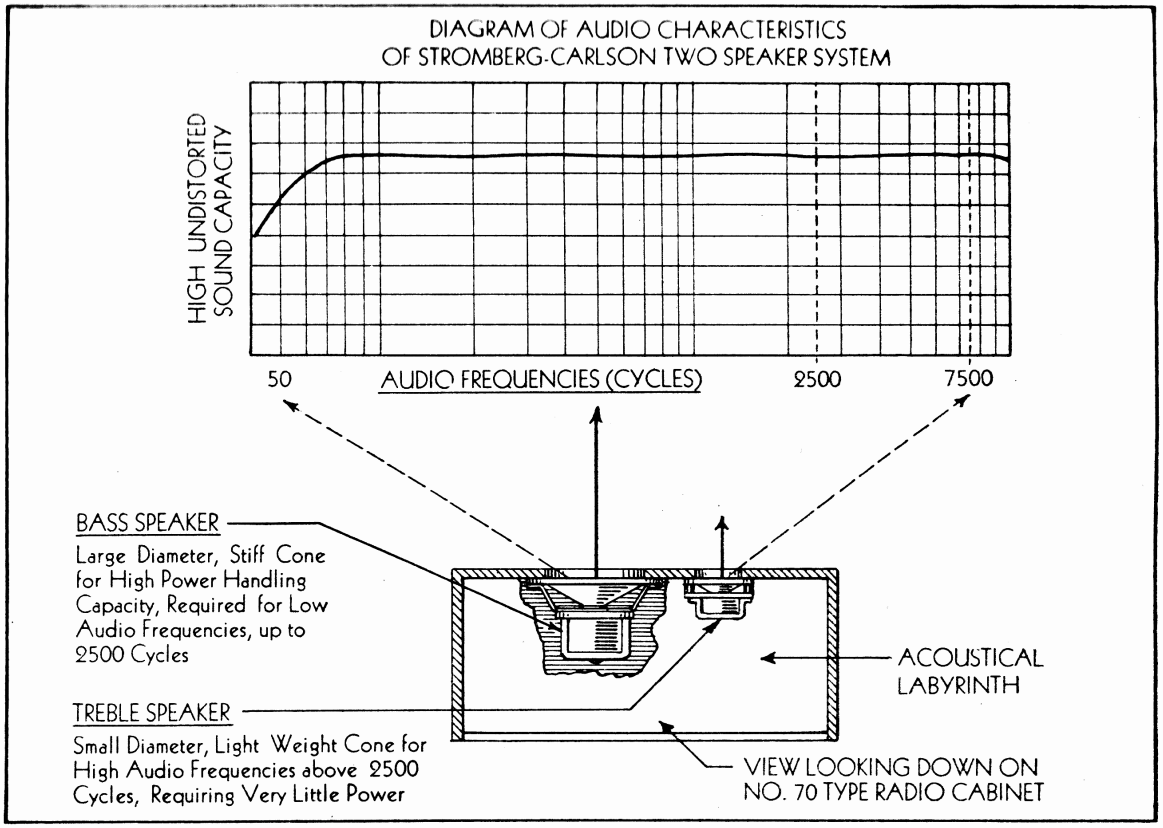


Fig. 37

Diagram Showing the High Undistorted Sound (Volume) Output Capacity and Smooth Response of the Two Speaker System with Acoustical Labyrinth Used Exclusively in Stromberg-Carlson No. 70 Series of Receivers (Compared to System Shown in Lower Diagram).

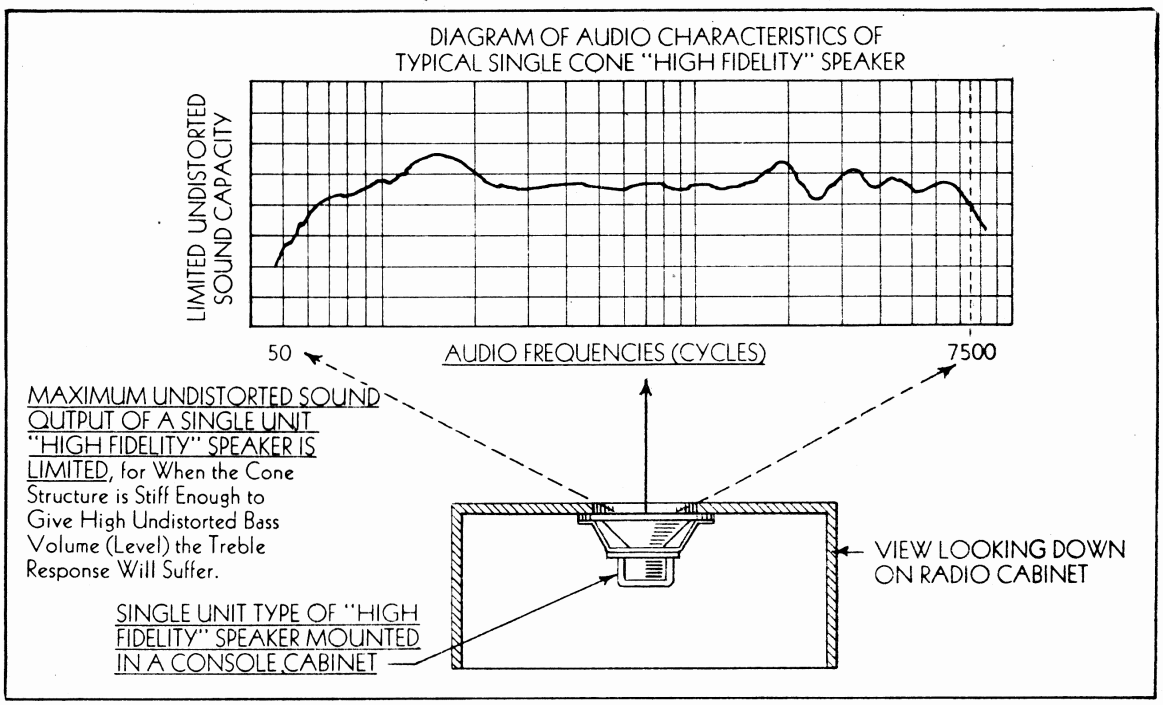


Fig. 38

Diagram Showing the Limited Undistorted Sound (Volume) Output Capacity and Uneven Response of an Ordinary Single Cone Type "High Fidelity" Speaker System (Compared to the Two Speaker System Shown in the Above Design).

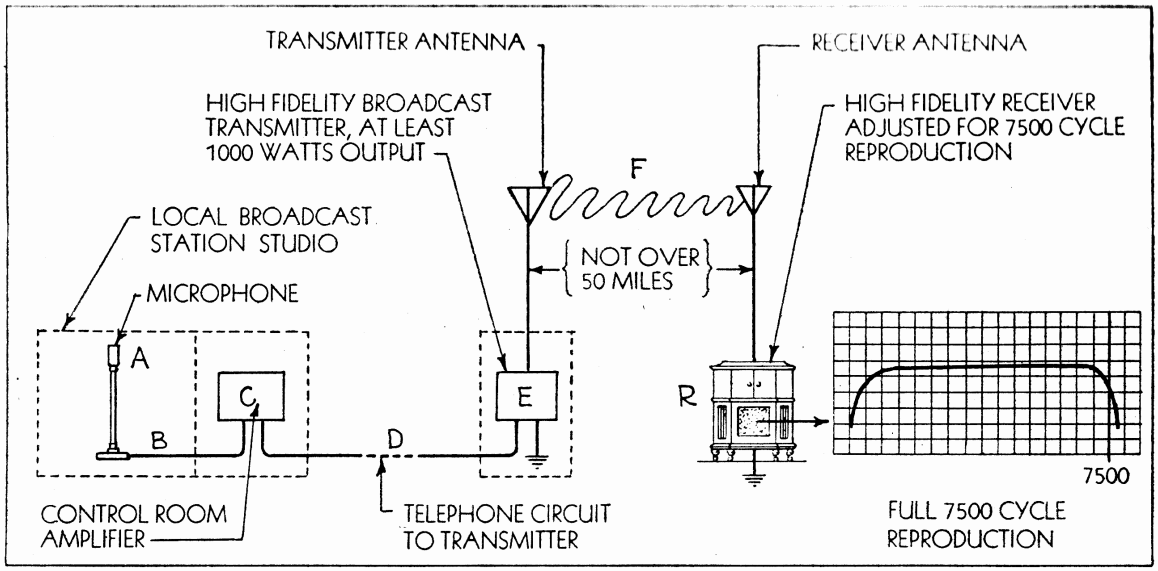


Fig. 39

Diagram of a Complete Broadcasting System, Showing Some of the Important Conditions Necessary for 7500-Cycle Reproduction.

(a)—Desired Program should be from a Nearby (Not Over 50-Miles Away) Powerful High Fidelity Transmitter, Broadcasting on a "Clear" Channel (No Other Station Broadcasting on the Same Channel).

(b)—No Interfering Signal should Reach Your Antenna from Broadcast Transmitters on Either of the Adjacent Channels.

(c)—All Elements in the Broadcast System, Shown in the Above Diagram by Letters A, B, C, D, E, and R, Should Have an Audio Frequency Range of At Least 7500 Cycles.

All of these requirements for real high fidelity reproduction are provided in the Nos. 70, 72 and 74 Receivers, and as explained elsewhere in this Chapter, many of the most important features are exclusive Stromberg-Carlson developments.

It will be noted, that with the exception of the first feature (reproduction of high frequencies up to 7500 cycles), all of the remaining features on the above list apply to standard audio range broadcasting. Therefore, the No. 70 series Receivers are capable of giving a pronounced improvement in audio quality when used on regular broadcast reception in which the higher frequencies are limited to less than 5,000 cycles. The continuously adjustable Fidelity Control, provided on the No. 70 series Receivers, permits of changing the high frequency response of the receiver to fit the fidelity conditions of the received program.

These seven improvements in tone, excluding the reproduction of high frequencies up to 7500 cycles, also apply to phonograph operation, so that standard phonograph recordings sound more natural than ever before, when played on the phonograph combination instruments Nos. 72 and 74.

15—High Fidelity Reproduction a Broadcast System Problem

The radio receiver is only one element in an elaborate sound transmission system, this system consisting briefly of the following (See Figs. 39 and 40):

Studio Microphone.

Control Room Amplifier.

Telephone circuits connecting the Control Room to the Transmitter (also used in outside pickups and in network broadcasting).

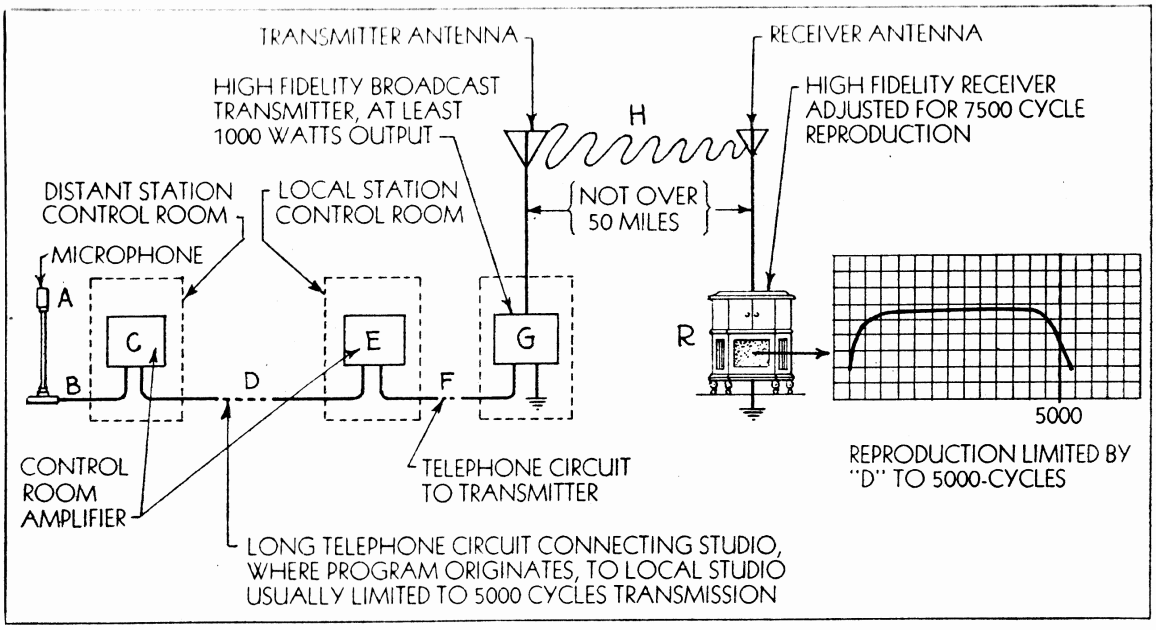


Fig. 40

Diagram Showing Fidelity Limitation Imposed by a Long Distance Telephone Circuit such as used in Network Programs. If this Telephone Circuit ("D" above) is Limited to 5000-Cycles (See Text) and Even Though All Other Elements in the Broadcast System, Shown Above by Letters A, B, C, E, F, G and R, have an Audio Frequency Range of 7500 Cycles, the Reproduction from the Loud Speaker will be Limited to 5000 Cycles. Reproduction is Only as Good as the Weakest Link in the Chain.

Broadcast Transmitter.

Transmitting Antenna.

Space intervening between the transmitter antenna and the receiver antenna.

Receiver Antenna.

Radio Receiver.

The transmission of the sound frequencies from the studio microphone to the loud speaker in the receiver, passes through all of these elements in series, which means that for a desired fidelity of reproduction at the receiver, each element must be capable of performing up to that standard.

Like the strength of an anchor chain, which is only as great as its weakest link, the quality of a broadcast program can be only as good as the quality of its poorest unit, whether it be the microphone, the control room amplifier, or any other element in the system. Thus, in Fig. 40, the "long telephone circuit", which for example is limited to 5000 cycles transmission, is the "weak link" in the broadcast system, and even though all other "links" including the radio receiver are capable of 7500 cycle transmission and reproduction, the sound output from the loud speaker will be limited to 5,000 cycles.

From this brief statement of the importance of the various elements entering into the transmission and reception of a radio program, it is realized that the problem of obtaining of high fidelity reproduction is one involving a complete system, with **all elements, excepting the receiver and its antenna, out of control of the radio listener.**

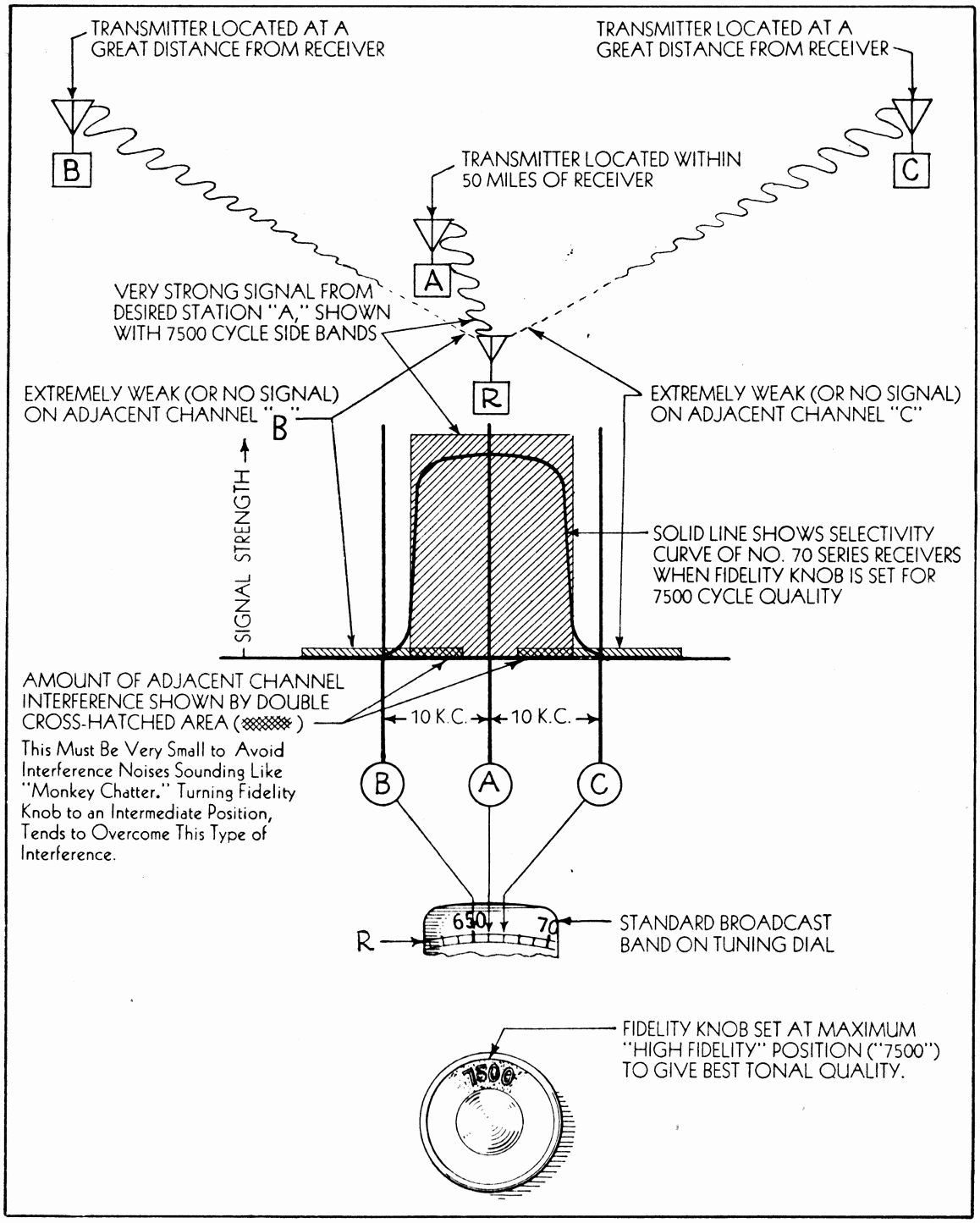


Fig. 41

Diagram Showing Conditions Necessary for Satisfactory Reception when the Fidelity Knob of a Stromberg-Carlson No. 70 series Receiver is set at Maximum High Fidelity Position for Best Tonal Quality. This is for Standard Broadcast Channels on 10 K.C. Separation. Adjacent Channel Signals Must Be Extremely Weak so as not to Cause Interference (Cross-Talk or "Monkey Chatter").

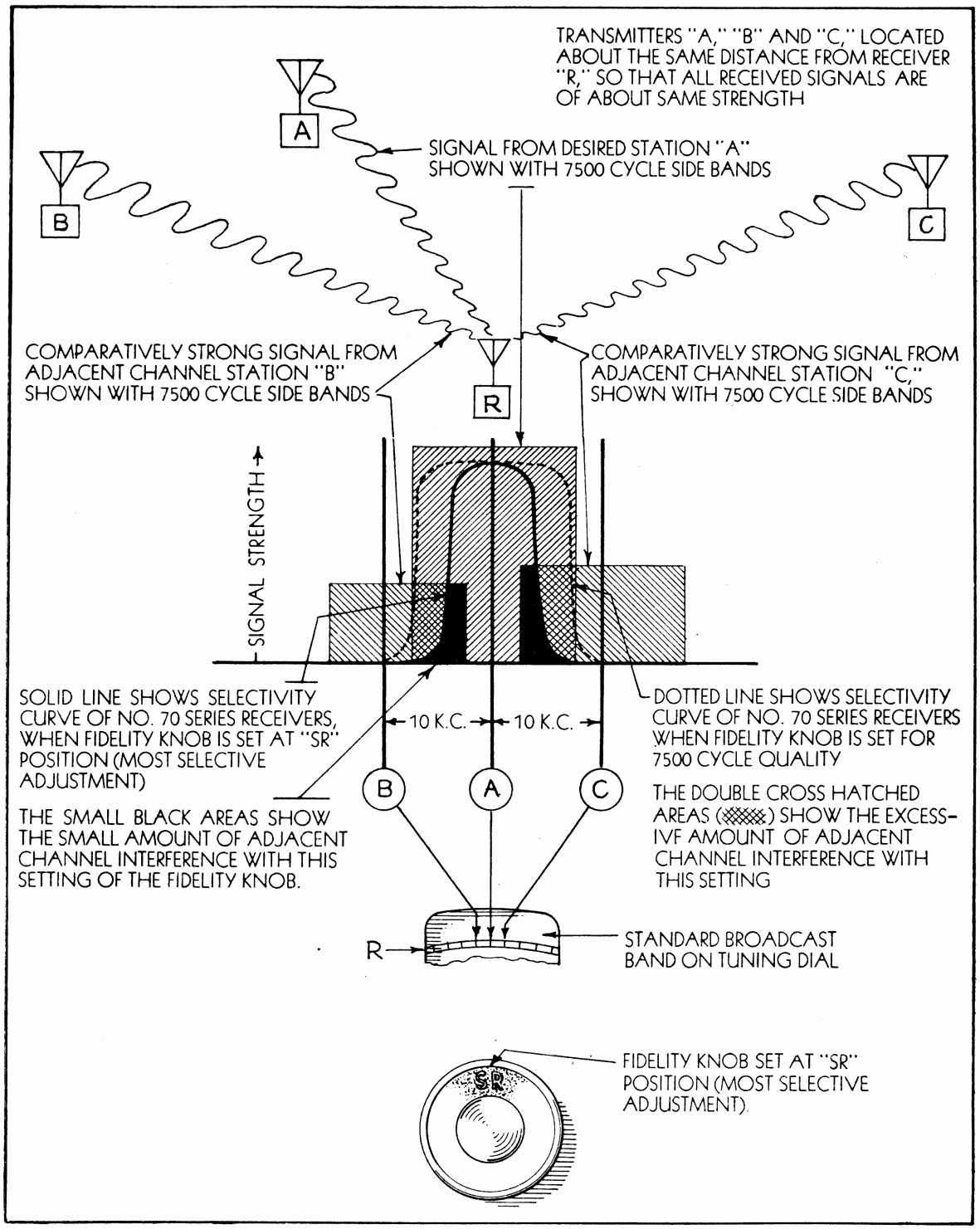


Fig. 42

Diagram Showing That When the Strength of the Signals of Stations on Either or Both Adjacent Channels Approach the Strength of the Desired Signal on the Channel Being Tuned, it is then Necessary to Set the Fidelity Knob on the No. 70 series Receivers to the Most Selective Position (Marked "SR" on the Knob) in Order to Prevent Adjacent Channel Interference (Cross Talk or "Monkey Chatter"). If the Signals from Adjacent Channels are too Strong, the Selectivity Necessary for even Standard Fidelity may permit slight "Cross Talk" as shown by the black Areas in the Above Diagram.

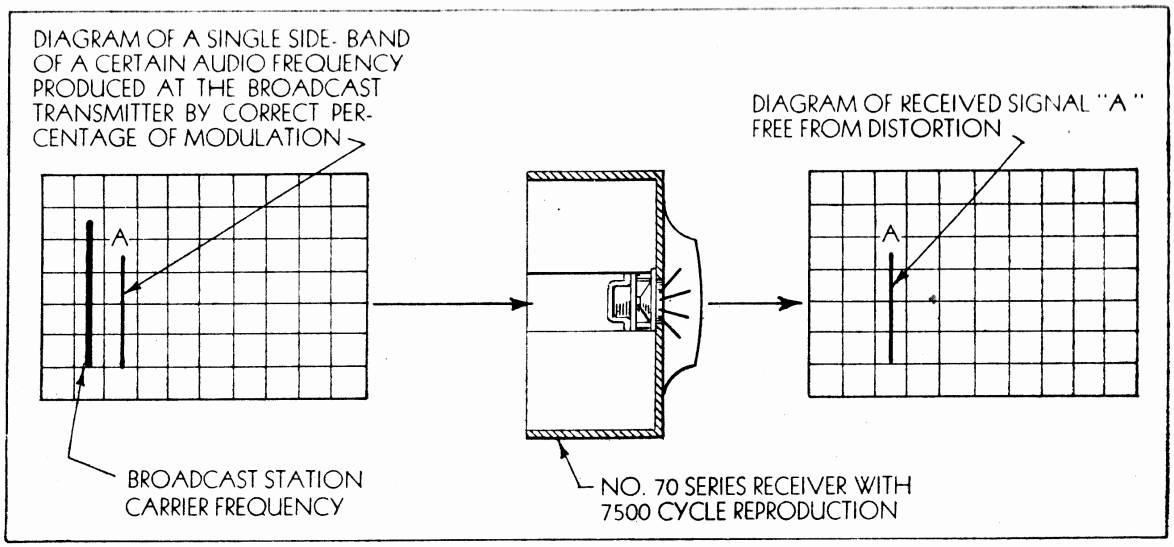


Fig. 43

Diagram Showing that a Correctly Modulated Signal at the Broadcast Station will give a Clear-Cut Natural Reproduction on the No. 70 series Receivers, Even When the Fidelity Control is Set for 7500-Cycle Reproduction.

16—Limitations Imposed by Broadcasting Through Space

This broadcasting problem is further complicated by the fact that there are as many broadcast systems as there are broadcasters and that the one receiver at a particular location has to be capable of being "connected" (by tuning adjustments) to any of the signals of these broadcast stations (within range) and with a minimum of interference from other station signals. In other words, even though the apparatus and telephone circuits included in each broadcasters system were up to a high fidelity standard, there remains the indefinite factor of transmitting the radio signals through space.

Besides the natural difficulties of transmitting the radio signals through space, so that a sufficiently strong and steady signal will reach the receiving antenna, there are other limitations having to do with the extent of the separation of the radio transmission channels, that limit the quality of the program. This separation of Standard Broadcast Channels in the United States has been fixed at 10,000 cycles (10 kilocycles), which on the average limits the useful side bands (program frequencies) to less than 5,000 cycles. This is considerably below that required for high fidelity reproduction (7500 cycles). Theoretically, the separation of broadcast channels should be at least 15,000 cycles (15 kilocycles) in order to provide 7,500 cycle side bands, without encountering adjacent channel interference.

In the Standard Broadcast Band, the allocation of channels to any one district in the United States has been arranged so that no two local stations are on adjacent channels. This permits the reception of 7500-cycle side bands from a powerful local station as shown in Fig. 41. The upper part of this diagram shows a powerful local station "A" with the adjacent channel stations "B" and "C" located at a sufficient distance away so that their signals reaching the receiving antenna are too weak to cause interference. When this condition exists, and the local transmitter is sending out 7500 cycle frequencies, then the Fidelity Knob on the No. 70 series Receivers can be set for maximum fidelity (Knob with "7500" at top as shown at the bottom of Fig. 41). This setting of the Fidelity Control actually broadens the selectivity of the tuning circuits of the receiver so

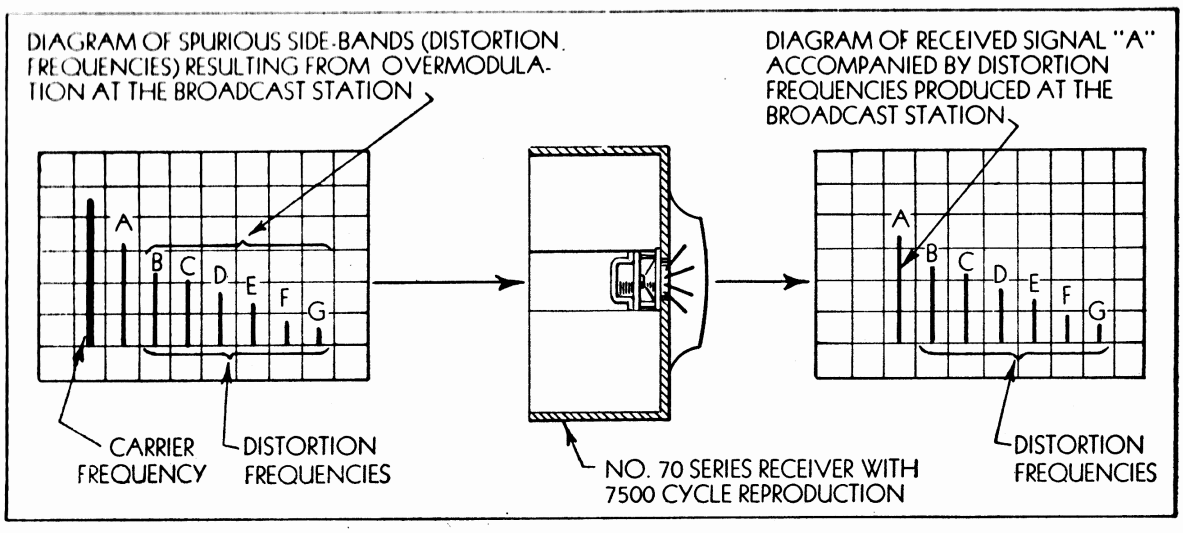


Fig. 44

Diagram Showing that an Overmodulated Signal Produces Distortion Frequencies at the Broadcast Station and That When This Distorted Signal is Received and Reproduced by a High Fidelity Receiver, with the Fidelity Control Set for 7500-Cycle Reproduction, the Spurious (Distortion) Frequencies, which are mostly in the High Frequency Range, are Reproduced Along With the Desired Signal. This Distortion gives a "Raspy" or "Rattling" Reproduction that is Often Mistaken for a Mechanical "Rattling" of the Loud Speaker Cone. This Defect is being Remedied by the more Particular Broadcasters, by use of High Fidelity Monitoring Equipment.

as to admit a wider band of program frequencies as shown in the middle portion of the diagram in Fig. 41.

It is obvious that broadening the selectivity of the receiver, to obtain higher fidelity reproduction, allows signals from the adjacent channel transmitters to be picked up and amplified along with the desired program signals. Thus, if these adjacent channel signals are fairly strong, as compared to the signal from the desired station, interference will result, as shown in Fig. 42 (See dotted selectivity curve for 7500 cycle quality). In such cases, the Fidelity Control Knob must be turned counter-clockwise to the position where the resultant increase in the receiver selectivity will correct this condition.

Even when the Fidelity Control Knob is set at "SR" for standard radio reception (maximum selectivity), there will be some adjacent channel interference if the signals from one or both of the adjacent channel stations are fairly strong as compared to that of the desired station. The black section of Fig. 42 shows the extent of this interference when this latter condition exists. Sometimes the interference can be further reduced by operating the Tone Control.

Adjacent channel interference can be recognized as cross-talk or "monkey chatter" (spasmodic, high pitched interference sounds breaking through the program) and can be reduced or completely eliminated by properly setting the Fidelity Control Knob. Continued cross-talk and other sound interferences usually are heard when listening to a station which is sharing the same channel with one or more other broadcast stations. It is not possible to eliminate this type of interference by radio receiver design, as all of the signals are on the same broadcast channel and will come in with varying strengths, according to the distance away, the one nearest being heard loudest. This can be compared to several persons talking at one time, in a room, any one listener hearing the nearest speaker more distinctly than distant speakers.

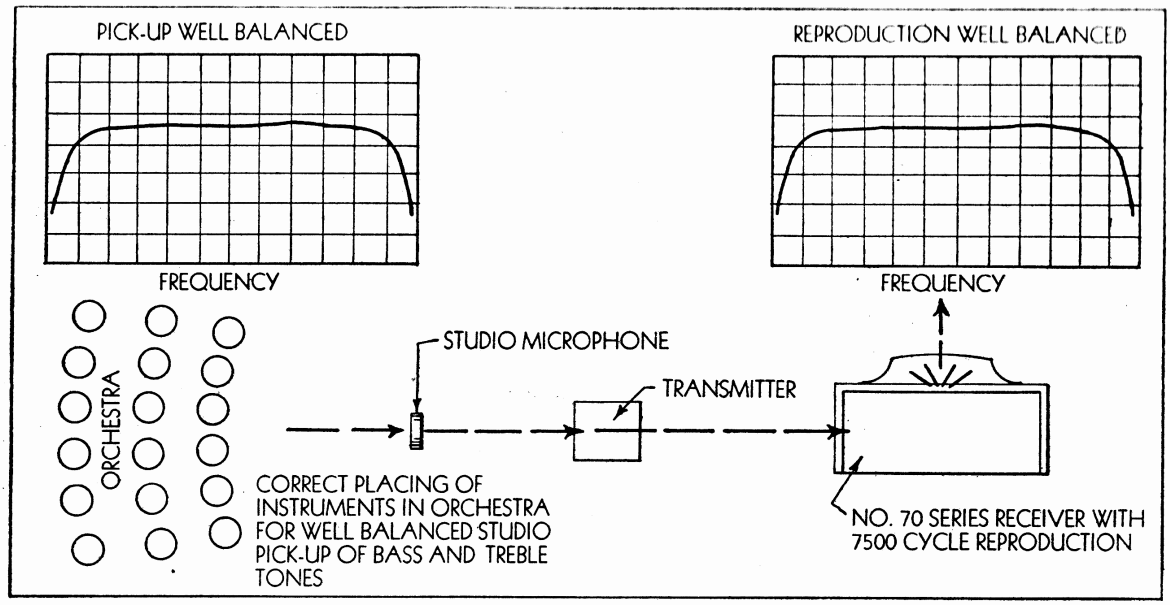


Fig. 45

Diagram Showing a Correctly Balanced Audio Reproduction from the No. 70 series of Receivers, when the Sound Picked Up by the Studio Microphone also is Well Balanced as Regards Low and High Audio Frequencies (Bass and Treble Tones). The Better the Studio Technique the Better the Reproduction. The Use of High Fidelity Monitoring Equipment by the Broadcasters allows better Audio Balances to be maintained.

17—System Requirements for High Fidelity Radio Programs

Now, by combining the high fidelity apparatus requirements of Fig. 39 with the requirements of minimum or no interference in reception of the radio signal of Fig. 41, a complete radio system for high fidelity transmission and reproduction is obtained. Briefly, these requirements for high fidelity are as follows:

(a) **All of the elements in the broadcast station equipment, from the microphone to the output of the transmitter, must be capable of transmitting all frequencies from about 50 cycles to 8000 cycles, with uniformity (Flat Response).** Many of the more important broadcast stations have equipment suitable for high fidelity transmission or are at present rebuilding with the view of meeting high fidelity standards.

(b) **All of the telephone lines used in connecting the various elements of the broadcast station equipment must be capable of transmitting all frequencies from about 50 cycles to 8000 cycles with uniformity (Flat Response).** At present the long distance telephone circuits regularly employed in network broadcasting have a flat response from 100 cycles to 5000 cycles. This is ample for the best of the standard designs of radios. Higher Fidelity network circuits (50 to 8000 cycles) can be furnished by the Telephone Companies, if the radio listeners demand this better service.

(c) **Better Monitoring of Programs by the Control Room Operator to provide maximum dynamic audio range in the transmitted program without over-modulation.** A correctly modulated signal is transmitted and received free from distortion as shown in Fig. 43. An over-modulated signal produces spurious side-bands (distortion frequencies) at the broadcast station as shown in Fig. 44.

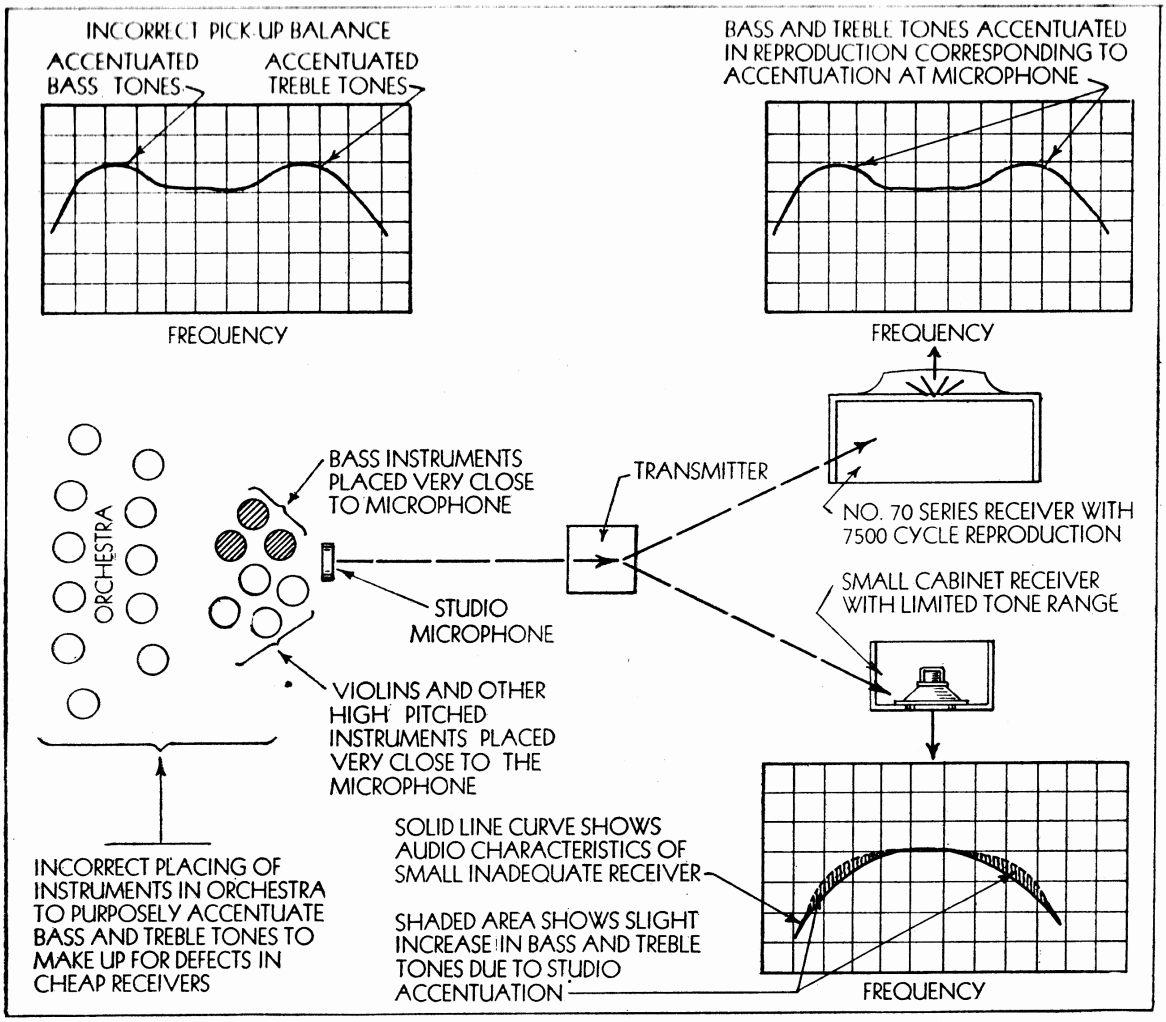


Fig. 46

Diagram Showing in the Upper Right Hand Curve, an Unbalanced Audio Reproduction from the No. 70 series of Receivers Due to an Unbalanced Pickup at the Studio Microphone (Poor Studio Technique). This Accentuation of Bass and Treble Tones by Incorrect Location of Musical Instruments in an Orchestra, Often is Done to Favor Small Cabinet and Poorly Designed Radio Sets which are Normally Deficient in Bass and Treble Response, such as shown in the lower Right Hand Curve.

A high fidelity receiver, adjusted for 7500 cycle reproduction, will receive and reproduce these distortion frequencies, along with the program, producing "Raspy" or "Rattling" sounds that are often mistaken for mechanical rattling of the loud speaker cone.

(d) **Better Studio Technique in the placing of musical instruments with respect to the microphone so as to obtain the same transmitted audio balance and variation in sound intensities as would be obtained if the program were intended for a listener in the studio.** Fig. 45 shows that a well balanced studio pickup of an orchestra will be reproduced in the same good balance by a high fidelity radio of the No. 70 type. Fig. 46 shows the result of an attempt on the part of some broadcast studios to make up for shortcomings of midget and other inadequate radios (limited frequency range, see Figs. 22 and 23) by placing the bass and the high pitched instruments close to the microphone so as to send out over-accentuated low and high frequencies. On a high fidel-

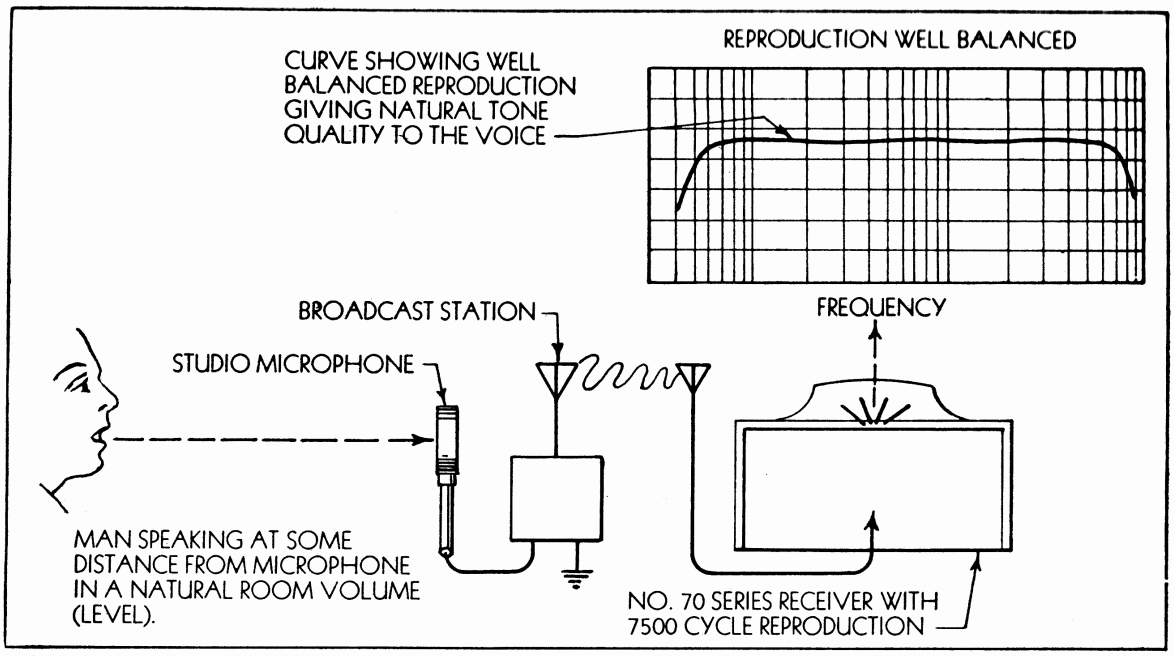


Fig. 47

Diagram Showing a Correctly Balanced (Natural) Reproduction of Tones, in the No. 70 series of Receivers, when a Male Speaker Talks in a Natural Tone at an Average Room Volume Level and at a Distance of several feet from the Microphone, and the Reproduction Kept at the Same Volume Level as the Original Sound.

ity receiver, these over-accentuated bass and treble tones will sound as exaggerated as would be the case if the listener's ears were in the same location as the microphone.

It is necessary that broadcast stations be equipped with high fidelity monitoring speaker equipment, capable of giving a flat response between 50 cycles and 8000 cycles, to insure a correctly transmitted program.

(e) **Better Microphone Technique for Studio Announcers so that the reproduced voice on a High Fidelity Receiver will be as natural in tone and clear in articulation as would be the case if the speaker were in the room with the listener.** This requires that the speaker's lips be several feet away from the microphone (Fig. 47) and that the voice be pitched the same as when speaking to an audience at that same distance. When the speaker's lips are placed close to the microphone (Fig. 48) and a low level "confidential" tone is employed, the voice is richer in low frequencies than when speaking at an ordinary room level. Now, in order to bring the reproduction up to the proper level for regular broadcast listening, more amplification must be used, resulting in a boomy unnatural tone.

(f) **Better Apparatus Maintenance in Studio and Transmitter to insure a flat over-all audio characteristic from 50 cycles to 8000 cycles free from distortions, and with minimum noise level.** This noise can be high frequency in character or may consist of low frequency "hum" from the power supply equipment used somewhere in the broadcasting system. High fidelity receivers, capable of giving a flat response from 70 cycles to 7500 cycles, should be used by broadcasters for checking the over-all performance of the broadcast stations.

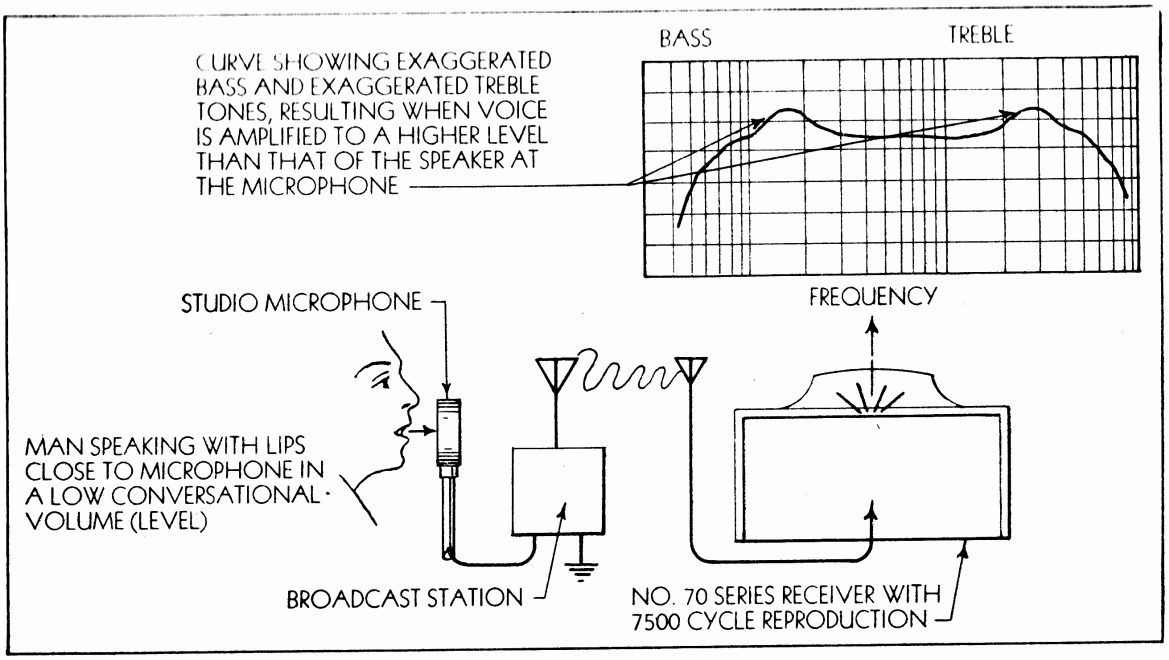


Fig. 48

Diagram Showing an Exaggerated Reproduction of "Bass" Tones also Exaggerated "Treble" Tones, Resulting from a Male Speaker Talking in a "Confidential" (Low Level) Tone, Close to the Microphone and the Reproduction Raised to a Higher Volume Level. The Acoustical Labyrinth in the No. 70 series of Receivers Prevents an Additional Accentuation, Due to Cabinet Cavity "Boom," which Happens in Other Designs of Radio Cabinets.

18—Determining When a Broadcast Program Has High Audio Frequencies

When reception conditions are favorable for the setting of the Fidelity Control of a No. 70 series Receiver to its maximum clockwise position (7500 at top of Knob), without encountering adjacent channel interference, it is possible to check the quality of the transmitted program as regards high frequencies, by listening to the reproduction of musical instruments that require high frequencies for complete recognition or for full tonal color.

For example, the "jingles" of a tambourine (small loose metal discs in the wood rim) sound natural when the broadcast system is transmitting high frequencies up to 7500 cycles, and the Fidelity Control is set for High Fidelity. If the "jingles" of the tambourine sound dead, like discs of lead, and there is no noticeable change in the tone quality of these jingles when the Fidelity Control is turned down to the Standard Radio position ("SR" at top of Knob), there are no high frequencies over 5000 cycles being transmitted in that particular program.

Making this same test, when listening to other distinctive high frequency instrument tones, such as from metal stringed guitars, metal triangles, etc., will show decided differences in reproduction, when the Fidelity Control is turned from "7500" setting to the "SR" setting.

If the program does not show a noticeable improvement in the reproduction of the higher frequencies, when changing the Fidelity Control from the "SR" to the "7500" settings, it is best to return the control to the "SR" position, so as to take advantage of the higher selectivity provided in the receiver at that setting.

19—High Fidelity Reproduction of Short-Wave Programs

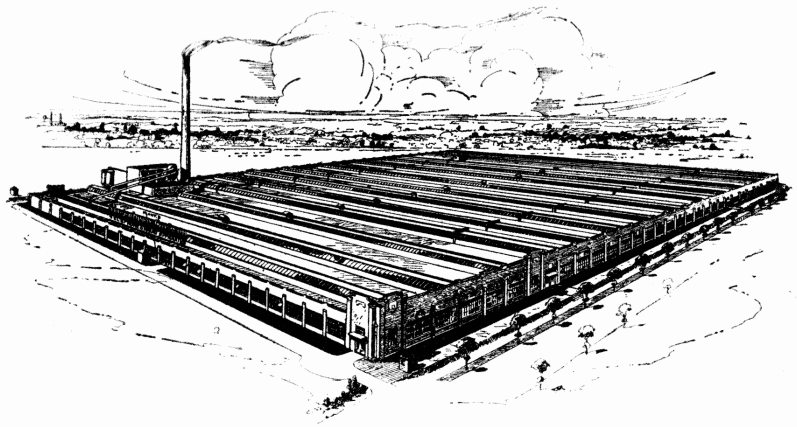
The successful reception of short-wave programs depends on good Radio selectivity and this prevents the use of band spreading, which is necessary when receiving radio programs with greater than 5,000 cycle side-bands. The smooth flat response, provided by the two speakers and Labyrinth system, in the No. 70 series Receivers, gives a much better quality of reproduction for short-wave programs than is possible with a high grade standard receiver.

In order to prevent incorrect operation of the controls on the receiver, and unknowingly having the circuits set for low selectivity, there are electrical interlocks provided in these controls which automatically adjust the radio circuits to maximum selectivity when the "Range Switch" (Fig. 7) is set for any of the three short-wave ranges.

20—High Fidelity Reproduction of Phonograph Records

The audio and speaker systems of the Nos. 72 and 74 Receivers, when used for reproduction of phonograph records, provides a much wider audio range than is recorded on present-day commercially available records. In fact, it is advisable to rotate the "Treble Control" Knob (See Fig. 10) clockwise about one-fourth revolution to reduce the high frequency response to equal that of the record, as the reproduction of any frequencies higher than recorded on the records will merely serve to increase the "surface noise" in the reproduction.

A WORD ABOUT STROMBERG-CARLSON



In Stromberg-Carlson's modern 14-acre daylight factory at Rochester, New York, a force of 1200 office and factory workers carry on all manufacturing, designing, testing, packing, sales office and executive operations under one roof.

ORGANIZED in 1894 to manufacture telephone instruments, switchboards, cable and supplies, Stromberg-Carlson soon became one of the largest suppliers for independent telephone operating companies. While the fact is not now generally known, there are more than five thousand independent telephone operating companies in the United States, who own more telephones than there are in all Europe. Many of them are Stromberg-Carlson customers. Stromberg-Carlson telephone products are likewise distributed to foreign countries on all continents, and manufactured in additional factories at Toronto, Canada and Sydney, Australia.

Alfred Stromberg, one of the founders of our company, was later influential in organizing the Stromberg Electric Company, manufacturers of time stamp systems, and the Stromberg Motor Devices Company, manufacturers of carburetors, but these three companies always have been separate corporate entities.

The Stromberg-Carlson Telephone Mfg. Co. is controlled by its employees as a group, many of whom have been in the company's continuous employ for thirty years or more. They have preserved to us the traditions and standards of workmanship which enable Stromberg-Carlson switchboards to still give satisfaction after thirty or more years of continuous service.

Entering the radio receiving set field in 1924, Stromberg-Carlson soon won a reputation for superior tone quality. This was natural; Stromberg-Carlson is the only telephone manufacturer who likewise produces home-type radio receivers, yet a radio receiver, from its detector tube on, through its audio transformers, audio amplifying tubes, loud speaker and the baffle characteristics of its cabinet, is essentially a telephone engineering problem. The electric phonograph, too, employs principles that were

first developed in telephone engineering laboratories, yet Stromberg-Carlson is the only telephone manufacturer who makes automatic record-changing phonographs.

Just as its telephone experience has benefited Stromberg-Carlson radio engineers, so its radio developments and researches conducted in its famous electro-acoustic laboratories have resulted in new and better telephones, and in many other products for the transmission, reception and reproduction of voices and music. Of all these products, it is safe to say, "There is Nothing Finer Than a Stromberg-Carlson."

HANDBOOK ON THE

Stromberg-Carlson

No. 70 Series

RADIO RECEIVERS

Featuring

ACOUSTIC LABYRINTH

HIGH FIDELITY TONE

ALL-WAVE RECEPTION

AUTOMATIC PHONOGRAPH

DOUBLE SPEAKER SYSTEM

SOUND DIFFUSING CABINET

LOW LEVEL BASS COMPENSATION

AUTOMATIC ANTENNA SWITCH

SELECTORLITE DIAL

AUTOMATIC VOLUME CONTROL

INTER-STATION NOISE SUPPRESSION

VISUAL TUNING METER

and provision for

TE-LEK-TOR REMOTE CONTROL

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