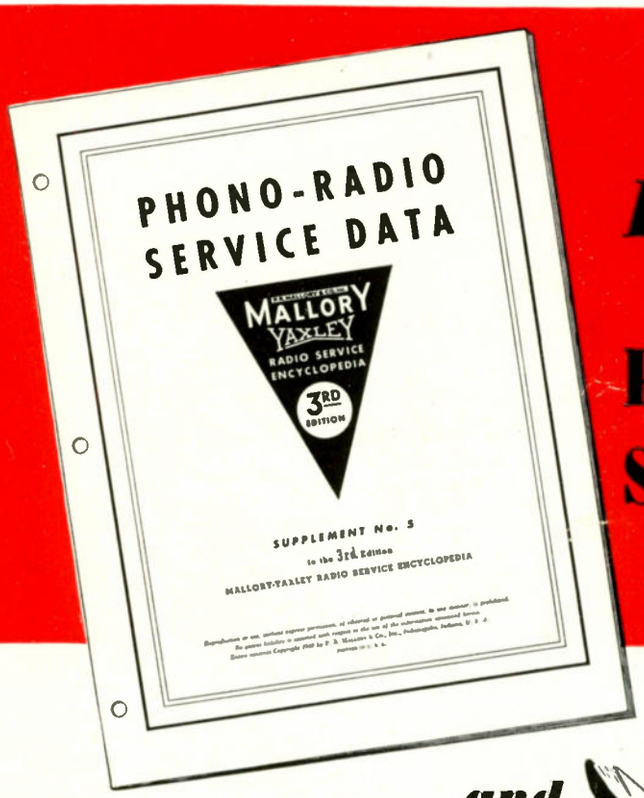
April 1946

Radio

# SERVICE DEALER

SOUNDMAN • JOBBER


price 20¢

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# Radio SERVICE-DEALER

SOUNDMAN AND JOBBER

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★ MEASURING receiver a-f response curve with record player, frequency test record and db meter. This makes a convincing home demonstration; is a direct road to alignment and improvement jobs. See article on page 10.


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**M. L. MUHLEMAN, EDITOR**

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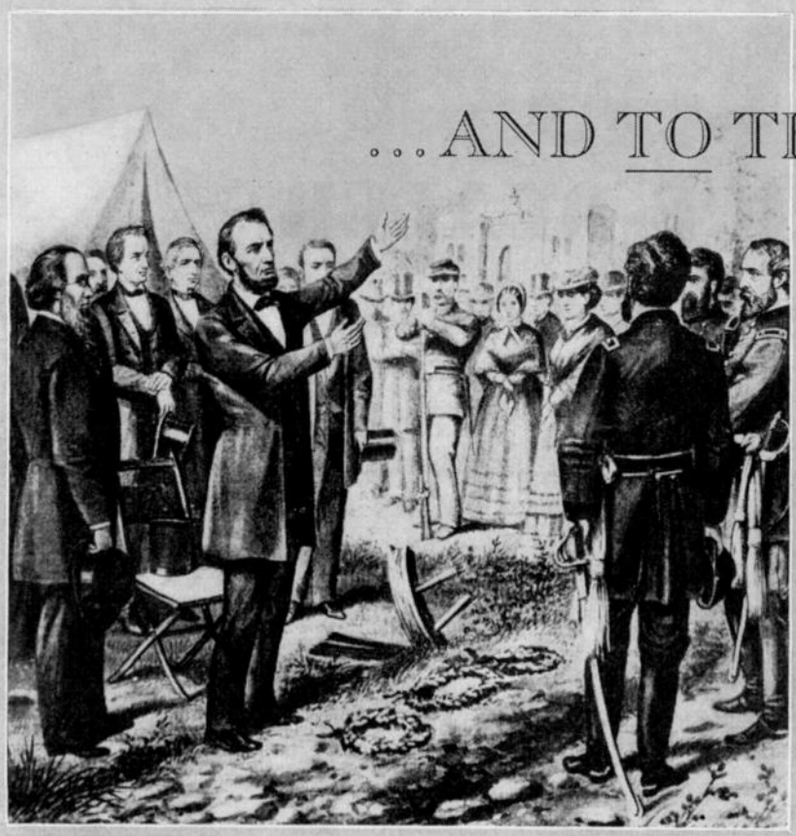
**OVER 16,000 COPIES OF THIS ISSUE WERE DISTRIBUTED**



# . . . AND TO THE PEOPLE!

Carved now in marble in America's most noble memorial, are the immortal words of the Gettysburg Address. Few even among those gathered on the battlefield heard them as they were spoken. Days, weeks, and even months and years were consumed before the speech traveled to all parts of the world. Radio would have winged it *to the people* instantly.

## A Service the Family of RCA Might Have Rendered

THE Family of RCA has kept a good many dates with history. As we shape our plans for presenting all sides of the issues of democracy *to the people* in this election year, we recall one date with history we wish we could have kept. It was before our time.

Just suppose there could have been an NBC microphone before the speakers at Gettysburg! Then the greatest words ever spoken by an American would have received an instantaneous world-wide hearing. Out over the two major National Broadcasting Company networks! Across the world via R.C.A. Communications, the radio message service of the Radio Corporation of America! To ships at sea through the radio services of Radiomarine!

The assembled crowd on the battlefield would hear each word clearly, impressively, thanks to a sound system developed in RCA Laboratories and built by the RCA Manufacturing Company. Listeners everywhere would hear a lifelike reproduction of the speech on RCA Victor radios. And motion picture audiences would listen to the address recreated by the RCA Photophone Magic Voice of the Screen.

Record lovers would, of course, turn to Victor for a higher fidelity recording of the American masterpiece. And the Gettysburg Address would be relived time and time again on RCA Victrolas.

You may be sure that the members of the Family of RCA will continue to dedicate themselves to their responsibilities *to the people*. Whatever radio can do will be done to further the cause of government "*of the people, by the people, for the people.*"

• • •

# Transients

**BOOM!** . . . That's just us entering the field. If you'll call our shots as they land, our chances of producing a magazine completely in phase with the reader will assume a rising characteristic.

★

**F.M.** . . . By the time your eyes reach this, the FCC will have decided the fate of Major Armstrong's wide-band system of frequency-modulation broadcasting. The Commission has given Television the green light (?!!) and will likely do the same for the-system-that-has-everything - but - the - means - to - survive. Given official sanction and the right to go commercial and F.M. will bloom as the flowers in spring.

We'd welcome any broadcasting system capable of making the public tone conscious. It would up the sales of consoles, put the midget in its proper place, pump more profits into manufacturing. selling *and* servicing.

★

**SARTORIAL** . . . Or, what the well-dressed serviceman will wear. Spring coyly beckons, the heat is on, and it is with deep-felt relief that the serviceman-about-town once again puts away his pin-striped trousers, cutaway coat and top hat for more informal and lighter wear.

This season the rage seems to be duck pants and beer jacket for morning service calls; shorts, a Basque shirt and a tennis racquet to swing jauntily, for afternoon sallies. Beret optional. Evening visits call for something in the way of a Palm Beach, with belt replaced by a sash of some gay pastel shade. Or tropical soup-and-fish if you're a stickler for formality.

Customers — bless their souls — will wear much the same clothes as the servicemen with whom they do business.

★

**SELLING** . . . A question of great moment is, "Should a serviceman sell?" It has been a question of great moment as far back in this field as we can remember. It has served as the title for numerous articles purporting to demonstrate conclusively that servicemen should sell, and in this sense has been a decoy, not a straightforward question.

We enjoy parrying the question with another of equally great moment; to wit —"Should a salesman service?"

What gets our fur up, and the reason we take delight in throwing the second question into the teeth of the first, is its apparent disregard for the facts of life. We know a man who can hew timber while playing a mouth organ, but we have no reason to suspect that everyone can duplicate the feat. Neither can all servicemen sell (or salesmen service).

It is our opinion that authentic servicemen should not sell, if by selling is meant the use of persuasive force on unwilling customers. In the first place, a good serviceman doesn't have to. He can do a good business in everything from tubes to phonograph needles without so much as mentioning the items. He does it by the simple process of giving a customer intelligent answers to problems many dealers are not equipped to solve.

The mistake a good serviceman often makes is to function as a free information bureau without at the same time serving as an outlet for the very parts and accessories he recommends. The upshot is that the potential customer is put to the inconvenience of having to make a trip to the nearest dealer.

★

**SOUND** . . . There exists no worse a blight on the radio industry than the tin-ear plague. Nine out of ten listeners have it, but are blissfully ignorant of the fact. Moreover, like halitosis, personal income and the sex life of flowers, it is a subject much too delicate to discuss.

The symptom is easily recognized; the afflicted imagine themselves excellent judges of tonal reproduction, and will stoutly defend their opinions to the last ditch. They seem completely unaware that their ears have sunk to low levels of tone consciousness due to constant exposure to radios that do not tell half of what they hear. The afflicted have, in a sense, become aurally immoral.

The only known cure lies in subjecting the patient to reproduced music of good quality for a period of two to three weeks. The ear slowly recaptures its discrimination and returns to the good life.

Unfortunately, the afflicted are unwilling to stand any such treatment—after all, they *like* the tone of their semi-articulate receivers, so why should they submit to an ear-lifting? Besides, who are you to tell them that full-to-the-left is not the only position for a tone control?

The ear may also become acclimated in time to distortion caused by overloading, a circuit fault, poor receiver design, etc., but seems to retain its ability to recognize an improvement. Hence, though the serviceman is seldom given the opportunity of presenting the case of tone quality as it is related to the range of audio response, he can serve as a good influence insofar as the elimination of distortion is involved. Moreover, since the presence of harmonic distortion in particular is more noticeable the wider the audio response, it accounts for the reason many listeners operate their receivers with the higher frequencies attenuated; and, since the elimination of such distortion also abstracts the unpleasantness from the upper range, the serviceman can readily sneak one over on his customer by adjusting the receiver for its maximum audio response and letting nature take its course. It doesn't always work, but often the customer remarks on the improvement in tone before he becomes aware that he's been duped. But, by that time, he's ready to accept the fact rather than make himself out a liar.

In spite of this waywardness of the human ear, the listener has tone quality as his only criterion of receiver performance. No other measure of performance has the slightest meaning to him.

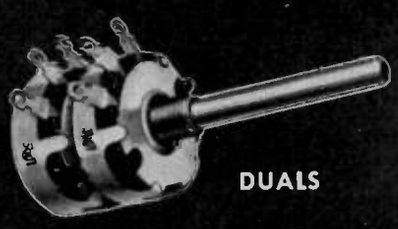
Since "quality" is the only factor he does understand, we say, sell 'em sound, and educate 'em to it when, as and if you can. In brief—Sell 'em Sound Service.

And, the next time you prepare an advertisement or a promotion piece, ask your customers this very simple question: *Does Your Radio Repeat What It Hears?*

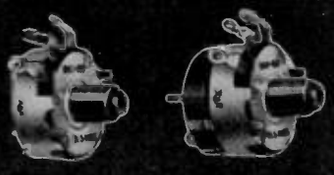
***EDITOR***

# *Every* REPLACEMENT TYPE FOR *Every* RADIO NEED

CS STANDARD



DUALS



MIDGETS

SPECIAL STANDARD

SPECIAL SHAFTS FOR EVERY NEED

AUTO RADIO

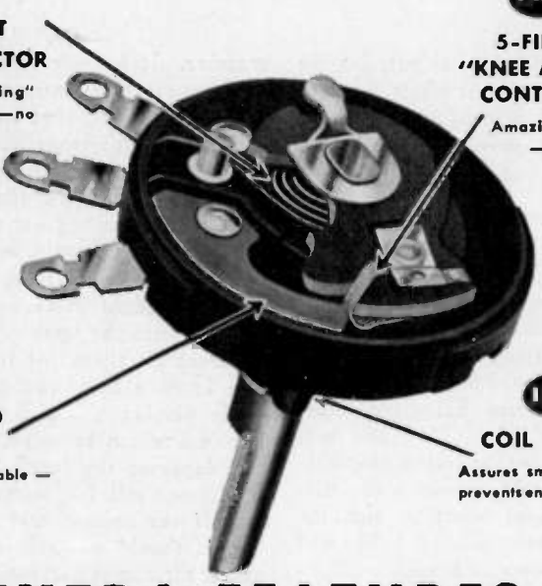
WIRE WOUNDS

**IRC** SILENT SPIRAL CONNECTOR

Positive "clockspring" connection—no slide—no friction—no noise.

**IRC** 5-FINGER "KNEE ACTION" CONTACTOR

Amazingly uniform —permanently quiet.



**IRC** METALLIZED ELEMENT

Moisture-proof — durable — outstandingly smooth.

**IRC** COIL SPRING

Assures smooth rotation prevents end play of shaft.

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# VOLUME CONTROLS

*Makers of Resistance Units in More Types, More Shapes and More Sizes for More Applications Than Any Other Manufacturer in the World*


**THERE'S A TYPE OF NEEDLE FOR EVERY PURPOSE; A PURPOSE FOR EVERY TYPE**

# THEY NEED NEEDLES

***PHONOGRAPH NEEDLES REPRESENT A PROFITABLE REPEAT BUSINESS FOR THE SERVICEMAN WHO ASSISTS HIS CUSTOMERS IN SELECTING THE PROPER TYPE***

AS hot as swing is the record business; hotter still are the Platter Bugs who go quietly mad over all manner of musical hypos from China Boy to Beethover.'s Fifth.

Equally as torrid, but more confounding, is the needle business. Eventually, record lovers become seekers after tone perfection; turn eyes to the important link between groove and pickup; end up in confusion over the seeming complexities of the needle problem.

Foggy on technicalities, incapable of formulating sound opinions on such matters, the average record user is left to the untender mercies of the local Young Edison or the man-who-knows-a-man when it comes to making a choice of needles. True, the dealer has a needle everyone swears by, including himself—but are its characteristics such that it will accomplish this or that? Well, that he cannot say, if he's the average dealer.

As a last resort (when it should have been the first) many record users have put the bee on their pet servicemen, quizzed them on the subject of needles, and emerged very well satisfied with the results. Said servicemen are today handling their customers' needle requirements—which is a fair exchange for information handed out—and doing very nicely with this sideline. Needles are with them wherever they go—not one, but many types—to meet whatever specific condition may arise.

Record users as a body are a bit touched, just as were the radio bugs of earlier days. There are, first, the quality hounds who purchase record-reproducing equipment "flat to 10,000" in spite of the fact (of which they are usually unacquainted) that there is little on a standard record but surface noise above 6000 cycles, if that high. There are, secondly, the timid souls who have been frightened out of their wits by the magnified pictures of needle points having the appearance of dentist drills, and are more concerned with record preservation than full-range reproduction. In the third classification we find the more robust individual who wants his music loud but unscratchy, and let the highs fall where they may. Fourth, the long-playing-needle fans; and, finally—the least cracked of the group—the enthusiasts who want as good a reproduction of music as a modern record can afford, with as little surface noise and record wear as may be consistent with that prime requirement.

It might seem that servicemen would have their hands full attempting to pacify customers with such widely divergent views. Actually, there are more types of needles of different characteristics than there are customer obsessions; hence, the problem of providing the record user with the kind of reproduction he wants is no problem at all.

That phonograph needles have "characteristics" should not come as a surprise. After all, the needle is the transmission medium between the modulated record groove and the reproducing unit. The degree of mechanical coupling between the needle and groove is dependent upon the shape and size of the needle point. The range of frequencies actuating the reproducer (assuming optimum coupling) is dependent upon the transmission characteristics of the needle as a whole.

### *NEEDLE COUPLING*

A standard record groove, magnified 200 times, is shown in Fig. 1. If the needle is to be properly coupled to this

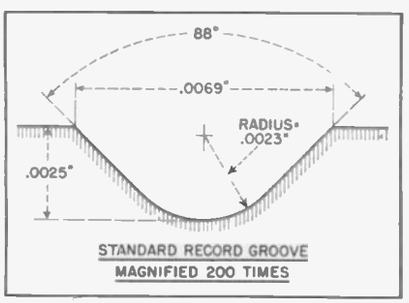



***Fig. 1. Cross-section of a standard record groove, with dimensions. It's this the needle must fit.***

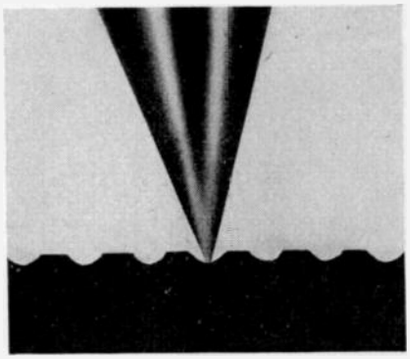


*Fig. 2. Point of this needle is too sharp for proper coupling to record groove. Result—poor tracking, needle chatter due to "play", groove plowing.*

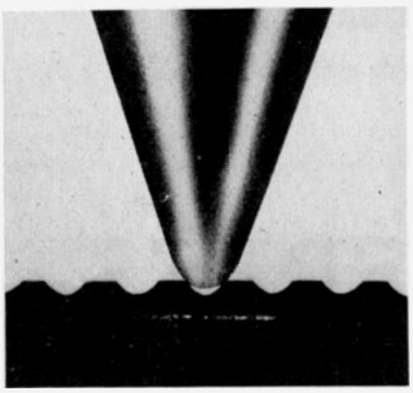


*Fig. 3. Point too broad for groove and proper coupling. Result—tracking failure at high frequencies, rapid "shouldering" of point, damage to groove walls.*

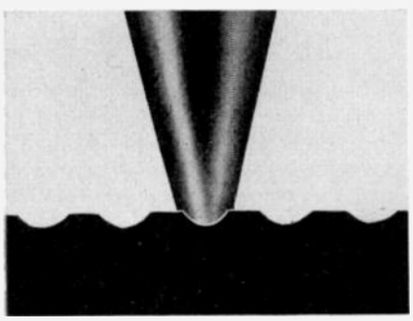


*Fig. 4. Point of this needle has shouldered due to excessive wear; or—what happens when a needle is used for more playings than recommended.*

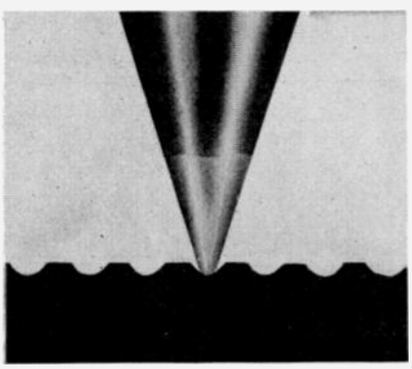


*Fig. 5. Needle with tipped radius to properly fit the record groove.*
(Photos courtesy Permo Products Corp.)

groove, its point must make perfect contact with the bottom and lower walls, but not the upper walls. Since the groove modulations impart a lateral movement to the needle, which tends to swing in an arc, this motion of the needle would be restricted if the point completely filled the groove. Therefore, the angle of the needle point should be less than the groove angle of 88° so that the needle may swing freely. Needle point angles range from 30° to 60°, depending upon type and character.

It is equally as important from the viewpoint of full-range reproduction, that the point of the needle be no larger than the groove wavelength of the highest recorded frequency. It is obvious that if the diameter of the needle point is greater than the length of the shortest "wiggle", it will not be able to follow the modulation but will ride over it; that is, the point of the needle cannot be guided through a groove modulation smaller than its own diameter.

On the other hand, if the point of the needle is so sharp that it makes contact with only a portion of the groove bottom, it is free to skid from side to side and cannot, therefore, properly track in the groove. Conversely, if the diameter of the needle point is greater than the groove width, the needle will ride the top of the groove and track only on the lower frequencies. If the point is excessively broad, the needle may jump the groove.

The photo-micrograph of Fig. 2 shows a needle with too sharp a point for proper coupling to the groove. Not only can the needle slosh about and damage the higher frequency groove modulations, but, by virtue of the sharpness of the point, may also plow up the groove bottom for some distance before the point is worn down by friction.

Fig. 3 shows a needle with too broad a point. The needle rides the top of the groove, is poorly coupled to it, and fails to track at the higher frequencies. It also has a tendency to erase the higher frequency groove modulations by riding *through* them in a straight course.

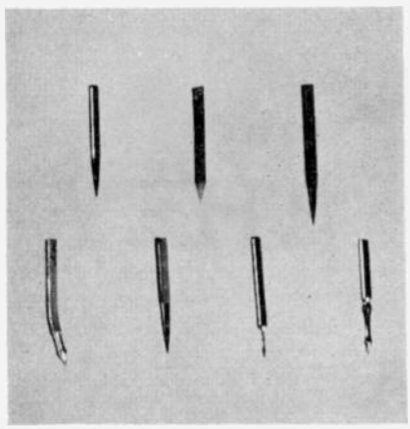
The photo-micrograph of Fig. 4 shows a needle that has "shouldered" due to excessive wear. It not only completely fills the record groove, thus restricting free motion, but also rests on the record surface. It cannot reproduce properly because of the added pressure at the sides, and will damage the groove.

In Fig. 5 is shown a needle with correct tipped radius to properly fit the groove, and an included point angle which will permit free motion of the needle at all recorded frequencies and amplitudes.

### *TRANSMISSION CHARACTERISTICS*

The transmission characteristics of a needle are determined by the material of which it is made, its stiffness, and its shape. Generally speaking, the frequency characteristics of metallic needles are superior to those of non-metallic needles, irrespective of shape. Moreover, of the metallic needles, those having thick shanks transmit a wider range of frequencies to the reproducer unit than do the thinner needles.

A needle having rigidity by virtue of its structure, its shape or both, is an efficient conductor of the higher audio frequencies. A needle having flexibility (such as the fibers, the thorns and the thin steels) tends to flex at frequencies above 4000 cycles or so, and the rapid vibrations are dissipated in the body of the needle rather than in the terminating impedance of the reproducer unit.



*Top, left to right: Loud-playing steel; a typical thorn needle; a shadowgraph-inspected and polished steel. Bottom, left to right: A bent-shank sapphire long-playing needle; a chromium semi-permanent; a thin steel, non-shouldering semi-permanent; long-playing Permo Point.*

A flexible needle also has a tendency to "talk" at one or more frequencies in the upper range, or to produce a shrillness on loud musical passages. However, this effect may also be caused by a stiff pick-up coupling or resonance in the pickup arm. One type of needle may aggravate the condition, another type eliminate it.

The average transmission level of non-metallic needles is from 1 to 2 db at 2000 cycles; of metallic needles, at the same frequency, from 3 to 5 db for the thin steels, and from 5 to 6 db for the so-called "loud" needles. By the same token, the scratch level of the non-metallics is from 1 to 2 db, and from 4 to 6 db for metallics. In actual practice, there is not a wide difference in scratch level for a given volume level, providing the needles have much the same frequency characteristics. The use of a non-metallic needle calls for an increase in the setting of the volume control for the desired level of sound; a metallic needle for a decrease in gain for the same output.

*(Turn to page 25)*

# THE CATHODE FOLLOWER

★ *VACUUM-TUBE TRANSFORMER FOR REMOTELY-CONTROLLED P-A SYSTEMS, RECORD PLAYERS, RADIO TUNERS*

THE cathode follower is a special type of feedback amplifier, and derives its name from the fact that the entire load resistor is located in the cathode lead, as in Fig. 1. This causes the entire output voltage to appear in series with the input or signal voltage, with the result that operation conforms to that of an amplifier with 100 percent inverse feedback.

Examination of the circuit from such a standpoint shows that: (1) The effective gain $\frac{A}{1 + AF}$ reduces to a figure slightly less than 1 regardless of tube or load impedance. (2) The *effective* output impedance is greatly reduced, due to the lowering of the effective plate resistance caused by the large amount of inverse feedback. In the case of 100 percent feedback, the output impedance becomes approximately: $\frac{1{,}000{,}000}{G_m}$ where $G_m$ is, as usual, the mutual conductance of the tube.

These two results of the high order of feedback provide what amounts to a *vacuum-tube transformer* of excellent frequency response and negligible distortion. Moreover, the step-down of impedance is not accompanied by a corresponding step-down in voltage as would be the case with a conventional transformer, which means that considerable economies may be effected.

### EXAMPLE OF USE

To take a specific case, suppose it is desired to couple a radio tuner, or a microphone or phonograph pre-amplifier, to a remotely-situated power amplifier. The usual method of accomplishing this is shown in Fig. 2. *T1* is a plate-to-line transformer which steps the primary impedance of about 50,000 ohms down to 500 ohms. This transformer has a turns ratio which is equal to the square root of the impedance ratio, and therefore accomplishes the impedance transformation at the expense of a voltage step-down of 10:1. To overcome this voltage reduction, it then becomes necessary to insert at the end of the line, close to the amplifier, another transformer, *T2*, which steps the voltage back up to its original value (where fidelity is not important, it may step the voltage up to a value somewhat higher than the original).

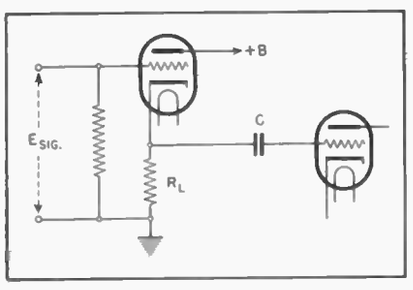



*Fig. 1. The cathode follower is a feedback amplifier with the load resistor in the cathode circuit.*

By the use of a cathode follower, the same result may be accomplished much more simply. In the case of a 6C5 tube, the mutual conductance is equal to 2000 micromhos. Substituting in the formula given, it is seen that the effective output impedance will be reduced to 500 ohms. A line may thus be connected directly across the coupling resistor of the 6C5,

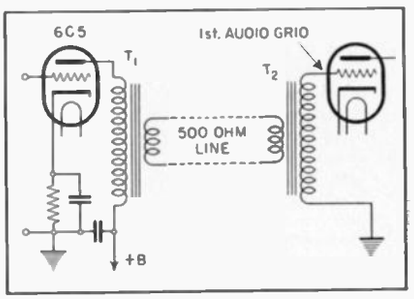



*Fig. 2. Usual manner of coupling a remote stage to input of p-a system.*

as in Fig. 3, and will have negligible effect upon response or output, even though the line may be several hundred feet long. Moreover, since the output voltage of the cathode follower is practically the same as its input, this impedance step-down is accomplished with no accompanying voltage loss, and there is thus no necessity for an input transformer at the grid of the following amplifier.

Fig. 3 shows how this may be done and gives suitable values for use with a 6C5. It also illustrates how an ordinary 100,000-ohm grid potentiometer may be installed as a remote volume control at the amplifier without affecting response, because of the low effective impedance of the line.

### REMOTE VOLUME CONTROL

Sometimes the volume control is required to be a true remote unit, located neither at the pre-amplifier nor the main amplifier. This would be the case if a single unit p-a amplifier were being used and it was desired to control the volume from some point in the audience. The circuit of Fig. 3 is unsuitable for such a control because the impedance at the grid of the tube reaches rather high values when the control is turned up about halfway. For such operation, Fig. 4 may be used.

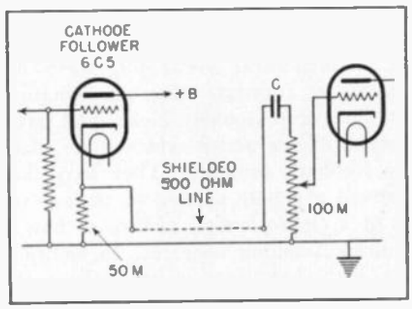



*Fig. 3. Use of cathode follower as "vacuum-tube transformer" for coupling remote equipment to p-a system.*

With this circuit the volume control itself becomes the cathode resistor, and any capacitive effect due to the line is corrected by the high percentage of feedback, since the cathode resistor is also the source of feedback voltage. This connection is to be avoided, however, unless necessary for convenient operation, because it requires a control which does not have a tendency to become noisy when carrying current.

### PRECAUTIONS

All circuits of the cathode-follower type have one main drawback. Due to

*(Turn to page 31)*

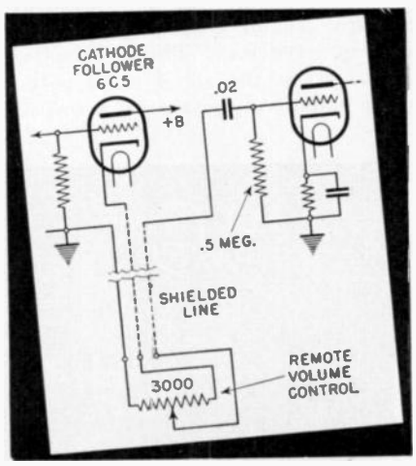



*Fig. 4. The load resistor of the cathode follower may be used as a remote volume control.*

# PRACTICAL USE OF

DURING the past several years, much has been written about inverse feedback in audio amplifiers, with particular accent on how it can be applied to the design of such equipment.

Unfortunately, these articles, although completely and technically correct from the mathematical viewpoint, have neglected to translate this mathematical data into a reasonably clear qualitative analysis of the action which takes place in a feedback amplifier. They have thus deprived a goodly portion of their readers of a clear physical picture of how a feedback amplifier operates. In addition, very little has been written about the practical advantages to the serviceman of feedback amplifiers, and still less information has come to light regarding the practical application of inverse feedback to existing systems. It is the purpose of these articles to review in as simple form as possible, the theory of inverse feedback, its effects on performance, and its application to both new and existing audio systems.

Inverse feedback may be defined as the process of injecting into the input circuit of an amplifier, a portion of its output, in such manner that certain undesirable characteristics of the output tend to be balanced out in the final signal. In order for this action to take place it is necessary for the feedback and input voltages to oppose each other; i.e., they must be as near as possible to 180 degrees out of phase. This action is just the reverse of regeneration, and by comparing it to a simple regenerative circuit, it becomes quite easy to understand.

### REGENERATION AND DEGENERATION

Fig. 1 is the diagram of a simple regenerative circuit which is well known to every serviceman. The input voltage appears across the coil *A* and a portion of the output voltage appears across coil *B*, known in the early days of radio as the "tickler." Coupling between the two coils is so arranged that the voltage across coil *B* will induce a corresponding voltage in coil *A* which is thus re-applied to the grid circuit of the tube.

You will recall that in order for regeneration to occur, the leads to coil *B* had to be connected so that the voltage induced from it re-inforced the signal in the grid circuit; that is, the signal voltage and regenerative voltage had to be in phase. If the tickler leads were reversed, the gain decreased instead of increasing, and the effect was known as "degeneration" instead of regeneration. This degeneration, properly controlled, is identical with "inverse feedback," and is always accompanied by a decrease in gain.

**PART I**

★ The first of two articles on the practical application of inverse feedback to existing amplifier equipment. This article deals with the elements of degeneration, how to calculate the percentage of feedback, determine loss in gain and hence the additional gain required to compensate for the loss, and what inverse feedback will do. The second article will cover actual applications, including circuits.

Consideration of Fig. 2-A and B will show how this same degeneration or inverse feedback is applied to an audio amplifier, and how beneficial effects may be obtained from that application. Fig. 2-A is a conventional one-stage amplifier whose gain (neglecting transformer step-up) is 10 at some middle frequency such as 1000 cycles. Fig. 2-B is the same circuit with the exception that a divider

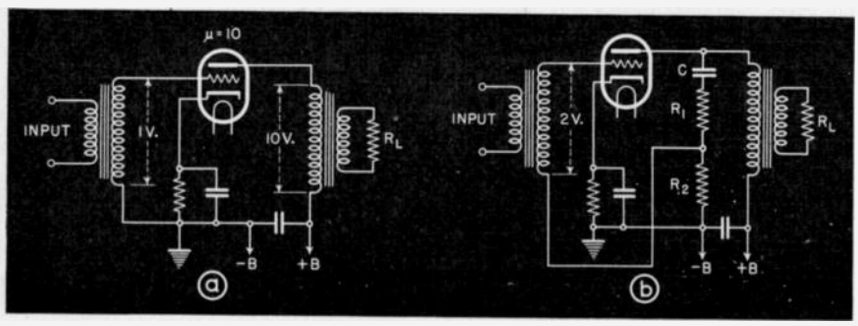



*Fig. 2. Circuit (a) is typical audio amplifier. Circuit (b) is same amplifier with the addition of inverse feedback.*

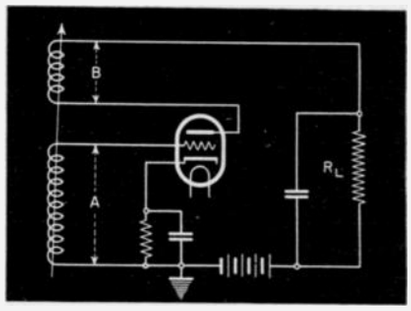



*Fig. 1. Regeneration or degeneration, depending upon phase.*

network, *R1-R2*, has been added across the output, and the lower portion, *R2*, has been connected in series with the input voltage by inserting it in series with the secondary of the input transformer. Thus the fraction of the output voltage which appears across *R2* is now in series with the input, and the voltage which appears at the grid of the tube will be the resultant of the input voltage and the feedback voltage. Since grid and plate voltages are 180 degrees out of phase, the feedback and input voltages will oppose each other, and the input which actually reaches the grid will be the difference between the two.

Referring to Fig 2-A, if 1 volt appears across the secondary of the input transformer, the output voltage across the primary of the output transformer will be 10 volts. In 2-B, however, if 1 volt is applied to the grid, and the divider in the output is adjusted so that 10 per cent of the output appears across *R2*, then 1 volt will appear across *R2*. Since *R2* is in series with the input, this 1 volt of feedback will tend to cancel the 1-volt input. If we wish to get the same output as before, we must therefore increase the input to 2 volts. Thus we see that the effective gain has been cut in half by the presence of the feedback voltage.

### CALCULATING GAIN LOSS

It can easily be shown that with such a circuit, the effective gain after feedback is introduced is equal to the original gain divided by a figure which depends upon the amount of feedback. Specifically:

$$Eff.\ Gain = \frac{A}{1 - AB}$$

Where *A* is the original gain.
*B* is the fraction of the output voltage which is fed back.

This formula is very convenient for mathematical calculation, but rather

# INVERSE FEEDBACK

**By MAURICE APSTEIN**

confusing when applied practically. It can be simplified as follows: The term $B$ is a minus quantity because it opposes the input voltage. If we assume that $B$ is always minus and combine the two minus signs in the denominator of the fraction, the formula becomes:

$$Eff.\ Gain = \frac{A}{1 + A \times F}$$

Where $F$ is the new feedback factor expressed as a fraction of the output voltage.

In other words, if we feed back 10 per cent of the output voltage, as in Fig. 2-B, the effective gain will be:

$$Eff.\ Gain = \frac{A}{1 + .1A} \quad or \quad \frac{10}{2} = 5$$

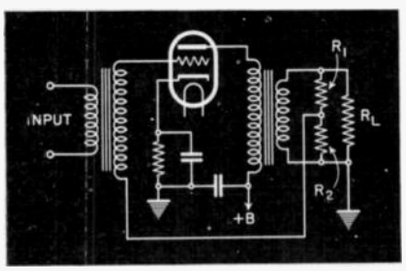



***Fig. 3. Same as Fig. 2 (a) but with output transformer included in feedback loop.***

So again we see by the formula that the original gain of 10 has been cut in half by the introduction of 10 per cent feedback. It will be convenient for the serviceman to remember this special case, which may be stated in words as follows: When the feedback factor is equal to *1/ Gain* the effective gain will be reduced by half.

In some early discussions of feedback, the degree of feedback was considered as above, in terms of percentage of output voltage fed back to input. From the equation for *Eff. Gain* however, it is evident that the effect of a given percentage of feedback will vary in different cases, depending on how much gain there is in the feedback loop. Thus, 10-per cent feedback over 1 stage (gain 10) and 10-per cent feedback over 2 stages (gain 100) will give entirely different results. Therefore, it has been found desirable to compare feedback circuits from some other aspect which is common to all applications.

From our original definition, all inverse feedback results in a decrease in gain. This decrease, expressed in db becomes a very convenient yardstick by which to measure the amount of feedback present in the circuit. Thus, when we say that an amplifier has 10-db feedback, we mean that it has that amount of feedback which will cause its original gain to be reduced by 10 db. In the special case mentioned, where the feedback factor was the reciprocal of the gain, it will be remembered that the gain was cut in half by this amount of feedback. This may be expressed as 6 db of feedback, because a voltage ratio of 2-to-1 is equal to 6 db.

The above discussion of the relation of feedback to gain forms a sound basis from which the various benefits to be derived from such circuits can be examined and appreciated. It must be kept in mind, however, that when we speak of the gain $A$ in the above discussion, we mean only the gain included between the points of feedback, and not the total gain of the amplifier. If a four-stage amplifier is being considered and feedback is accomplished over the last two stages, it is the gain of these two stages that is used in the equations, not the gain of the entire four stages. For feedback analysis purposes, such a four-stage amplifier is treated as a two-stage conventional pre-amplifier and a two-stage feedback amplifier.

Up to this point in the discussion, the only effect examined has been the loss of effective gain when feedback is introduced. Obviously, if this were the only effect, there would be little sense in its introduction. Actually, however, several beneficial effects accompany this gain reduction, and the improvements in performance due to feedback far outweigh the inconvenience of decreased amplification.

The three most important improvements accompanying the introduction of feedback are: 1) Improved frequency response; 2) Reduced distortion; 3) Improved output regulation.

### *FREQUENCY RESPONSE*

Analysis of Fig. 2-B at some other frequency besides the representative 1000 cycles, will show how frequency response is improved. Suppose that the response of the amplifier falls off 30 per cent at 50 cycles. This means that the gain at 50 cycles is 7 instead of 10, and that only 7 volts appears across the output. In order to get the same output as before, we must increase the input voltage to approximately 2.4 volts instead of 2. The output voltage is still 10 volts and the feedback voltage remains 1 volt, so the effective input at the grid is 1.4 volts and the reduced tube gain of 7 brings the output back to 10. From an examination of these figures, it will be seen that it was only necessary to increase the input voltage 20 per cent to overcome a drop in amplifier gain of 30 per cent, by virtue of the fact that the feedback voltage tends to increase the effective gain of the amplifier to compensate for a falling-off in response. Examination of the formula for *Eff. Gain* will show the same result. For a drop in response from 10 to 7 (30%), the effective gain drops from 5 to 4 (20%). Further examination will show that as the feedback factor is increased, this corrective action becomes more marked, and with large amounts of feedback the output remains practically flat despite wide variations in the original frequency response.

### *REDUCED DISTORTION*

In considering the circuit from the standpoint of distortion, it must be remembered that the feedback voltage contains not only the original signal, but whatever distortion the amplifier has introduced. Since the signal voltage does not have this distortion in it, when cancellation occurs between the two, the distortion component of the feedback is left over to be re-amplified. The feedback voltage originally is in phase with the output. By the time it again appears re-amplified in the output, its phase has been reversed by the tube with the result that the re-amplified distortion and the original distortion tend to cancel each other.

*(Turn to page 27)*

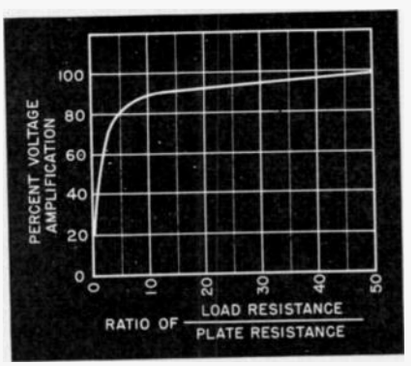
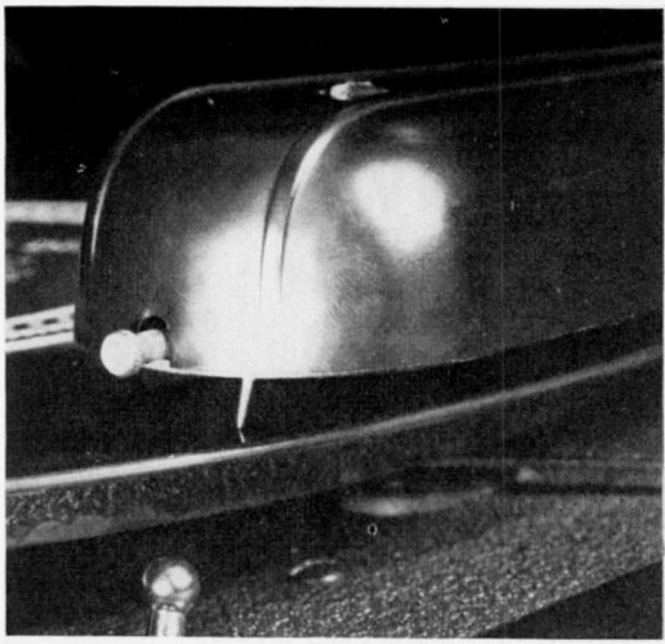



***Fig. 4. Effect of output tube load resistance on frequency response.***

# The Frequency Record as a Service Tool



*By ZEH BOUCK*

THE serviceman has long appreciated the utility of radio tests employing variable audio frequencies over the response spectrum of a radio. His reluctance to apply these methods widely has perhaps been due to the complications, expense and technique involved in an effort to use the variable-frequency audio oscillator to its full advantage. However, the variable-frequency phonograph record simplifies the problem to a mere matter of routine; and also provides a more spectacular method of demonstrating good and poor quality when tone is discussed as a sales argument.

A frequency record is employed primarily to determine the over-all fidelity, from antenna to voice coil, (sound pressure curves are relatively impractical from a service angle) or the a-f amplifier frequency response of a radio, for one or more of several purposes: *1*—To find out how good, bad or indifferent a radio is in respect to quality. *2*—To compare two or more sets on this basis. *3*—If frequency discrimination exists, to determine the range and degree of deficiency. *4*—As a service-sales argument to justify extensive improvements in a customer's present radio, or, *5*—To sell him a better set. As a service tool, the frequency record is also useful in determining the extent of combined r-f and i-f cut-off, by modulating an r-f oscillator and comparing this curve with one made with the pickup connected to the audio-frequency input. The continuously variable frequency record is also of considerable aid in diagnosing and locating undesired resonance effects, such as peaks, rattles, fuzzes and blasting.

### *FREQUENCY TEST RECORDS*

There are at least three frequency records readily available to the serviceman—the Columbia "Audio-Tone" No. 1; RCA-Victor No. 84522; and Speedy-Q No. 7884.

The Columbia* record is probably the best for general purposes. The frequency range is from 7000 to 50 cycles, continuously variable, and with a 1000-cycle reference at beginning and conclusion of the record. The disk is a 12-inch size, and vocal announcements of frequency are superimposed at 7000, 6500, 6000, 5500, 5000, 4500, 4000, 3500, 3000, 2500, 2000, 1500, 1000, 700, 500, 400, 350, 300, 250, 200, 180, 160, 140, 120, 100, 90, 80, 70, 60 and 50 cycles.

The Victor 12-inch record has a wider frequency recording of from 10,000 to 30 cycles, continuously variable. There are no 1000-cycle reference, nor frequency announcements. However, a buzzer signal is superimposed at 10,000, 9000, 8000, 5000, 4000, 2000, 1000, 500, 200, 100 and 50 cycles. The other side of this record is impressed with two continuous recordings of 433 and 1000 cycles at 33.3 r.p.m., or 1000 and 2300 cycles at 78 r.p.m.

The Speedy-Q is a 10-inch disk with a frequency range of from 5000 to 50 cycles, with vocal announcements at the 1000-cycle reference, and at 5000, 4000, 3000, 2000, 1000, 750, 500, 300, 200, 150, 100 and 50 cycles. These are the only frequencies available on this record, as they are grouped rather than continuous. The Speedy-Q is therefore less useful in showing up peaks. However, this record has an advantage in the fact that the voice is not superimposed upon the frequency—the tone being silenced for the periods of announcements. On the other records it occasionally happens that the voice or buzzer is lost under the frequency tone, due to incidental resonant effects. These records play from outside in, and at 78 r.p.m. The serviceman will find it worth-while to possess all three records.

Frequency records may of course be played on either wireless or direct-connected record players, and both systems will be employed in the course of tests.

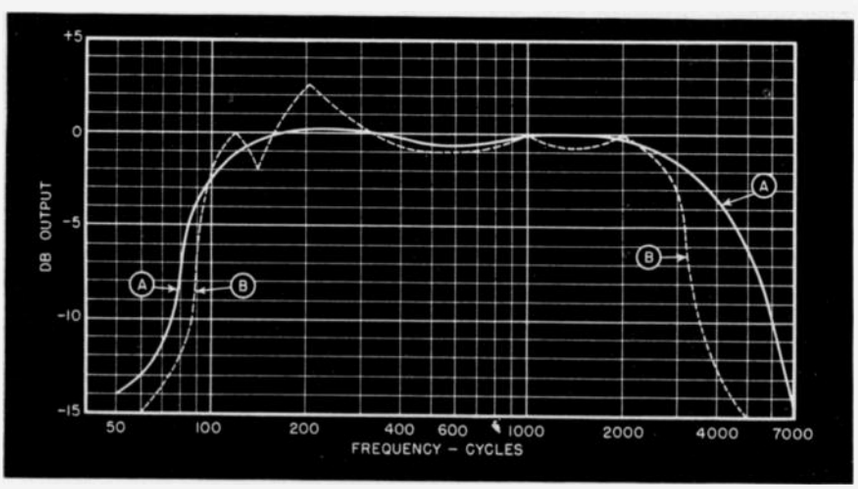



***Fig. 3. Typical response curves of two radio receivers made through the use of a frequency test record and a wireless record player.***

* Also No. 10003-M, from 10,000 to 50; No. 10001-M warbled frequency, from 10,000 to 100; and No. 10002-M noise spectrum, sweep-frequency band covering 10,000 to 40 in 12 seconds.

It is desirable that the characteristics of his equipment, in both arrangements, be known to the serviceman within a reasonable degree of fidelity in order that corrections may be made on subsequent curves if something better than merely comparative data is desired. These curves, kept on file, will also serve as a check on record wear.

***SET-UP***

Most servicemen possess p-a equipment incorporating a high-grade amplifier—flat, plus or minus 2 db, from 50 to 10,000 cycles—which will be adequate for check purposes. When direct connected to the pickup, a record should be kept of the exact circuit, resistors employed, etc., so that the conditions can be duplicated later. A speaker is connected to the amplifier output as a monitor, and a db meter suitably wired to the voice coil. The same amplifier and output arrangement can be used in making the correction or file curve with a wireless record player. It is only necessary to input a broad-tuning r.f.-detector circuit to the amplifier. Both the diode and the grid-leak-condenser triode have such a characteristic, and two of these arrangements are shown respectively in Figs. 1 and 2. In both diagrams, *LC* represents a tuned circuit which will resonate with the wireless record player.

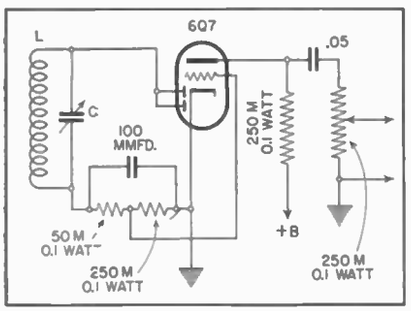



***Fig. 1. Broadly tuned r-f and detector circuit for use in conjunction with wireless record player.***

The frequency characteristics of the records are essentially flat, and Speedy-Q supplies a chart showing the response with different types of pickups and needles, which will be of some assistance to the operator in checking on his own equipment. Trick needles should be avoided. RCA "Full Tone" steel needles or their equivalent, changed each playing, give excellent fidelity with little record wear.

Simplicity and quickness in test is a major recommendation for the frequency record method, and these factors are further advanced by the use of the wireless type record player. While the frequency characteristics of these players have left much to be desired in the past, some of the recent models are quite good. Also, the serviceman may build himself one

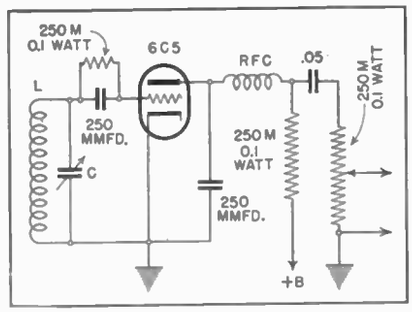



***Fig. 2. Another type of broadly tuned circuit which may be used with wireless record player.***

which is capable of high-fidelity, low-power broadcasting. If the serviceman possesses a test oscillator designed for external modulation, he will probably find it economical to incorporate a single-stage audio amplifier in the cabinet of a direct type record player, enabling him to modulate his oscillator. In any event, the degree of frequency distortion can be readily checked—as already described—and due compensation made when necessary. Playing the frequency record on a wireless record player also makes possible a fidelity curve as affected by r-f, i-f and a-f circuits. When using the wireless record player, the radio must be tuned to exact resonance—otherwise high-note response will be exaggerated. It is a good idea to have a regular musical record on hand for tuning.

When making tests with direct connection between pickup and amplifier, a shielded lead will usually be necessary. To reduce hum, try all possible radio and phono plug (115-volt) combinations, with and without ground to radio and record player. Even with radios specifically designed for operation with direct-connected record players, it will often be necessary (in the cause of stability and to reduce a barrage of noise) to connect a resistor across the pickup. Use as high a value as will eliminate the trouble—250,000 ohms is usually about right.

***MAKING CURVES***

The procedure of making the curve is the same with either the wireless or direct connection. A db meter is suitably connected to the voice coil of the speaker, and the volume adjusted for zero db (or any other convenient reference point) at 1000 cycles.

Some typical curves are shown in Figs. 3 and 4. In Fig. 3 both curves were made with a wireless record player, graph *A*, the solid line, representing the fidelity response of a reasonably good radio selling for around $75. Curve *B* was made on another receiver in the same price class. The poor high- and low-frequency response, as well as numerous peaks, show it up as an inferior article, regardless of its other merits.

The two curves in Fig. 4 were made on the same very satisfactory $100 radio—curve *A* with the wireless record player, and curve *B* with direct input to the audio system. A slight loss in highs, due to sharpness in tuning, will be noted. (The same pickup and record are, of course, used in both curves.)

Obviously, curves of this type provide direct answers to customer inquiries concerning tone quality, and a demonstration of how they are made is even more convincing. The layman will readily comprehend that, in a theoretically perfect receiver, the needle of the db meter will not fluctuate throughout the playing of the record, and that the amount of variation is an inverse indication of the tone quality of the radio. (While from a strictly engineering point-of-view this statement merits some qualification, it conveys the general idea, and it is not sufficiently inaccurate to mislead the customer.)

As a record player is readily portable, these demonstrations can be made in the client's home—perhaps in the course of a

*(Turn to page 29)*

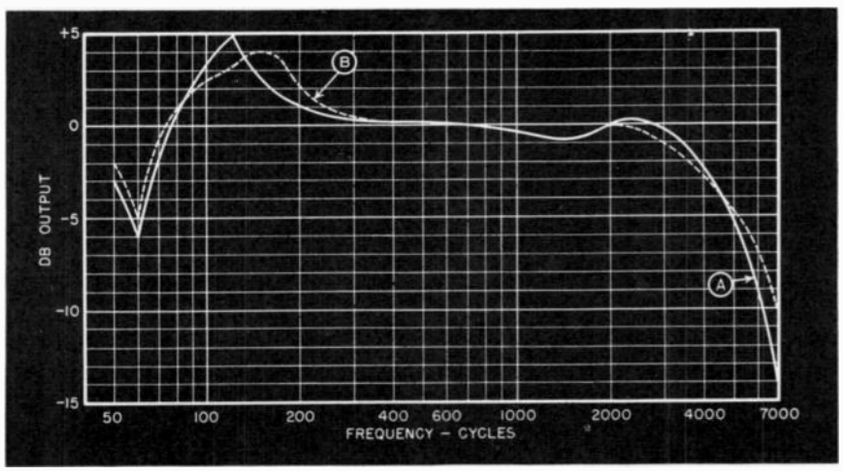



***Fig. 4. Two curves made on the same receiver; curve A with wireless record player, curve B with direct input to audio system.***

# Circuit Court

## CONTACT POTENTIAL

UNQUESTIONABLY YOU have noticed that, in many of the smaller receivers now on the market, some of the tubes appear to be operating without grid bias. Yet the performance is not adversely affected; in fact, the sensitivity is somewhat higher than we would normally expect, and there is no apparent increase in distortion. Actually, bias voltages are present but they are secured in an unconventional manner.

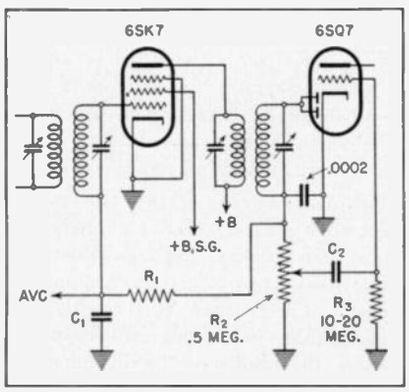



***Fig. 1. Circuit in which both tubes shown are biased by means of contact potential.***

Let us consider the partial schematic shown in Fig. 1, which represents an i-f stage, diode detector, avc and first a-f stage of a modern midget receiver. In the i-f stage, a 6SK7 is shown, with its cathode grounded. The control grid returns to the avc bus through the i-f transformer secondary and it is apparent that a bias voltage, due to avc action, will be applied to the i-f tube grid *when a signal is being received,* since then the second detector diode will rectify the signal voltage and cause an avc voltage to be developed across the diode load, *R2*. This avc voltage will then be filtered by the resistance-capacity filter *R1-C1* so that a substantially pure d-c negative bias will result which will increase in voltage as the signal strength increases.

This is clear enough, but whence comes the bias when no signal is being received? If we assume that the only d-c voltage which is present in the avc circuit is that which results from diode rectification of a signal, then, since the cathode of the 6SK7 is not biased, it is not immediately evident that a negative bias voltage is available when no signal is being received. The answer is that a limiting bias under such conditions is supplied by what is known as "contact potential."

Contact potential, as the term is commonly applied, refers to the inherent bias which results from electron bombardment of a tube element when no external voltage is present. This is due to the high initial velocity of the electrons emitted from the cathode which causes a small current to flow in the external circuit to which the tube element is connected. This effect occurs in control-grid circuits of triodes or pentodes as well as in diodes.

In the 6SQ7, which is shown in the diagram, contact potential serves a double purpose. In the diode circuit, it causes sufficient current to flow through the diode load *R2* to give a one-volt negative bias to the tubes under avc action when no signal is being received and thereby prevents excessive plate current flow in these tubes when no avc voltage is being developed. In operation, this limiting bias is increased due to the presence of noise voltages which reach the diode and increase the minimum bias available in the circuit.

The action of contact potential in the grid circuit of the 6SQ7 triode is somewhat different. In the preceding case, though the diode draws current, the negative voltage which thus results serves to bias the controlled tubes and prevent the grids from drawing current, which would cause inefficient operation of the tubes and circuits. But in the triode section of the 6SQ7 we find that contact potential causes grid current and consequently loading of the circuit to which the grid is coupled. When an audio voltage is fed to the 6SQ7 control grid, on the positive half of the cycle the grid current flow through *R3* is increased because the grid becomes more positive. On the negative half of the cycle, however, a point may be reached where the negative voltage thus applied to the grid may be sufficient to stop the flow of grid current due to contact potential. Then the input resistance of the grid circuit is greatly increased and the loading effect is reduced. The net result is that the positive half of the wave is slightly flattened while the negative half is not, thereby causing a distorted output.

To reduce this distortion, the grid resistor *R3* in such circuits is made very high—from 10 to 20 megohms. Then, on the positive half of the cycle, the amount of grid current is limited by the extremely high resistance in the grid circuit, while on the negative half, substantially the same load is present.

In actual tests, it has been found that less than 5 percent distortion results when the grid leak is 10 megs. or higher and the applied signal voltage is not greater than 1 volt. The gain obtained is slightly greater for signal levels of less than 1 volt, than results when a bias is applied in the usual manner and the conventional 1-meg. leak is used. In addition, the circuit is simpler and cheaper; there is no cathode bias resistor nor a bypass condenser.

✦

## PHASE INVERTER

SHOWN IN FIG. 2 IS a unique, double-barreled version of the contact potential stunt for eliminating the cathode bias resistor. The schematic shows a 6SC7 high-mu twin triode operating as a phase inverter in the new Stromberg-Carlson Model 455 amplitude- and frequency-modulation receiver.

While normally the 6SC7 operates with a 2-volt negative grid bias, by using 10-megohm grid resistors, the cathode bias resistor is dispensed with. There is a saving only of a resistor in this instance, since phase inverter cathode bias resistors are usually unbypassed. But greater stability of operation is secured because the common coupling in the cathode circuit, which sometimes results in motorboating, is eliminated.

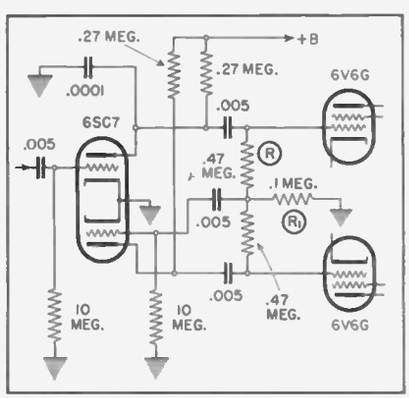



***Fig. 2. Balanced phase inverter with degeneration—triode of 6SC7 biased by means of high-resistance grid leaks.***

In operation, the a-f signal impressed on the first grid of the 6SC7 is amplified in the plate circuit and fed directly to one of the 6V6G output tube grids. Since the grid return of the inverter is through *R* and *R1*, an a-f voltage in opposite phase to that at the input grid is present at the junction of these two resistors. This voltage is fed to the second section

of the 6SC7 and is amplified and applied to the other 6V6G grid in the same manner, but in reverse phase from that of the first signal voltage. Thus push-pull operation is achieved.

The amplitude of the signal voltage applied to the second section of the 6SC7 is determined by the ratio of *R1* to the sum of *R1* and *R* which makes up the voltage divider network, or about one-sixth of the voltage in the example cited. If one section develops more output signal voltage than is required for balanced, and therefore perfect, push-pull operation, the excess signal voltage is carried over to the opposite push-pull grid where it acts to oppose the signal voltage present at that point. This action serves to reduce the input grid signal to the triode section which is delivering too much output and thus equalizes the output voltage from each section.

Note that the coupling condensers are small (.005 mfd.) in these circuits. Larger coupling condensers are undesirable when 10-meg. leaks are used, since the time constant becomes high and the circuit then tends to block momentarily on strong signals. This should be watched when making replacements.

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## TONE CONTROL

AN INTERESTING fidelity control network is employed in the Chevrolet 1940 eight-tube auto radio No. 985536. This control and its compensating circuits are between the 6K7 audio amplifier and 6R7 driver, as shown in Fig. 3. A breakdown of the switching sequence is shown in Fig. 4.

When the switch is in the "Voice" position, the signal is fed through a .05-mfd condenser, then through a .001-mfd condenser which presents a high impedance to low frequencies, thus limiting the frequencies passed to the middle and high range. The signal appears across the 40,000-ohm and 100,000-ohm resistors which act as a voltage divider, and the signal to the 6R7 grid is taken off at the junction. Likewise there is a 3-meg. resistor from the 6R7 grid to ground. While this is shunted across the 100,000-ohm resistor, its effect on the circuit is negligible, its real purpose being to form a grid return circuit when the fidelity switch is in the "Soft" position.

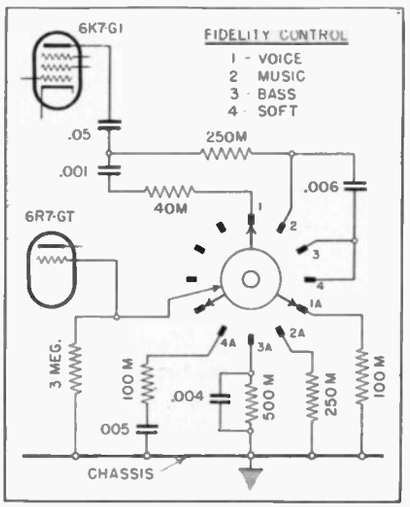



*Fig. 3. Fidelity control switching arrangement in Chevrolet 8-tube auto radio. Breakdown at bottom of page.*

When the switch is in the "Music" position, the signal is fed through a .05-mfd condenser and two 250,000-ohm resistors in series to ground. The signal voltage is taken off at the junction of these two resistors. This position provides normal response which is well rounded with both low and high frequencies.

For the "Bass" position, the signal passes through the .05-mfd condenser, the 250,000-ohm resistor, and a 500,000-ohm resistor terminating at ground and shunted by a .004-mfd condenser. This condenser bypasses the highs so that the lows and middle range predominate.

For the "Soft" position, the a. f. is fed through the coupling condenser (.05), the 250,000-ohm resistor, a .006-mfd condenser, a 100,000-ohm resistor and a .005-mfd condenser to ground. The grid of the 6R7 is fed from the junction of the .006-mfd condenser and the 100,000-ohm resistor. The function of the .006-mfd condenser is to pass highs and middle frequencies, while the purpose of the .005-mfd condenser is to bypass the highs so the resultant output covers the middle range, cutting both the highs and lows. As previously mentioned, the purpose of the 3-meg. resistor is to provide a grid return circuit.

*Fig. 4. Breakdown of switching sequence in fidelity control circuit of Chevrolet 8-tube auto radio, shown in Fig. 3.*

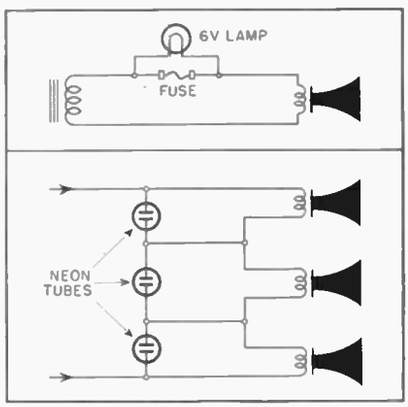
◆

## SPEAKER PROTECTION

SOUNDMEN ARE ALL too familiar with the tendency of some voice coils of dynamic units to burn out or open in the middle of an important job.

An excellent self-indicating protective device for this type of speaker consists of a small, quick-acting, 1-ampere cartridge-type fuse in series with the voice coil of each unit. Across the fuse is shunted a 1- to 2-ampere, 6-volt auto dashlamp, as shown in Fig. 5.

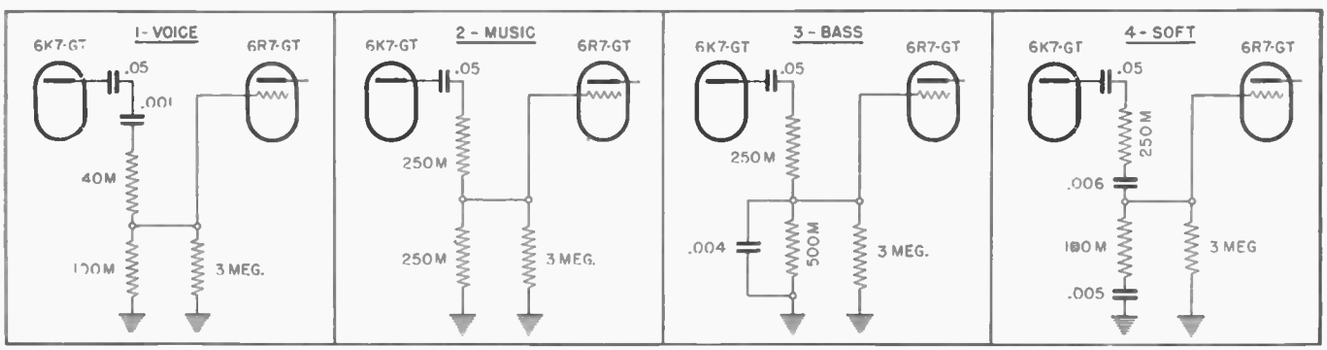
With a 15-ohm voice coil, if the input to the speaker exceeds 15 watts for any length of time, the fuse will blow, but the circuit will not open since the lamp is then in series with the voice coil. Thus, power to that particular speaker is reduced at the same time that the lamp begins to flash, indicating that something is wrong and the fuse blown.




*Figs. 5 & 6. Self-indicating protective devices for dynamic speaker units.*

If the speaker has an 8-ohm voice coil, a 2-ampere fuse is required.

If several speakers are hooked up in series, a small .25-watt neon tube connected across each voice coil, as shown in Fig. 6, is also helpful. During normal operation the voice coil shorts the neon tube, but when one of the voice coils opens, the voltage rises sufficiently to ionize the tube, and its glow indicates which unit has gone west.



# THE BIG SHIFT

★ *SCHEDULED REALLOCATION OF BROADCAST FREQUENCIES TO OPEN UP HAPPY HUNTING GROUNDS FOR SERVICEMEN. BIG JOB AHEAD RESETTING NATION'S PUSH-BUTTONS*

UNDER the provisions of the North American Regional Broadcasting Agreement, designed to eradicate interference between stations in the United States, Canada, Mexico and Cuba, close to ninety percent of the U. S. broadcasters will start moving to new channels on August 1st. Though the F.C.C. has provided a year in which to make the prescribed changes in station assignments, it seems certain that efforts will be made to complete the frequency shifts prior to election time.

Stations holding down channels from 550 to 720 kc are not affected (see list to right). Stations occupying frequencies above 720 will eventually settle down one or two doors from their former channels. New York's WJZ will vacate 760 kc and move up the line 10 kc to 770; WABC will leave 860, take a 20-kc walk to 880. Still forthcoming are specific assignments for stations occupying present frequencies (in Column 1) to which are coupled two or more new frequencies (in Column 2). Apart from these, you can determine from the list the new channel addresses for the stations in your area.

Somewhat flabbergasted will be the owners of push-button sets. Decidedly in pocket will be the servicemen who prepare for the load and show their ability as quick-change artists. When the stations start moving, tomorrow isn't going to be time enough for re-sets when the listener's pet program comes on at 7 or 11 and where in the name of heaven has it gone to.

The serviceman's big problem will be how to re-set the greatest number of push-button sets in the shortest possible time at a moderate cost to the customer. Best answer to the problem is to start making plans now. Here are suggestions:

### *PLAN NOW*

If you haven't a radio set census of your territory, start working up a list of push-button set owners, with make and model of receiver in each case. Check the names of your steady customers on this list, and count on serving them first. They'll expect it of you, and if you slight 'em, the fellow around the corner may pull a snatch—for keeps.

Arrange your list into sections, blocks or streets so as to reduce waste motion in your rounds when the Big Shift hits the town. Don't dash madly from one end of town to the other and then back again or you'll eat up all your profits in lost time.

Go through your Manuals and earmark for segregation and study the button re-setting dope on all the receiver makes and models in your list. You'll waste good time if you put off reference to this data until you are on the job.

Contact all your regular push-button customers beforehand; advise them of the proposed channel shifts and try sewing

*(Turn to page 33)*

**A Broadcast Station Assigned to a Channel in Column 1 Will be Changed to the Channel on the same Horizontal Line in Column 2 to Comply with North American Regional Broadcasting Agreement.**

| *Column 1* | *Column 2* | *Column 1* | *Column 2* |
|---|---|---|---|
| 550 kc | 550 kc | 1080 kc | 1110 kc |
| 560 kc | 560 kc | 1090 kc | 1120 kc |
| 570 kc | 570 kc | 1100 kc | 1130 kc |
| 580 kc | 580 kc | 1110 kc | 1140 kc |
| 590 kc | 590 kc | 1120 kc | 1150 kc |
| 600 kc | 600 kc | 1130 kc | 1160 kc |
| 610 kc | 610 kc | 1140 kc | 1070 or |
| 620 kc | 620 kc | | 1170 kc |
| 630 kc | 630 kc | 1150 kc | 1180 kc |
| 640 kc | 640 kc | 1160 kc | 1170 or |
| 650 kc | 650 kc | | 1190 kc |
| 660 kc | 660 kc | 1170 kc | 1200 kc |
| 670 kc | 670 kc | 1180 kc | 1170 or |
| 680 kc | 680 kc | | 1200 kc |
| *690 kc | ..... | 1190 kc | 1210 kc |
| 700 kc | 700 kc | 1200 kc | 1230 kc |
| 710 kc | 710 kc | 1210 kc | 1240 kc |
| 720 kc | 720 kc | 1220 kc | 1250 kc |
| *730 kc | ..... | 1230 kc | 1260 kc |
| 740 kc | 750 kc | 1240 kc | 1270 kc |
| 750 kc | 760 kc | 1250 kc | 1280 kc |
| 760 kc | 770 kc | 1260 kc | 1290 kc |
| 770 kc | 780 or | 1270 kc | 1300 kc |
| | 1110 kc | 1280 kc | 1310 kc |
| 780 kc | 790 kc | 1290 kc | 1320 kc |
| 790 kc | 810 kc | 1300 kc | 1330 kc |
| 800 kc | 820 kc | 1310 kc | 1340 kc |
| 810 kc | 830 kc | 1320 kc | 1350 kc |
| 820 kc | 840 kc | 1330 kc | 1360 kc |
| 830 kc | 850 kc | 1340 kc | 1370 kc |
| *840 kc | ..... | 1350 kc | 1380 kc |
| 850 kc | 870 kc | 1360 kc | 1390 kc |
| 860 kc | 880 kc | 1370 kc | 1400 kc |
| 870 kc | 890 kc | 1380 kc | 1410 kc |
| 880 kc | 910 kc | 1390 kc | 1420 kc |
| 890 kc | 920 kc | 1400 kc | 1430 kc |
| 900 kc | 930 kc | 1410 kc | 1440 kc |
| *910 kc | ..... | 1420 kc | 1450 kc |
| 920 kc | 950 kc | 1430 kc | 1460 kc |
| 930 kc | 960 kc | 1440 kc | 1470 kc |
| 940 kc | 970 kc | 1450 kc | 1480 kc |
| 950 kc | 980 kc | 1460 kc | 1500 kc |
| *960 kc | ..... | 1470 kc | 1510 kc |
| 970 kc | 1000 kc | 1480 kc | 1520 kc |
| 980 kc | 1020 kc | 1490 kc | 1530 kc |
| 990 kc | 1030 kc | 1500 kc | 1490 kc |
| 1000 kc | 1040 kc | *1510 kc | ..... |
| 1010 kc | 690, 740, | *1520 kc | ..... |
| | 990 or | 1530 kc | 1590 kc |
| | 1050 kc | *1540 kc | ..... |
| 1020 kc | 1060 kc | 1550 kc | 1600 kc |
| *1030 kc | ..... | *1560 kc | ..... |
| 1040 kc | 1080 kc | *1570 kc | ..... |
| 1050 kc | 1070 kc | *1580 kc | ..... |
| 1060 kc | 1090 kc | *1590 kc | ..... |
| 1070 kc | 1100 kc | *1600 kc | ..... |

** Not assigned in United States*

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# MEISSNER F-M RECEPTOR

THE Meissner Model 9-1021 F-M Receptor is designed for use with an external audio system, although space is provided on the chassis for the assembling of the audio amplifier shown within the dotted lines in the accompanying schematic diagram. If this amplifier is employed, the 400-ohm, 3-watt resistor, *R*, in series with the high-voltage output of the power supply, should be removed and the terminals *P-P* tied together.

### THE CIRCUIT

A high-gain s-f (signal frequency) stage employing an 1852 is coupled to the 6SA7 mixer-oscillator. Oscillator frequency drift is kept at a minimum by the use of the temperature-compensating condenser *CT*, and the VR-150 voltage-supply regulator tube.

The i-f amplifier is tuned to a mid-frequency of 2.1 mc and the acceptance band broadened by over coupling in the transformers and resistance loading of the primary and secondary coils.

The 1852 limiter supplies avc voltage to the first and second i-f stages. The discriminator i-f transformer is air-trimmed to prevent drift and permit a precise cross-over adjustment.

A 6AD6G dual-shadow tuning indicator is used with a separate amplifier circuit employing a 6SC7 to provide accurate tuning of the s-f circuits so that the i-f signal will fall at the mid-frequency. This condition prevails when the two shadows of the 6AD6G are practically equal in angle.

Two values of audio level are provided, as shown; "Hi" for low-gain amplifiers and "Lo" for high-gain amplifiers.

### TONE CONTROL

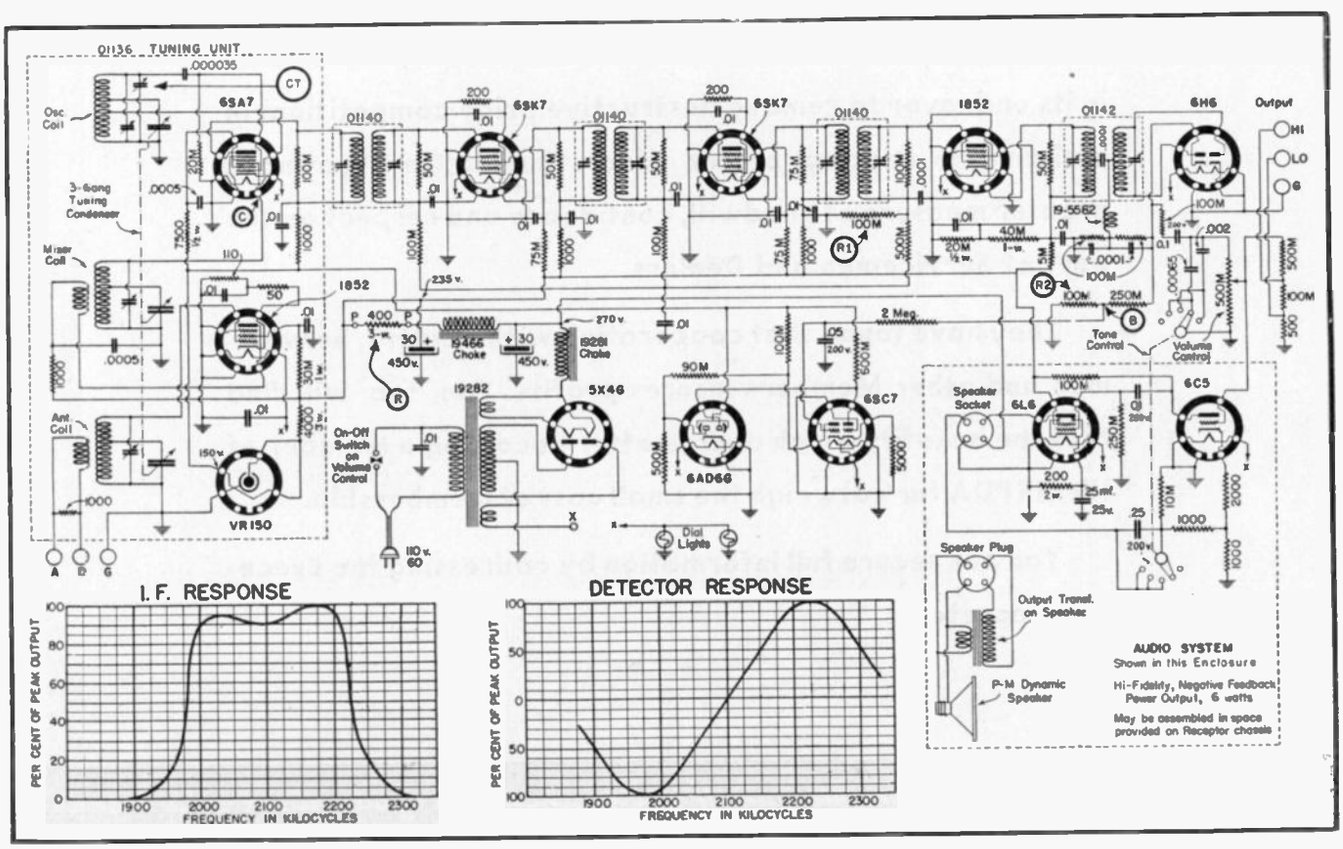
As long as the built-in audio system is not a part of the Receptor, only three gradations of tone are available. Counting from the left-hand (right-to-left in diagram) position of the switch, positions 1 and 3 provide extra high-frequency attenuation while positions 2 and 4 provide normal equalizing high-frequency limitation. Position 5 gives no high-frequency control at all and the higher audio frequencies and harmonics will be pronounced in the output.

With the built-in audio system installed, five distinct tone positions are available. The lowest tone is obtainable with the switch in the extreme left-hand position. In this position, bass boost is provided in conjunction with extra high-frequency attenuation. In position 2, bass boost is also provided but the highs are not reduced as much, a normal degree of high-frequency equalization being present. In position 3, the bass boost is eliminated and the extra high-frequency attenuation is present. This position might be considered to provide a "mid-range" response as the lows and highs are both relatively weak. In position 4 normal high-frequency equalization is provided, again without bass boost. This is similar to the condition provided by position 3, except that more highs will be present in the output. In position 5, the utmost in high-frequency reproduction is obtained. There is no bass boost and no high-frequency attenuation. A noticeable accentuation of the higher audio frequencies will be obtained in this position. This extra high-frequency response is useful if the Receptor is connected to an audio system that has deficient high-frequency response.

### ALIGNMENT

Although it is most convenient to align

*(Turn to page 31)*




***Schematic of Meissner F-M Receptor. Audio system separate. Seek for above i-f and discriminator response curves when aligning.***

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# Serviceman's Diary

By J. P. HOLLISTER

MONDAY—Arrived early and got Jerry to help me hook the extension ladders to the side of the truck. Antenna installations are easy when Jerry's along; he climbs up the ladder rungs so easily and quickly that you would think they were merely stairs. I just stand at the base, steadying the ladders, which is not quite as soft a job as it seems. Once the hammer slipped out of his back pocket when he was thirty feet up, bounced off one of the rungs and missed my head only by inches. Since then, I keep my eye on him even though I do get a crink in my neck.

Nothing bothers Jerry. You'd think he'd keep his mouth shut when he's in a customer's home and let me do the talking. Not so. You can't tell when he's going to bust out with some remark that would dash a diplomat of the new school. Yet he seems to get away with it. Nobody, so far, has ever kicked about his impudence. But I wish he wouldn't practice on me, especially when I'm driving.

This morning he slid over to the corner of the seat, stuck his elbow out the open door window, and started to read the newspaper. We hadn't gone a block before he let loose.

"Listen to this," he said. "According to what it says here, there are 4.2 persons and 1.1 radios in each home of this town. Now what do they mean by that? What's a .2 person—a baby? And did you ever see a .1 radio?"

"I've seen plenty of .1 radios," I said, "but that isn't what they mean. Those figures are simply averages. For instance, if there are 42 persons in 10 homes, that means that there is an average of 4.2 persons in each home. And if there are 11 radios in these 10 homes, then the average is 1.1 radios per home."

"I see," he replied. "And if there is one serviceman for each thousand radios, that means that there is a .001 serviceman for each radio."

"That's the idea," I admitted.

"Would you call yourself a .001 serviceman?" he asked, looking serious.

Some people are hopeless. But we were almost to the Caldwell home, so I didn't bother replying.

I drove around the semi-circular driveway which led up to the front door of the long, white two-story Colonial home of the Caldwells, turning off near the chauffeur's quarters above the garage. Together we got out of the car and gave the aerial the once-over from the outside, before ringing the bell.

One end had been attached to a tall oak at the rear of the house. A rope, weighted at one end, passed through a pulley and thence to the antenna. The idea looked good, the weight keeping the wire under constant tension even when the tree swayed, yet preventing excessive strain. However, the rope had become snarled in the pulley and during the windstorm yesterday, the tree had swayed enough to snap the wire. We looked for another anchorage for the aerial and selected the garage. I got the chauffeur out to help Jerry and went inside to check up.

The housekeeper told me the Capehart record-changer had been working all right since the records with the off-center spindle holes had been discarded, but that the little midget in Mrs. Caldwell's bedroom was giving trouble. We went upstairs together.

Mrs. Caldwell was still in bed, just finishing her breakfast. Her hair is white, though she must be still in her thirties. Her black eyebrows, dark eyes and pale, but not sickly, complexion make her appearance particularly striking. She is always cordial without ever becoming familiar.

"Nice of you to come over so quickly," she smiled. "This little radio has been working *so* well until last night. And then, *right* in the midst of Jack Benny's program, it made such a *terrific* noise that I had to shut it off. And now it plays so *beautifully*. It's like a toothache—when you go to the dentist . . . "

"The pain stops," I said, finishing it for her.

"Yes," she said. "Now, the radio . . ."

"Were there any other radios operating in the house at the same time last night?" I enquired.

"My daughter's—yes. But it was very quiet. We didn't try the big set downstairs because the aerial was broken and we could hear the wire hitting against the house during the storm. Could *that* have been it?"

"Probably not," I told her. Both midget sets upstairs used indoor aerials. I took off the back of the set, a Fada ac-dc midget, and tapped the tubes. No microphonics. Checked the outlet and found the plug fitted tightly. Twisted the power cord during operation. Everything checked okay. I stopped to think for a moment. There were no electrical appliances on the second floor and anything in operation on the floor below would probably have affected both upstairs receivers. If the noise was bad, the source of the trouble must have been very close. The set was on a little table by the bed; in all probability she must have been in bed while listening. Yet the Benny program came on at seven.

*(Turn to page 27)*

*HORACE —*

# Shop Notes

### FARNSWORTH AK-58, AK-59

*Changes*

The 6H6 second detector has been replaced by a 6J5GT in chassis stamped 3.

Chassis stamped 2 employ the revised phonograph input circuit shown in Fig. 1-A.

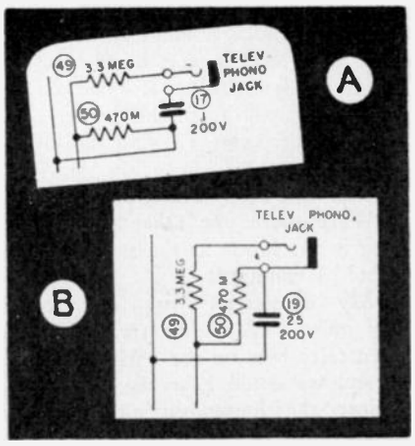



*Fig. 1. Circuit changes, Farnsworth AK-58, AK-59.*

The phonograph input circuit shown in Fig. 1-B applies to the combination models AK-58 and AK-59 only.

◆

### FARNSWORTH BC-72, 80, 81, 92, 101, 102 and BK-86

*Improvement*

A jumper has been added from the loop shield to one wafer of the bandswitch. It has been found that by using the loop shield in conjunction with the loop winding a marked improvement in short-wave performance is secured.

*Change*

Second detector changed from 6H6 to 6J5GT.

◆

### GENERAL ELECTRIC HJ-514 AC-DC

*Alignment Precaution*

If the signal generator is a.c.-operated, use an isolating transformer between the power supply and the receiver power input. The use of an isolating condenser is not recommended as a.c. through the condenser will introduce hum modulation and may also burn out the signal generator attenuator.

◆

### HUDSON AUTO SA-40, DB-40

*Low Sensitivity*

In cases of low sensitivity not traceable to weak tubes or defective parts, check the setting of the antenna trimmer. If the set has been aligned using any dummy antenna other than the 80-mmfd. condenser recommended, the setting of this condenser will be off considerably.

In all cases, the trimmer should be adjusted to the regular car aerial. Install the set in the automobile and connect it to its antenna. Do not mount the control unit, but place it in some accessible place. Tune in a weak station, near 1400 kc, remove the plug button covering the antenna trimmer from the case, and adjust this trimmer for maximum volume.

Another possible cause of low sensitivity is mis-alignment of the i-f transformers caused by the upper and lower units being aligned at different times, since one i-f trimmer is on the control unit and the balance are in the lower unit. To correct this, realign both units of the receiver.

*Hum*

A possible source of hum difficult to trace, is caused when the lower end of the volume control accidentally becomes grounded in the control unit, in addition to the ground which is made in the lower radio unit. Removing the accidental ground in the control head will clear up this difficulty.

■

### MOTOROLA AC-DC RECEIVERS

*Alignment Precaution*

When aligning Motorola ac-dc receivers, it is advisable to use a blocking condenser in series with the ground connection to the signal generator. If the signal generator is ac-operated, it may not be possible to connect to the modulator grid for i-f alignment because of hum. If this is so, in the case of the Motorola sets for 1940, feed the 455-kc signal into the antenna lead, advancing signal generator attenuator accordingly. In the loop models, connect to the coupling turn in the loop.

■

### RCA VICTROLA MODEL U-9 (Chassis RC-482B)

*Phonograph Mechanism*

The phonograph motor is self-starting and operates the turntable through friction drive between the motor spindle and the rubber tire on the underside of the turntable.

The rubber driving tire on the turntable should never be removed since it is ground in to be concentric with the spindle. If replacement is required, the entire turntable should be replaced.

The speed regulator raises and lowers the motor. This changes the driving ratio between the motor and the turntable due to the motor spindle being conical in shape. It is important to adjust this regulator for a turntable speed of 78 r.p.m. while playing a 10-inch record with the needle approximately one inch from the outer edge of the record.

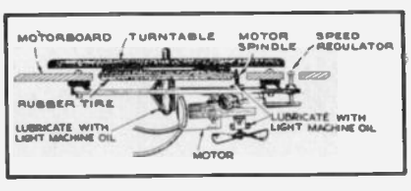



*Fig. 2. RCA Victrola Model U-9 motor-turntable assembly.*

Lubrication.—The motor should be lubricated as follows: Place a few drops of S.A.E. 20 (or equivalent) on the turntable spindle and saturate the oil retaining felt pads on the motor shaft with S.A.E. 10 oil. This oiling process should be repeated once or twice a year. Caution.—The motor drive spindle and rubber driving tire on the turntable must be kept clean and entirely free from oil and grease at all times.

◆

### RCA TUBES 12K8 AND 12SR7

The 12K8 metal type triode-hexode converter is similar to the 6K8 except for heater rating. The heater of the 12K8 requires 12.6 volts and 0.15 ampere.

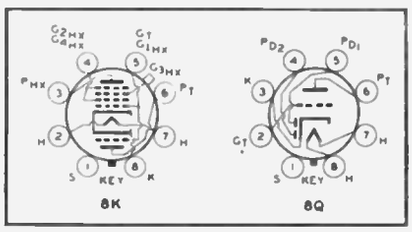



*Fig. 3. Socket connections for 12K8 (left) and 12SR7 (right).*

The 12SR7 metal type duplex-diode triode is similar to the 6R7 but utilizes a single-ended construction with the grid lead brought out through the base. Heater requirements are 12.6 volts and 0.15 ampere.

Bottom view of socket connections for both tubes are shown.

◆

### RCA VICTOR T63 and U-45 (Chassis RC-472F and RC-486-C

*Calibration Scale*

In these models the tuning dial is fastened in the cabinet and cannot be used for reference during alignment; therefore a calibration scale is attached to the tuning drum. The setting of the gang condenser is read on this scale, which is calibrated in degrees. The correct settings of the gang in degrees, for each alignment frequency are as follows:

Model T63—15 mc in C band at 132°; 600 kc in A band at 23.5°; 1500 kc in A band at 156.5° in the order of alignment procedure. Improvise a pointer by fastening a piece of wire to the chassis and bending it so that it points to 0° when the gang condenser plates are fully meshed.

Model U-45—15.2 mc in C band at 47°; 3.44 mc in B band at 57°; 600 kc in A band at 200°; 1500 kc in A band at 22°. Set improvised pointer at 240° with condenser plates fully meshed.

## RCA VICTOR GOVERNOR PHONO. MOTORS

**(Used in Models U-125, U-126, U-130, U-132, U-134, U-103, U-105, U-124, R-98, etc.)**

*Lubrication and Adjustment*

To assure normal and satisfactory operation, every motor requiring service should be lubricated and adjusted as follows:—

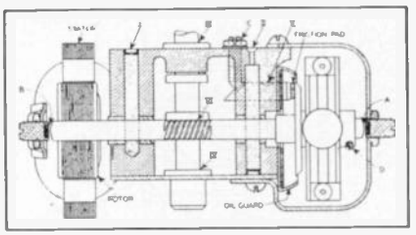



***Fig. 4. Details, RCA Victor governor-controlled phonograph motor.***

Remove motor end brackets, bottom cover containing lower spindle bearing, and governor. Slide vertical spindle downward, remove C-washer; then push upward to disengage worm gear. Slide rotor and shaft from motor.

Clean rotor bearings and rotor shaft thoroughly with "Carbona" or "benzine." Flush oil reservoirs I and II with the same solvent, preferably after removing oil wicks.

Remove governor felt friction pad V. Replace this pad with revised type Stock No. 34058, being certain to saturate thoroughly with oil.

Put slight amount of oil in each rotor bearing, and reinsert rotor shaft. See that shaft revolves freely when in position.

Oil bearing IV, grease gear VI, and reinstall bottom cover; checking to assure that vertical spindle revolves freely and worm is properly meshed after cover is in place and screws tightened. Do not misplace small disc of bottom thrust bearing.

Inspect governor to see that springs move freely under retaining washers, and that governor is otherwise in good condition. Install on rotor shaft, checking for possible bind of sleeve on the shaft.

Replace end brackets containing thrust screws "A" and "B".

Adjust thrust screw "A" so that *one* steel lamination of rotor shows beyond the stator laminations as illustrated. This positions rotor at the electrical center of the stator, for maximum torque.

Adjust thrust screw "B" to provide 1/16 inch clearance from end to rotor shaft.

Fill both wells I and II with oil. At least 30-50 drops are required. Also oil bearing III.

Position governor so that when it is fully contracted (closed), the friction disc is aligned with outer edge of oil guard. Tighten set screw "D".

Connect motor to source of power, and adjust screw "C" to give 78 r.p.m. After allowing motor to run a short time, to compress felt pad, it may be necessary to recheck position of governor to give sufficient range of speed adjustment.

Test motor, after allowing it to reach operating temperature, by grasping spindle and noting relative amount of force required to cause governor to contract. Also stall motor, and release, to see that governor has "snappy" response.

*Special Notes*

Do not interchange parts of different motors, especially bearings, shafts, or gears.

Where a new rotor or turntable spindle is installed, allow motor to run-in for eight hours; preferably under load.

The motor should not be tested or used at temperatures below 65 degrees Fahrenheit.

Where thrust bearing screw "A" is badly worn or does not have a fibre insert, replace with RCA Stock No. 31616.

Governor motors should be thoroughly lubricated after approximately 300-500 hours of operation. This is equivalent to 1-2 years usage in the average home.

*Lubricant Specifications*

Only *mineral* base oils and greases should be used.

For points requiring oil, use a type having a high viscosity index (with a viscosity rating of SAE 20-30), such as "Esso Motor Oil, Uniflo No. 3."

For points requiring grease, a light gear grease having good clinging properties, such as "Cities Service No. 7035-A1" or "Koolmotor Universal Trojan No. 1," should be used.

*Governor Waver—Causes*

Drifting of motor speed at a slow rate, or erratic shift to other than normal speed, is generally caused by (1) binding of rotor or spindle bearings due to lack of lubrication, (2) scored shafts or bearings, (3) binding due to tight adjustment of thrust bearing "B," (4) binding of turntable spindle bearing on motor board (where used), (5) improper centering of motor with respect to turntable spindle.

*Governor Chatter—Causes*

When the governor rattles or flutters rapidly, accompanied by excessive mechanical noise, the likely source of trouble is (1) glazed felt friction pad due to lack of lubrication, (2) rotor not centrally positioned in stator, (3) thrust bearing "A" worn, (4) mis-aligned or rough governor disc.

◆

## SPARTON MODEL 590-1

*Circuit Change*

Early production sets of the Model 590-1 employed the same circuit as the present runs except that a different filter and voltage-reducing network was used.

The original circuit is shown in Fig. 6 and the revised circuit is shown in Fig. 7.

This circuit revision should be incorporated in any original Model 590-1 sets, as it will safeguard the life of the 1.4 volt tubes in case the change-over (transfer) switch is raised while the set is being operated on a.c., or in case tubes are changed while the set is being operated on a.c.

The only extra part required is a small resistor, R14 (2000 ohms, .25 watt, Part No. C-2795-67B).

◆

## STEWART-WARNER 01-81, 08-81, 010-81

*Hum*

In some of the first sets produced, the 6F6G grid resistor (23) was 470,000 ohms.

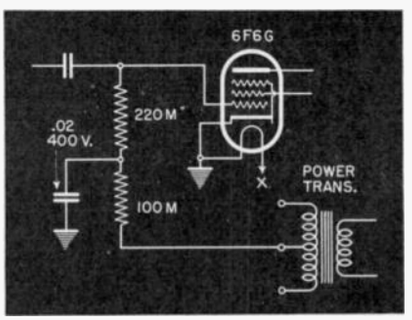



***Fig. 5. Circuit rearrangement for reducing hum in Stewart-Warner 01-81, etc.***

The hum level in these sets can be reduced by replacing resistor 23 with one of 220,000 ohms and the addition of a 100,000-ohm resistor and .02 mfd., 400-v. condenser, connected as shown.

◆

## STEWART-WARNER 02-42

*Oscillation*

If this set is turned on without an antenna, some oscillation may be noticed near the low frequency end of the dial. This condition is not serious since the oscillation ceases when an antenna and ground are connected. Should the condition persist when both antenna and ground are connected, the i-f and r-f, alignment should be checked.

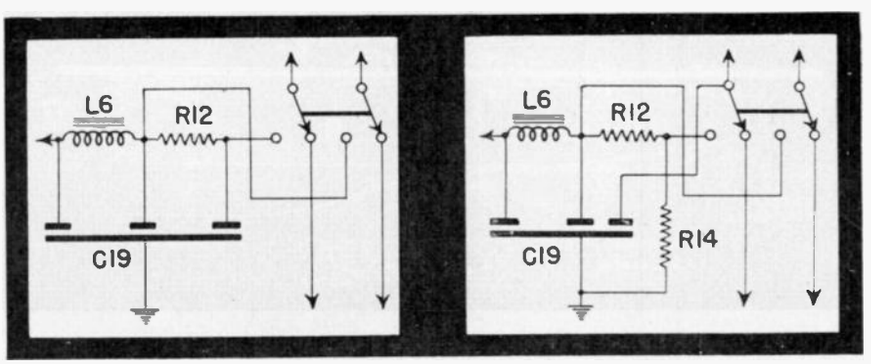



***Fig. 6. Original Sparton circuit. Fig. 7. Circuit change.***

# WILCOX-GAY RECORDIO

UP and coming is practical home recording as a receiver auxiliary, with Wilcox-Gay's A-70 Recordio setting the pace. Reasons—surprisingly good cuttings from mike or air on inexpensive blanks; no operating complexities.

Following data is good reading for those who have skipped the elements of recording; important where an A-70, or an A-72 recording and playback unit, comes up for service.

Both units are neatly engineered, the crystal cutting head, the crystal mike and the crystal pickup being properly compensated in respect to each other so as to provide optimum frequency response in recording and playback. As an incidental note, this matching of individual response of cutter, mike and pickup is of such a nature that records cut on an A-70 or an A-72 will not have so good a quality if played back on another machine.

The schematic diagram and alignment data on the A-70 are shown on the opposite page. A four-button selector switch offers radio, p.a., mike recording and off-the-air recording. A study of the switching sequences given below the schematic will indicate that during off-the-air recording, the loudspeaker is operated as a monitor at reduced output, but is silenced during mike recording. In the radio and p.a. switch positions, the cutter is not energized.

### *CRYSTAL CHARACTERISTICS*

Crystal devices such as used with Recordio function with greatest efficiency when operated at normal room temperature.

If operation of these units is attempted while cold, the low audio frequencies will be noticeably predominant and a slight loss of volume will be noticed. Also in playing records, either commercial or home recordings, a pronounced rumble may accompany the reproduction. This is due to the "stiffness" of the crystal unit and its mounting within its cartridge while cold.

Extremely low temperatures have no effect upon the crystal units other than noted above.

Extremely high temperatures, however, do have a detrimental effect upon the crystals. The crystal units should never be subjected to temperatures greater than 120 degrees Fahrenheit. The crystals begin to soften at 125 degrees, and will be permanently damaged under these conditions.

The crystal devices used with Recordio are mounted within substantially built containers, but nevertheless are sensitive to severe shock. If the recording or playback arm were permitted to drop onto the turntable, quite likely the unit would be damaged, perhaps not to the extent that the crystal would be fractured, but no doubt the stylus or needle mounting would be damaged.

Components in the magic eye (6U5) circuit have been chosen to permit the eye to close just before the recorded volume becomes great enough to cause overcutting into adjacent grooves on the record. For this reason the volume control should be adjusted so that the eye just closes when recording.

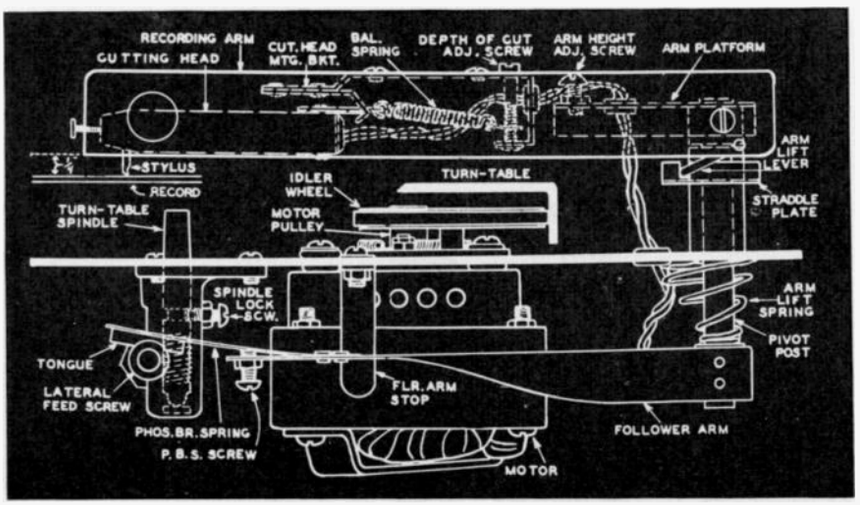



*Fig. 1. Mechanical details of Recordio motor-turntable, cutting head and drive mechanism.*

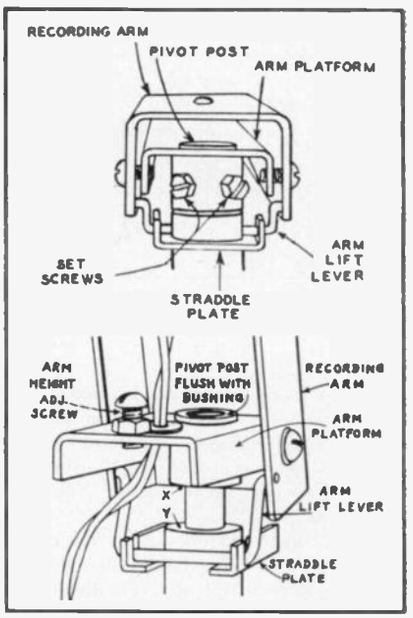



*Fig. 2. Mechanical details of recording-arm anchorage.*

### *DEPTH OF CUT*

The depth of cut may be observed by holding the record in such a position that a light is reflected from the grooves. If the depth of cut is correct, the grooves will appear to be about as wide as the spaces between them.

The correct depth of cut will produce a thread cut from the record surface that is firm, although neither coarse and stiff, nor light and fluffy.

Provided a new cutting stylus, or one known to be in perfect condition, is being used, the correct depth of cut may be gauged by permitting the cuttings to remain upon the record until completed, then rolling the cuttings into a hard ball. The size of the ball thus obtained should be approximately ⅜-inch in diameter, for the 6½-inch record.

With proper care, the cutting stylus will cut dozens of records satisfactorily, before being dulled so that replacement is necessary.

Many times it may be apparent from casual observation, that because an incorrect cut is being made, an adjustment is in order to bring about correct depth of cut, whereas the trouble may be due to the cutting stylus having become dulled, either accidentally or through natural wear.

It is well to first try a new cutting stylus before making any adjustments, to preclude the necessity for a complete readjustment. Adjustments made with a dulled cutting stylus being used, will have

very little effect upon the depth of cut.

The point and cutting edges of the stylus are *razor sharp,* and it is obvious that if the cutting stylus should bump or scrape against the turntable or other metal object, it would be dulled and rendered useless.

During periods of inoperation, the recording arm should always be returned to its normal horizontal position to the right of the turntable.

The cutting stylus should never be permitted to rest on the turntable. Its point is infinitesimally small, and compared to its normal pressure of approximately 1¾ ounces against the record surface (equivalent to several hundred pounds per square inch) it can readily be realized that if this stylus pressure were exerted against a metal surface, its razor sharp point would be crushed or flattened. A magnifying glass is usually required to observe the damaged condition of the stylus point.

### *DEPTH OF CUT ADJUSTMENT*

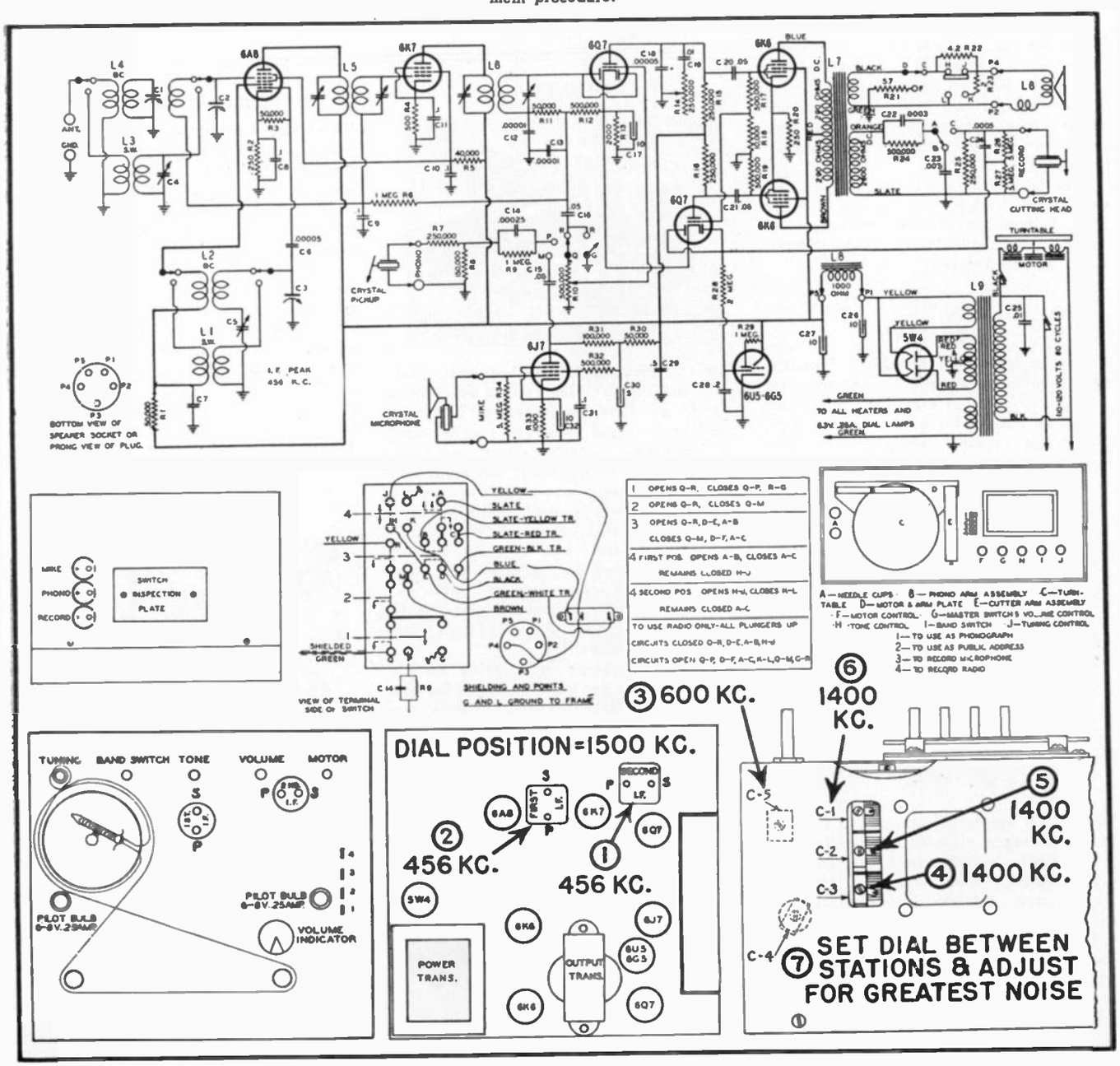
The depth of cut is regulated by an adjustment of the flathead screw on the top of the recording arm, as shown in Fig. 1. Turning the screw to the right (clockwise) increases the depth of cut. Turning the screw to the left (counterclockwise) decreases the depth of cut.

An examination of the recording arm assembly will show the function of the coil spring attached to the cutting head is to oppose the weight or pressure of the cutting stylus against the record surface, so as to allow cutting a groove of definite depth. For example, it will be seen that turning the screw to the right changes the angle on which the spring acts, so that the groove depth is increased. Turning the screw to the left changes the angle on which the spring acts, so that the groove depth is decreased. It will be seen that the actual spring tension remains very nearly the same and the angle of the axis on which it operates is changed to bring about the possibility of adjusting the depth of cut.

In some of the early Recordio models the adjusting screw was threaded throughout its full length, although only the lower portion of the screw over a span of approximately ⅜-inch contributes to the useful range of adjustment. If the adjusting screw is turned in a clockwise direction so as to raise the spring holding lug to the upper threaded portion of the screw, the adjustment will have passed through a

*(Turn to page 34)*

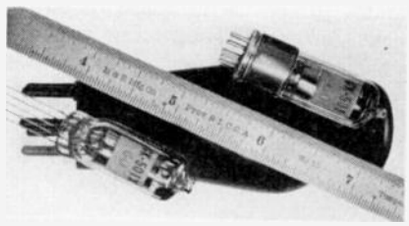
***Recordio A-70 schematic, switching connections, chassis layouts and alignment data. Numbers in circles indicate order of alignment procedure.***



# Presenting — NEW PRODUCTS

### RAYTHEON

***Hearing Aid Tubes***—Four tiny filament pentodes are available for use in wearable hearing aids; one a voltage amplifier, the other three output tubes. Available either in based or tinned lead construction.



The filament drain of 33 ma at 1.25 volts is low enough to make standard flashlight cells economical sources of power.

The amplifier tube is of low microphonic design. Although bias improves operation, the tubes will all operate at low distortion at zero bias.

The tinned lead tubes are only 1½" long and ½" in diameter. The based tubes are 1¾" long and 9/16 in" diameter. By Raytheon Production Corp., Newton, Mass. RADIO SERVICE-DEALER.

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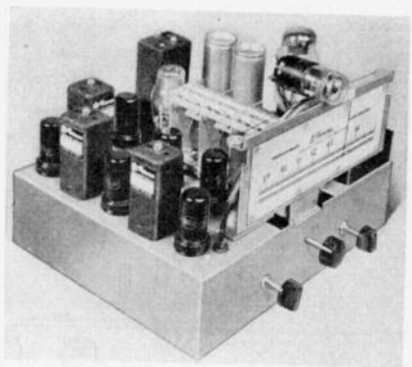
### MEISSNER

***Frequency Modulation Receptor*** — Complete, factory-built, 10-tube job for use with any receiver or external amplifier. Space provided on chassis for assembling of high-fidelity a-f amplifier where desired. Console cabinets available.



Receptor employs high-gain s-f stage, three i-f stages, air-trimmed discriminator transformer, dual-shadow tuning indicator with amplifier, voltage-regulated oscillator supply and ceramic insulation in h-f circuits.

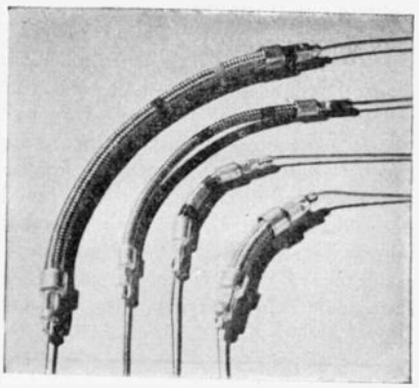
Limiter action commences with a signal input of 10 microvolts. A high-frequency equalizing network provides flat over-all response of audio frequencies. By Meissner Mfg. Co., Mt. Carmel, Ill.—RADIO SERVICE-DEALER.

### CLAROSTAT

***Fibre-Glass Resistors***—Glasohm power resistors and heating elements are now available to the radio trade generally, for the use of servicemen and others.

Wattage ratings are stepped up several hundred per cent through the use of fibre-glass cores and braided coverings.

Glasohms are available in two sizes: 1/16" dia. cores, 1 watt per body inch; and ⅛" dia. core, 2 watts per inch. Self-supporting. Metal ferrule ends with bare wire leads. Color-coded. In all popular resistance values. By Clarostat Mfg. Co., Inc., Brooklyn, N. Y. RADIO SERVICE-DEALER.



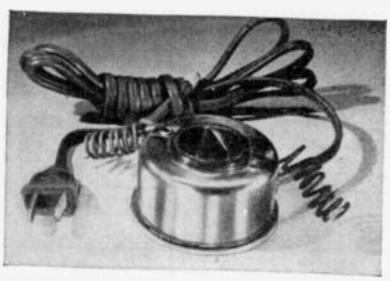
### AMPLIFIER CO.

***Direct-Coupled Amplifier***—A 30-watt push-pull amplifier available with any one or all of the following features: Non-overloading push-pull expander, non-frequency discriminating scratch suppressor, combined expander-suppressor, automatic volume compressor, remote volume control, automatic volume control, audio spectrum control, calibrated volume indicator, high-frequency control, low-frequency control, low-gain inverter, high-gain inverter, low-gain push-pull input, high-gain push-pull input, automatic volume limiter, single photocell input, dual photocell input, push-pull photocell input.

Provides packaged engineering for the consumer, who can select suitable features with the amplifier for his particular requirements. By Amplifier Co. of America, New York, N. Y. RADIO SERVICE-DEALER.

### TECHNICAL APPLIANCE

***Power Line Antenna*** —Utilizes the electric wiring of the building and the power lines beyond. This does away with radio dead spots, where loop sets cannot give satisfactory results, without sacrificing the portable feature of the small set. This antenna substitute is especially desirable in apartment houses where outside aerials are often prohibited. The Power Antenna is non-directional. It is small enough to mount inside the set cabinet. A red wire connects with antenna terminal of set, and a black wire connects with ground terminal or directly to chassis. Set line cord plugs into receptacle of Power Antenna, while plug of latter goes to usual electric outlet. By Technical Appliance Corp., New York, N. Y. RADIO SERVICE-DEALER.



### ELECTRICAL INDUSTRIES

***Leach Recorder***—The Leach Model CA-12 Recorder with 12-inch turntable is a compact, portable unit, complete with microphone, amplifier, recording level meter, cutting head, pickup, tubes and speaker. Simple to operate.

Also available less cutting head for playback only. By Electrical Industries Mfg. Co., Inc., Red Bank, N. J. RADIO SERVICE-DEALER.

## THEY NEED NEEDLES

*(From page 6)*

But the "soft playing" non-metallic and thin steel needles start cutting off in the vicinity of 3000 or 4000 cycles in the first case and around 5000 cycles in the second case, and hence serve to attenuate surface noise (at the expense of full-range reproduction). On the other hand, the "loud playing" metallic needles may be substantially flat out to or beyond 6000 cycles; hence the surface noise is greater.

### *RECORD AND NEEDLE WEAR*

Only .002" of the needle point comes in contact with the record groove. But the tip radius is so small that, even with modern pickups where the needle pressure is no greater than 2 to 3 ounces, the weight of the needle point on the record groove is equal to 9 to 10 tons per square inch. During the playing of a 12-inch record, the needle travels approximately 740 feet.

With such friction, something is bound to wear. But standard records are tougher than one would imagine. For one thing, the surface material has a degree of resiliency which prevents chipping or ruptures under normal conditions. Secondly, the material is itself abrasive and will quickly wear off burrs on the needle point, and at the same time shape the point to the groove. If, then, the needle is soft as compared to the record material, the needle will wear instead of the spiral groove.

Be that as it may, unless the needle material is particularly soft, as it is in the non-metallic group, it is not the hardness of a needle that causes record wear, but roughness. If the point is smooth, friction is greatly reduced, and the point may be as hard as a diamond without increasing wear. But, if the needle point is hard *and* rough, the record will take the wear instead of the needle.

### *TYPES OF NEEDLES*

The soft metallic and non-metallic needles cause little record wear, but are good for only a few playings, depending upon the type. The best of these are the shadowgraphed steel needles, such as the Actone, which are individually polished and inspected, but may be used but once. All of the soft needles lose their points rapidly and thereafter cannot follow the high-frequency groove modulations. Hence, the high-frequency response is progressively reduced as the point of the needle gets duller. Some of the non-metallic needles are particularly bad on this score, but others stand up surprisingly well, due in large part to the resiliency of the material, and can

*(Turn to page 27)*

# Presenting—



### SPRAGUE PRODUCTS

***High-Voltage Electrolytics***—Types AP, AD and RC, in round and square can, and square cardboard, are dry electrolytics connected in series, with working voltages of 600 and 800, for theatre and p-a applications.

***Tel-Ohmike*** –Compact condenser and resistor analyzer which servicemen can use with their own milliammeters and voltmeters. Permits capacity measurements from .000010 mfd to 2000 mfd; insulation resistance up to 10,000 megohms; resistance measurements from .5 ohm to 5 megohms; power factor and leakage current of electrolytics. Has direct-reading scales. By Sprague Products Co., North Adams, Mass. RADIO SERVICE-DEALER.

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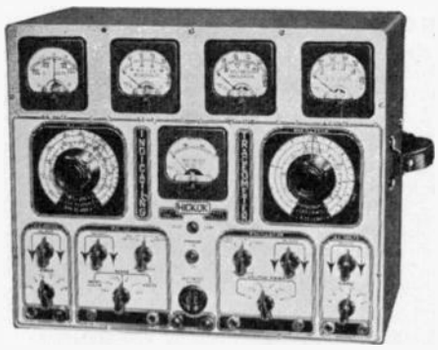
### HICKOK

***Model 155 Traceometer***—Permits measuring and tracing the signal simultaneously in any five circuits without affecting set performance. Measurements that can be made



are: Signal in microvolts at any point in r.f.-i.f. section; oscillator voltage throughout entire range; d-c voltages, avc, afc, power supply; a.f. or a.c. voltage in any circuit; a-c watts to 300.

Meters have ample ranges for all purposes. Vacuum-tube voltmeter circuits arranged to prevent accidental overload from damaging meters. Has self-contained voltage regulation for v-t voltmeter. By Hickok Electrical Instrument Co., Cleveland, Ohio. RADIO SERVICE-DEALER.

### ATR

***Replacement Vibrators***—The new line of ATR Replacement Vibrators for auto and farm radios has been announced by the American Television & Radio Co., St. Paul, Minn.

These Vibrators have large oversized 3/16" diameter tungsten contacts having full wiping action, perforated reed of Swedish spring steel, magnetic circuit with formed base, mica and metal stack spacers with two-bolt construction, flexible leads with tinned clamp, supports, manufacturing tolerance on practically all parts within .0005". RADIO SERVICE-DEALER.


### RADIO CITY PRODUCTS

***Dynoptimum Tube Tester***—The model 308 Series D Tube Tester just announced by Radio City Products Co., New York City, incorporates a 9-inch meter.

Provision is made for testing all tubes including the new miniature types. In addition there are spare large and miniature sockets to take care of new tube types as they make their appearance. Pilot lamps, headlights, miniature bulbs and all ballast tubes are also provided for with all heater and filament voltages up to the full line voltage.

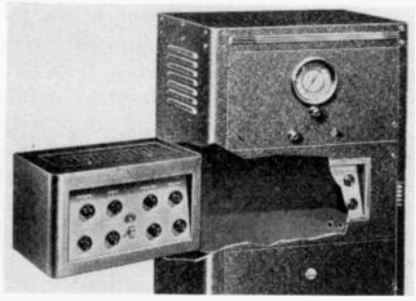
Rotary selector switches provide not only for general "quality" tests but also for testing individual sections of multi-purpose tubes and rectifiers, testing individual elements for shorts and leakage, tests for noise and hum. Tests are made under RMA specified loads, selected by a rotary switch.

Smooth line voltage control is provided over the range of 103 to 135 volts with direct meter indication. The line is double fused with fuses instantly renewable and a jeweled pilot lamp indicates when the tester is on. Accompanying charts are celluloid covered for protection.

This tester is available in counter and combination counter and portable models. The former is 11" x 18½" x 7½" while the combination model is 13" x 18½" x 9" and weighs 15 pounds. RADIO SERVICE-DEALER.

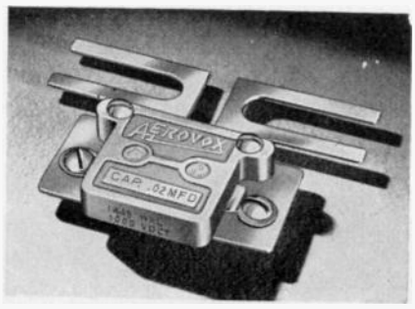
### MONTGOMERY WARD

***Professional Public Address***—Amplifier designed around a standardized Preamplifier and mixer unit. Preamplifier has four individual mike channels and two phono inputs. Also separate booster bass and treble controls. One master phono volume control is used for the two phono inputs and a second master control with provisions for remote operation is used to adjust the overall volume of all channels.



When more than 100 watts is wanted, extra 100 watt chassis are connected to the Preamplifier. Provisions are made for using up to five 100 watt chassis, giving a total power output of 500 watts.

Equipment by Montgomery Ward, Chicago, Ill. RADIO SERVICE-DEALER.




### AEROVOX

***Meter-Shunting Mica Condensers***—Bakelite-molded mica condensers provided with handy meter-mounting brackets, for the purpose of radio-frequency shunting of meter windings, are announced by Aerovox Corporation, New Bedford, Mass. The heavy 3/16" thick brass brackets are mounted and connected to the popular series 1445-57 mica condensers. Long slots in the brackets permit attachment to the terminals of any of the standard panel-mounting meters. RADIO SERVICE-DEALER.

*(From page 25)*

be used for as many as eight playings before they require resharpening.

In the "semi-permanent" group are a few of the thorn needles just mentioned; the non-shouldering needles such as the Recoton, Musicraft Velva-Point and RCA Victor Red Seal, all of which are good for approximately ten playings each; the harder needles such as the Columbia and RCA Victor chromiums, good for about 25 record sides; and some of the tungsten points.

In the long-playing group are the sapphires, such as the bent shank Walco and Musicraft, which are good for 2000 playings or more before appreciable wear takes place; the RCA Victor Long Life, and the Permo Point Fidelitone and Transcrip-Tone, good for approximately 1000 playings.

The sapphire needles have the desirable hardness and smoothness, but a sapphire is brittle; hence the needles must be handled with some degree of care. It is questionable if they are satisfactory for use with heavy pickups of early make, although the bent shanks offer a degree of protection to the sapphire point.

The Permo Point needles have alloy tips made from the platinum group of metals, such as Ruthenium, Osmium and Rhodium. The metal is not so much hard as it is wear-resisting, and has a smooth surface. Needles of this type require a bit of breaking-in, but are quiet and long-wearing after the first few playings.

The long-playing needles are particularly adaptable to automatic record-changer reproducers. Special needles with sturdier point construction, such as the RCA Victor Red Seal and Recoton Automatic, are available for mechanisms with a tendency to slap the needle into the groove.

***NEEDLE ADAPTATION***

In some standard recordings the higher frequencies, in the vicinity of 5000 cycles, are emphasized for the two-fold purpose of reducing apparent surface noise and getting through tone brilliance by brute force. All modern recordings on the whole have a lower level of surface noise than earlier discs. The volume level is also higher.

By virtue of these improvements, the theoretical deficiencies of non-metallic and thin steel needles are not always apparent in practice. As a matter of fact, they often provide the most pleasing reproduction with the least amount of surface noise. For this reason they should not be ignored.

On the other hand, the rigid needles with a much wider transmission range often serve to compensate for marked deficiencies in the frequency response of the record-reproducing equipment . . . to say nothing of possible aural deficiencies in the Platter Bug.

The serviceman will do well to carry in his kit, along with spare tubes, a wide variety of needles to meet all possible conditions, including the normal position of the tone control!

## SERVICEMAN'S DIARY

*(From page 19)*

"How did it happen," I asked, "that you went to bed so early last night?"

"I *beg* your pardon!" she snapped.

"Please don't misunderstand," I said. "I thought you might have had occasion to use an electric hot-water heater, a heating pad or something during the program, and Benny goes on at seven. If so, I wanted to test it."

"Oh," she said, and reached under the covers. "I *did* use this last night." It was an electric heating pad.

I plugged in the pad and waited until it heated. No noise. Then as I shook it, a gratifying sputter burst from the radio. Noise was never so welcome.

"Well, of *all* things!" She was smiling again. "I feel almost foolish!"

"I *did* feel foolish," I said, and we both laughed.

Just a few sincere words, nicely spoken, yet they mean so much to a fellow who has to tackle all kinds of jobs for all kinds of people.

# Reporting— THE MONTH'S NEWS

FROM PITTSBURGH was received a letter asking the Federal Communications Commission to bar all "Confucius Say" jokes from the air.

A Shickshinny, Pa., woman charges that a certain station broadcast two musical compositions similar to those composed by herself.

So, there are headaches in Washington, too.

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### RCA LAUNCHES NEW PLAN

The RCA Manufacturing Company is embarking upon a broad program designed to develop still further the activities and services of parts jobbers, which L. W. Teegarden, Manager of the Radio Tube and Equipment Division, termed the fastest growing channel of distribution in the radio industry.

The plan centers around a newly-appointed group of territorial representatives who will assist RCA Parts Distributors in developing the rapidly expanding scope of their business. The eight members of the group have long been identified with the merchandising of RCA products, and are conversant with market conditions throughout the country. They will work out of the District Sales Offices.

"We believe that the advice and help of the new territorial representatives will be of great value in further developing this part of the radio industry," Mr. Teegarden said. "Meanwhile, RCA will carry on its extensive program of service meetings conducted by John F. Rider, test equipment demonstrations under the supervision of William H. Bohlke, the publication of the popular "RCA Service News" and "Ham Tips from RCA," the development of sales promotional plans, and the many other 'helps' which enable the Distributor to expand his business."

The new territorial representatives are spending a week at RCA's Camden headquarters to confer with department heads in preparation for intensive promotion of the new program. Henry C. Bonfig, Commercial Vice President; Fred D. Wilson, Manager of Field Sales Activities; D. J. Finn, Advertising Manager, and Mr. Teegarden are among the officials conferring with the visitors. Tours of the Camden and Harrison, N. J., plants of the RCA Manufacturing Company, are also included.

The territorial representatives are C. V. Bradford, Boston; W. H. Allen and W. H. Autenreith, New York; W. P. Laws, Atlanta, D. M. Branigan, Chicago; F. J. Gallagher, Kansas City; Fred Dobbs, Dallas, and A. C. Nash, San Francisco.

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### RSA NEWS

RSA announces there are now thirty-five chapters of the organization throughout the country who have qualified under the Guarantee Service Plan and have further made cooperative arrangements with local broadcasters. This represents the first definite step to raise the level of radio servicing that has ever been attempted on a national basis.

The results from the experimental setups of the RSA under this plan have been so gratifying that the entire membership of the RSA will be included in this plan as rapidly as conditions permit.

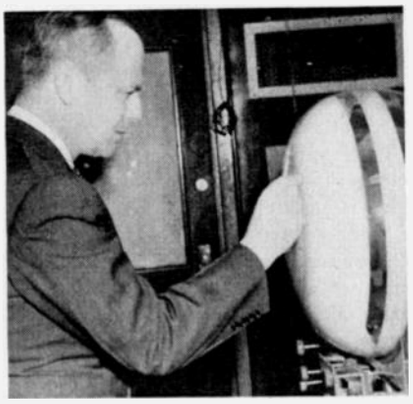
The RSA announces the application for the formation of another chapter of the RSA in Milwaukee, Wisconsin.

Executive Secretary, Joe Marty, Jr., has just returned from a 7,000-mile trip around the chapter territories of the RSA in the middlewest and throughout the New England and Atlantic Coast states. He reports servicemen members of the RSA enthusiastic over the possibilities for increased business during 1940, through the cooperation of the NAB and the RSA.

*RCA territorial representatives in conference with RCA executives at Camden. Left to right: E. C. Hughes, Fred Dobbs, F. J. Gallagher, W. P. Laws, A. C. Nash, D. J. Finn, L. W. Teegarden, W. H. Allen, A. L. Saltzman, C. V. Bradford, W. H. Autenreith, John Allen, and D. M. Branigan.*

### INSPECTS TELEVISION SYSTEM

Previously demonstrated a couple of months ago to other members of the Federal Communications Commission, the Du Mont flexible system of television has been inspected by Commissioner T. A. M. Craven, at the Allen B. Du Mont Laboratories in Passaic, N. J.



*FCC Commissioner T. A. M. Craven inspecting Du Mont 20-inch teletron during his recent visit to the plant.*

The latest Du Mont demonstration included comparisons between the present R.M.A. standard 441-line 30-pictures-per-second images, and the Du Mont 625-line 15-pictures-per-second images using the exclusive Du Mont "memory" type screen for eliminating flicker. The Commissioner was shown both stills and movies via the two systems, reproduced by several different kinds of cathode-ray screen materials.

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### RETURN REPLACED PARTS

"There's a lot of good business psychology in returning all replaced parts to set-owners," states Vic Mucher, who heads Clarostat sales and knows more than a thing or two about the service business.

"Successful auto repairmen are doing just that, and since these auto boys have many years on us when it comes to service psychology, we surely can't go wrong following in their footsteps.

"Remember, your public is always suspicious of service bills. So if you include an item for replaced parts, there's that lurking suspicion that some fancy gypping is going on. But if you include the replaced parts when you return the set, the customer is promptly disarmed on that score and perhaps on all scores.

"Just think what this practice means to your customer. It's simply sales dynamite. The customer gets the idea you have no use for old parts and don't want them kicking around."

*(From page 27)*

I found Jerry had already finished the antenna job and was downstairs at the Capehart, checking the radio operation. Leaning over one corner of the cabinet watching him was one of the Swedish maids. They seemed to be getting along very nicely.

""I'll bet you're married," she had just said.

"Sure I am," replied Jerry. "All rights reserved, including the Scandinavian."

"Jerry!" I yelled. What'll I do with that guy, I thought.

"Don't worry, mister," the maid said. "I know he's only kidding."

Nobody misunderstands Jerry.

## FREQUENCY RECORDS

*(From page 11)*

regular service call. You will experience no difficulty in building up and holding the interest of your audience—be it better or lesser halves, or intermediaries. Play the frequency record once, and every member of the family this side of Helsinki will be at your feet—demanding to know what in thunder is that gawd-forsaken racket! But, invariably, they will hang around to watch the needle through four minutes of aural agony.

## INVERSE FEEDBACK

*(From page 9)*

Determination of the exact amount of distortion reduction due to feedback may be made by application of a formula very similar to that for gain reduction:

$$D = \frac{d}{1 + Bd}$$

Where:
*d* is the original distortion before feedback is introduced.
*D* is the distortion after feedback.
*B* is the feedback factor as before.

Solution of this formula for various cases shows that distortion is reduced by *the same number of db as the gain reduction that accompanies it.* This situation makes clear the value of expressing various amounts of feedback in db; to predict the effect of feedback in a given case requires only the knowledge of the number of db of feedback introduced. If, for example, 10-db of feedback is to be introduced: 1) The effective gain will drop 10 db. 2) The distortion will drop 10 db. 3) In order to obtain the original overall amplification, 10-db additional gain must be added *previous* to the stages containing the feedback loop.

When the feedback is accomplished as of Fig. 2-B, the distortion and frequency response of the output transformer have little or no effect on the feedback voltage. Consequently the circuit compensates only for distortion and frequency discrimination due to the tube itself. If the feedback voltage is taken off after the output transformer, as in Fig. 3, it tends to correct for frequency and amplitude distortion due to the transformer also. From the above may be drawn the generalization that feedback can only improve the operation of that part of the circuit which is included in the feedback loop.

A further generalization can be drawn. Everything that has been said about the effects of feedback on distortion will also hold true for hum, noise, or any other component of the output (and therefore the feedback voltage) which is not present in the signal voltage. However, it is equally true that hum or tube noise from stages previous to the feedback loop will not be affected.

### *PHASE SHIFT*

From what has been said, it may seem that the advantages to be derived from the use of feedback are limited only by the amount of gain which we can afford to lose in any given case. The actual limiting factor is something quite different. During our analysis of feedback action, we assumed that when we fed back a representative (1000 cycles) frequency in such a way that it was out of phase with the input voltage, all other frequencies

would likewise be fed back out of phase. Unfortunately, this is not true.

The phase shift in all amplifiers varies to some extent from one end of the response range to the other. Obviously, if the phase shift at one end of the response range is more than 180 degrees with respect to the 1000-cycle frequency, this excessive shift will cause some of the feedback to return in phase with the input voltage and result in regeneration or oscillation. In order for the amplifier to remain stable, therefore, the total phase shift between input and output must be less than 180 degrees.

The phase-shift characteristics of conventional single-stage amplifiers varies as follows: Resistance or impedance coupling, up to 90 degrees; transformer coupling, up to 180 degrees. In practice, careful design can limit the shift to considerably less than the maximum figures given, but, in general, feedback across several stages is more practical with resistance coupling than with transformer or impedance coupling.

### *OUTPUT REGULATION*

One of the most important advantages of inverse feedback is its effect on plate resistance. It can be shown by analyses similar to those for gain and distortion that the introduction of a feedback voltage which is proportional to the output voltage tends to decrease the apparent plate resistance of an amplifier tube. The result of a relatively high or low plate resistance upon frequency response can be appreciated by an examination of Fig. 4. If the load resistance is less than three times the plate resistance of the tube, a slight change in load impedance will greatly affect the amplification. If the load resistance is many times larger than the plate resistance, wide variations in the former will have little effect on the gain.

Since all power amplifiers have an optimum value of load impedance, it is not practical to vary this factor very much. However, by reducing the apparent plate resistance of the tube (through the introduction of feedback) and leaving the load resistance at its previous value, then, no matter how the load resistance varies, it will still be many times the plate resistance, and the gain remains practically constant.

One of the most troublesome problems in p-a installations is speaker impedance matching. First of all, no dynamic speaker has a constant impedance at all frequencies. The so-called voice coil impedance is that impedance which the speaker shows at some middle frequency (400 or 1000 cycles), or else it may be an average of the impedance variation over some middle range of frequencies. The net result is that no speaker can be "matched" to an amplifier at all frequencies. Moreover, due to resonance peaks throughout the response range, the speaker impedance usually varies abruptly at several points in the range. If an amplifier has a high plate resistance, as would be the case if pentode or beam tubes were used in the output, this variation of loading will result in very irregular response. However, with feedback reducing the value of plate resistance, these variations can be made to have little or no effect on the amplification.

In addition, it often becomes necessary in the field, to mismatch a speaker load to an amplifier, because the proper impedance taps are not available. A feed-

back amplifier can tolerate this kind of impedance variation with no difficulty. It is perfectly feasible to design a feedback amplifier so that a mismatch of 2:1 in the speaker load makes no apparent difference in the performance. Any p-a operator with field experience will appreciate the convenience of such flexibility.

From the above discussion it is hoped that the reader will have gathered the fundamental concept of feedback action, and the benefits to be derived from its application. Next month, practical methods for introducing feedback into conventional circuits will be treated.





## CATHODE FOLLOWER

*(From page 7)*

the fact that the cathode is considerably above ground potential, cathode-to-heater leakage causes hum to be induced into the stage. It would seem that this hum would be balanced out by the feedback action, and a large portion of it is, but enough usually remains to be troublesome unless care is taken to select a tube with particularly low leakage.

Moreover, it is always desirable to keep the cathode-to-ground potential as low as possible. This may be accomplished by using the minimum value of cathode load resistor that delivers the required output. Since the effective plate resistance is only a few hundred ohms, this means that the load resistor may be anything from 1000 ohms up to the normal value of load resistor in an ordinary circuit for the same tube. A good compromise is to use the same value of load resistor as would ordinarily be used for obtaining bias if the tube were operated as a straight amplifier.

Care should be taken to see that excessive plate voltage is not applied to the tube because of the low value of load resistor. The voltage *at the plate* should be adjusted to the same value that would appear if the plate circuit were resistance-coupled in the usual manner.

A further precaution to be observed is to make sure that all leads in any of the remote circuits are well shielded. Even though the impedance is low, there is usually sufficient gain after the volume control to make hum pickup in these leads troublesome.

In spite of these limitations, the advantages of the cathode follower insofar as convenience, simplicity and freedom from both frequency and harmonic distortion are concerned, make it a decidedly worthwhile arrangement for use in a wide variety of audio systems.

## MEISSNER F-M SET

*(From page 17)*

the Receptor with a frequency-modulated oscillator, a satisfactory job can also be done with an accurately-calibrated signal generator covering a range in the vicinity of 2.1 mc. The object of alignment is to adjust the i-f trimmers so that the i-f system has a pass band from 2.0 to 2.2 mc, and then to adjust the discriminator transformer to cover exactly the same band.

Proceed as follows:

1. Disconnect the mixer coil, the center coil on the s-f assembly from terminal #8, control grid, of the 6SA7 tube. This is point *C* on the circuit diagram.

2. Connect the hot terminal of the signal generator to this grid, and the ground terminal to the chassis.

3. Connect a 0-50 or 0-200 microammeter in series with the ground end of the 100,000 ohm resistor *R1* which connects the black wire from the 3rd i-f coil to ground. This will measure the grid current of the 1852 limiter tube. About 30 to 100 microamperes is all that should be expected at this point. If an electronic voltmeter is available, it can be connected directly to the grid return lead (black wire) of the same transformer without disconnecting the resistor *R1*. This measures the limiter grid bias voltage. A reading of 3 to 10 volts should be considered normal.

4. Set the signal generator at 2,175 kc and align the i-f trimmers for maximum response. Then go over all trimmers and tighten (turn clock-wise) each very slowly until a barely perceptible decrease in limiter grid current or bias voltage is noted. Then adjust the signal generator to 2,025 kc. The grid current (or voltage) should be approximately the same as at 2,175 kc. If it is not, adjust the i-f trimmers for maximum response, leaving them in the loosest position which will give this response. Then repeat the previous adjustment at 2,175 kc. The output should remain nearly the same when tuning between the two frequencies, and should begin to decrease on each side of the two frequencies. The approximate i-f response curve is shown in the diagram. Either peak may be up to 20 percent higher than the other without affecting performance.

5. Remove the microammeter and reconnect the 100,000-ohm resistor *R1* as it was before.

6. Connect the microammeter in series with the ground end of the 100,000-ohm resistor, *R2,* which joins the 2-megohm resistor in the detector load circuit to ground. A high impedance electronic voltmeter can be connected between the junction of the 100,000-ohm and the 2-megohm resistor and ground. (point *B*). This measures the detector output current or voltage, as the case may be.

7. Adjust the signal generator to 2,200 kc. Adjust both trimmers on the discriminator transformer (01142) for a peak. Re-adjust the signal generator to 2,000 kc. Reverse the connections to the microammeter or electronic voltmeter or read reversed values. Again adjust the two trimmers for a peak, turning them only a small amount one way or the other. Then slowly tune the signal generator to 2,100 kc; the detector-output current or voltage should decrease. Carefully re-adjust the secondary trimmer, nearest the 6H6 tube, until the current or voltage is zero. An insulated screwdriver is essential; this is an extremely important operation. Turning the signal generator dial one way should give a positive reading and the other way a negative reading. Again set the

signal generator to 2,200 kc and adjust the primary trimmer, nearest the 1852 tube, for a peak. Repeat the previous operation of centering the zero reading on 2,100 kc as was done with the other trimmer. This completes the alignment of the i-f channel. Re-connect the 100,000-ohm load resistor *R2* to restore the circuit to its original condition. An approximate discriminator response curve is shown in the diagram. Positive and negative peaks may differ by 10 percent without affecting performance.

8. Re-connect the control grid of the 6SA7 to the mixer coil and disconnect the generator from this point (point C).

9. Connect an antenna to the Receptor and again prepare to measure the limiter grid current or voltage. (Operation 3).

10. Set the dial of the Receptor to the frequency of any f-m transmitter that is within receiving range. The oscillator trimmer is the small variable condenser, provided with a screwdriver adjustment, on the sub-chassis near the dial. This should be adjusted so that the received signal produces a current or voltage reading on the limiter grid. Then adjust the trimmers on the mixer and antenna coils for maximum reading at the limiter grid.

These trimmers should align rather loosely. If they are tightened so that the frequency of the s-f circuit equals the oscillator frequency, spurious oscillations and responses will be produced. The oscillator frequency is normally 2,100 kc *lower* than the signal frequency. When the above adjustments are completed and the 100,000-ohm limiter grid load resistor is again grounded, the Receptor has been aligned.

## THE BIG SHIFT

*(From page 14)*

them up for the re-setting job. Attempt to arrange a definite appointment for the day the shift is to take place. The local newspaper will unquestionably announce changes well in advance. Follow up by contacting the remainder of the list, with the same idea in mind.

When the time arrives, keep someone glued to the office phone and call back periodically to pick up service calls. Also let the "office" work on your list by phoning prospective customers in the section in which you are working. Or take someone with you to push bells while you're occupied.

### *RE-SET CHARGES*

Chances are that all stations in a given area subject to the reallocation procedure, will not shift frequency simultaneously. The changes may take place days, weeks or months apart.

If this turns out to be the case, it would seem logical for servicemen to establish a "per button" re-set charge,

graduated in accordance with the type of automatic tuning involved and the complexity or simplicity of re-setting a position. You should be able to determine a fair figure for each case on the basis of past work of the same nature.

***AUTO-RADIOS***

Most listeners will give first consideration to home receivers. Whether servicemen should attempt the re-setting of auto receivers while doing the home sets will depend upon circumstances. If it turns out that you're as busy as a doctor in a flu epidemic, get the home receivers done first and handle the auto jobs afterwards. On the other hand, if it turns out that you haven't too many calls to make, do both jobs at the same time and save yourself a second trip to and from the customer's home.

It's too early to forecast conditions as they may be, but it appears that the Big Shift is going to take on all the aspects of a first-class emergency. We've got to be prepared for an avalanche in any event. Fortunately, there's time enough in which to do it.

## A-70 RECORDIO

*(From page 23)*

"dead-center" position, which will cause a bobbing up-and-down movement of the cutting head.

If it is found that when using a new cutting stylus, the depth of cut is too shallow, and the adjusting screw has been turned to the full clockwise position in the later models, or to the upper limit of the useful range in the older models, this is an indication that the balance spring is too strong. Its tension may be decreased by spreading the coils of the spring with a pair of diagonal cutting pliers.

Care should be used in removing and replacing the cutting head, when occasion arises, so that the balance spring is not stretched to a length that will prevent its returning to normal length and tension.

When the cutting head is in proper adjustment, and the recording arm is raised to a position approximately 25 to 30 degrees from the vertical plane, the cutting head should float freely in its mounting, with equal up and down movement. The balance spring holding lug should be in a position on the adjusting screw approximately ¼-inch from the shelf which holds the riveted end of the screw, as shown in Fig. 1.

***HEIGHT OF RECORDING ARM***

The components of the recording arm assembly are positioned so that the cutting head is parallel, and the stylus is perpendicular to the record surface, which condition obtains *only* with the nose of the recording arm adjusted to

the correct height of ¼-inch above the record surface.

An adjustable stop (arm height adjusting screw, Figs. 1 and 2) is mounted on the arm platform to provide a means for adjusting the height of the recording arm. With a blank record on the turntable and a cutting stylus inserted in the cutting head, the arm height adjustment should be made so that the bottom of the recording arm is ¼-inch from the record surface as shown in Fig. 1.

There is little likelihood that the arm height adjusting screw will get out of adjustment due to the lock nut becoming loosened. However, there is the possibility that the recording arm may be roughly handled by the operator. If the arm were to be forced backwards after having been raised to its vertical position, or if, while being lowered to its horizontal position to the right of the turntable, the arm were dropped or forced downward, the plate on which all of the recording mechanism is mounted, may be bent or sprung slightly. This would destroy the ¼-inch height adjustment, and readjustment of the arm height adjusting screw would be necessary to bring the nose of the recording arm to exactly ¼ inch above the record surface.

Also, the straddle plate (Figs. 1 and 2) may be bent down, whih would affect the arm height adjustment. In this event, the straddle plate should be removed and straightened.

The importance of the arm height adjustment may be judged by a study of Fig. 1. Note that the balance spring serves to hold the knife-edge pivot of the cutting head mounting, fully seated in the V-shaped trunnion bearing of the cutting head mounting bracket. Also, that the pull of the spring is slightly downward, as well as horizontal.

The initial tension and length of the balance spring must be such that when adjusted to the proper tension to produce the correct depth of cut, the spring holding lug will be positioned on the adjusting screw as shown, to create a slight downward pull on the cutting head mounting.

### *FOLLOWER ARM ADJUSTMENT*

The follower arm assembly shown in Fig. 1, consists of a steel channel at one end of which is attached the pivot post, and at the other end a flat phosphor bronze spring, with a portion of the spring bent at a right angle to form the knife-edge tongue which engages the lateral feed screw.

The lateral movement of the recording arm, as related to the rotation of the turntable is such that 109 grooves per inch are cut into the record surface.

The recording arm assembly is mounted on the upper end of the pivot post, and held in correct position by means of the two hex-head set screws as illustrated in Fig. 2.

The end of the pivot post should be flush with the bushing on the top side of the arm platform (Figs. 1 and 2) and when the recording arm is lowered to its horizontal position, a small gap should exist between the pivot post bushings *X* and *Y*, Fig. 2. A few drops of light lubricating oil applied to the pivot post between the bushings will provide smooth movement in the raising and lowering of the recording arm.

Before tightening the hex-head set screws, note that the recording arm is in correct position with respect to the follower arm, so that as the follower arm touches the follower arm stop, the cutting stylus will rest on the outside black line near the center of the record. This will provide a maximum playing time of approximately 2 1/5 minutes for the 6½-inch disc, 3½ minutes for the 8-inch, and 5 minutes for the 10-inch disc.

With the recording arm lowered to a position so that the bottom of the nose of the arm is 2 inches above the turntable, the tongue of the phosphor bronze spring should just clear the lateral feed screw.

***BRONZE SPRING ADJUSTMENT***

As the recording arm is lowered to recording position, it will be noted that the follower arm is also lowered, causing the phosphor-bronze spring tongue to become firmly seated in the bottom of the spiral groove of the lateral feed screw.

The pressure of the phosphor-bronze spring, bearing against the lateral feed screw should be sufficiently great so that the knife-edge tongue will not have a tendency to climb out of the grooves in the feed screw, which would result in unevenly spaced grooves cut into the record surface. In extreme cases of insufficient spring pressure bearing against the lateral feed screw, the cutting stylus may have a tendency to cut through into the adjacent previously cut groove.

The pressure should not be so great, however (caused by the follower arm being bent downward too far) that the phosphor-bronze spring will be lifted away from the end of the adjusting screw, as the arm is lowered.

An adjustment is provided on the worm and gear housing, to take up the end play of the lateral feed screw. To make this adjustment, loosen the large hexagonal lock nut and turn the slotted screw slowly to the right until all end play of the feed screw is eliminated. Then back off the adjustment slightly and tighten the lock nut.

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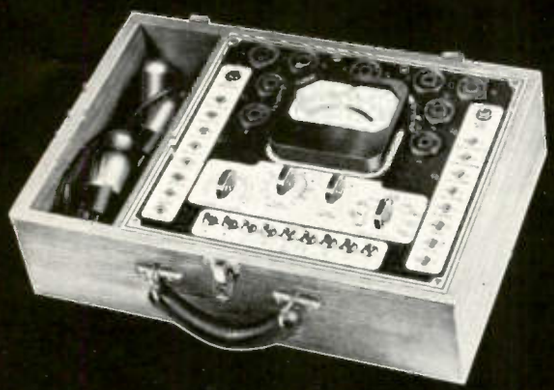

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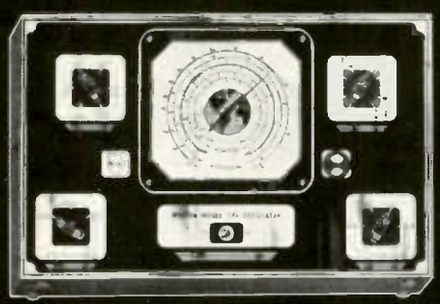

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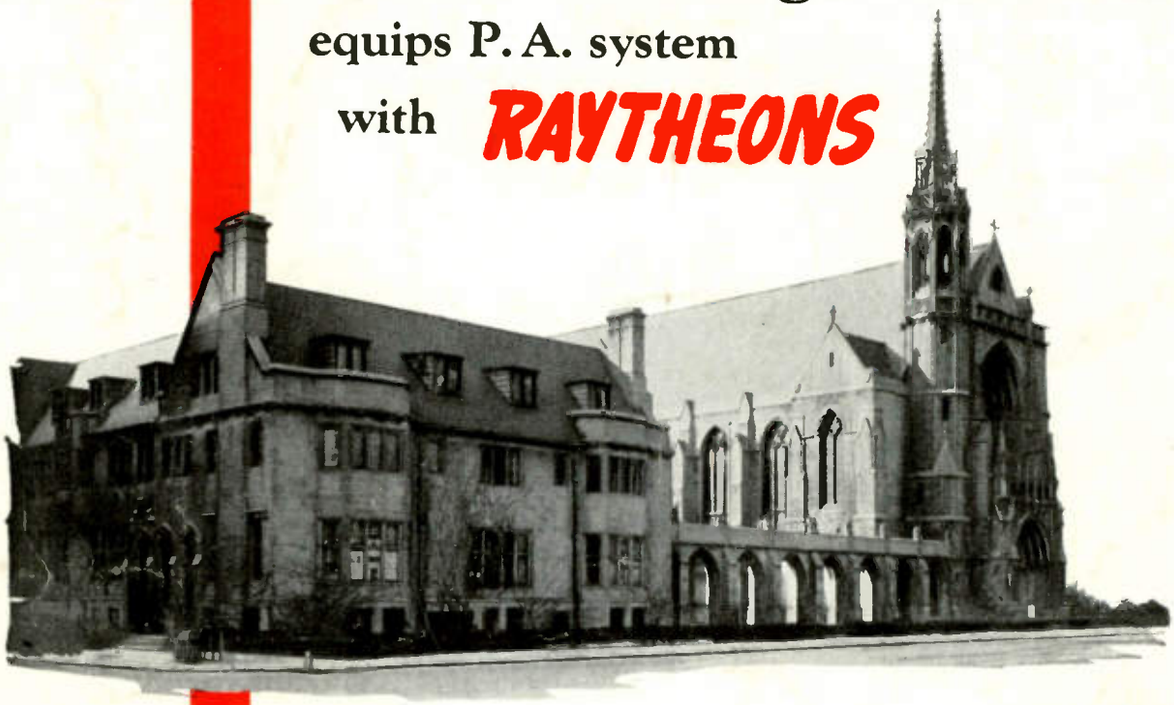

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