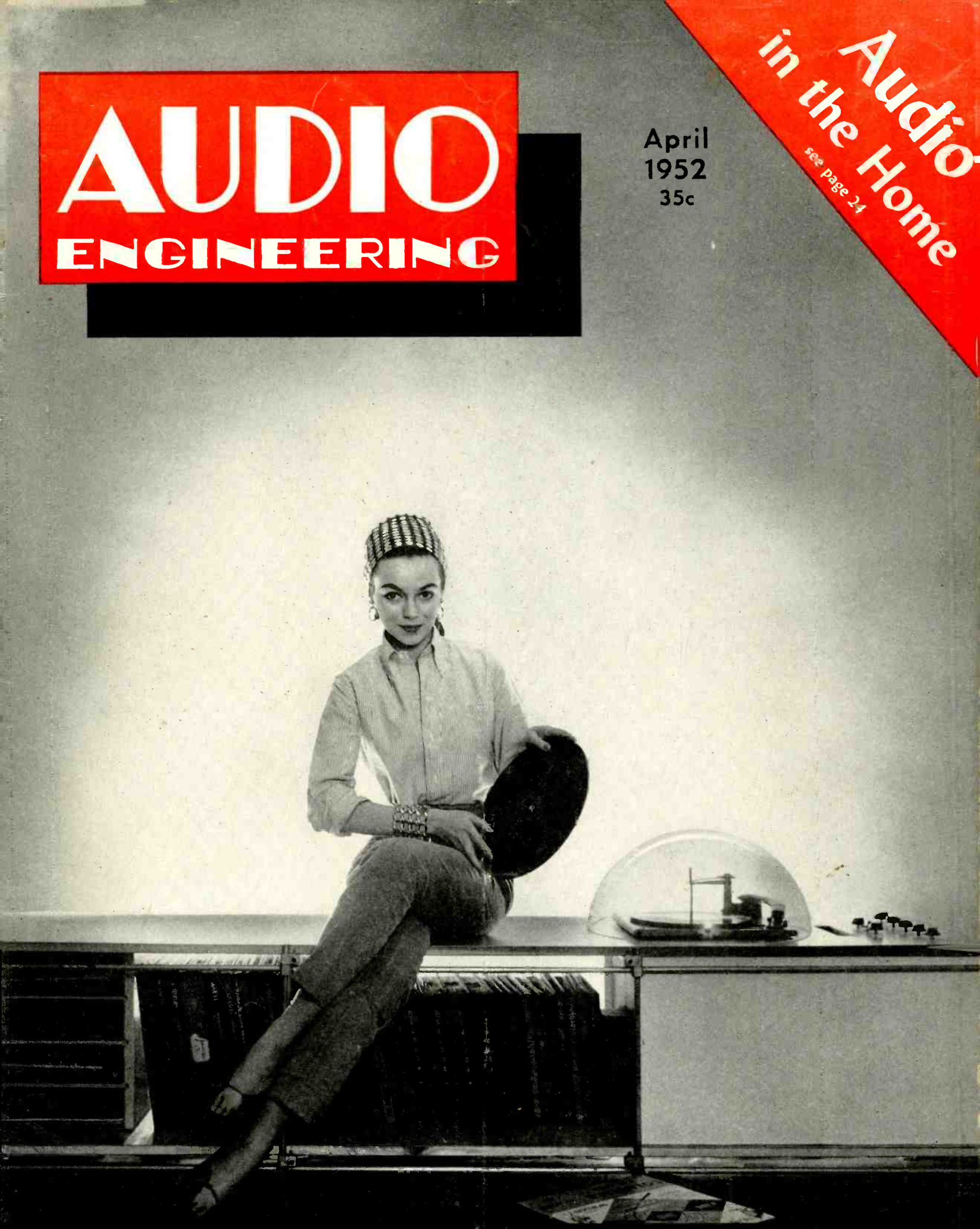
AUDIO ENGINEERING

April
1952
35c

Audio in the Home

see page 24



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CONTENTS — APRIL, 1952 — Vol. 36, No. 4

COVER

Build your own furniture to suit—as one owner has done. This attractive unit (the furniture, that is) was assembled from aluminum tubing and small clamps, using simple wooden slabs for the top and for shelves. The record changer is covered by a plastic half-globe, molded to order, and speaker, amplifier, and control unit are all included in this installation. Design by Dean McClure, architect; equipment by The Electronic Workshop. Details of the construction will appear in next month's issue.

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AUDIO PATENTS

RICHARD H. DORF*

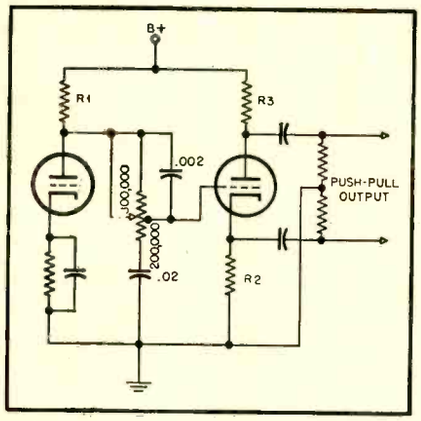


Fig. 1

TONE-CONTROL CIRCUITS exist by the hundreds, but here is one of especial interest because it is so simple. It combines in a single control attentuation of either high or low frequencies, together with a very definite flat-response position which is not dependent on balancing out opposing tone control circuits. The inventor is Robert J. Cowles of Fort Wayne, Indiana, and the patent, No. 2,571,112, is assigned to Farnsworth.

The circuit of the tone control appears in *Fig.* 1. It consists of a potentiometer of 1 megohm, with a tap 200,000 ohms above the "ground" end, and two capacitors, one being .02 μf, and the other .002 μf. The first vacuum-tube stage is a voltage-amplifier triode and the second the familiar cathodyne phase inverter with outputs taken from the plate and the cathode. The stages are direct-coupled; the correct bias for the second stage can be had by the right combination of R_1 (for a satisfactory low plate voltage to be transferred to the following grid) and R_2 for a high cathode bias to offset most of the positive grid voltage. R_2 would normally have a fairly high value in any case in this kind of phase inverter, and should be the same as R_3. The potentiometer has no effect on the bias of the second stage since it is not carrying d.c.

With the potentiometer arm at the tap point the circuit appears as at (A) in *Fig.* 2, since the 800,000-ohm portion of the potentiometer and its shunt capacitor are shorted out. The .02-μf capacitor has very little effect on frequency response.

With the potentiometer arm at the top, the circuit is as shown at (B) and is easily recognized as a high-boost circuit. At intermediate positions, the amount of action is regulated by the value of resistance across the .002-μf capacitor.

At (C) in *Fig.* 2 is shown what happens when the potentiometer arm is moved below the tap, for instance to the point where there remains 100,000 ohms between the arm and the .02-μf capacitor. The .002-μf capacitor, the 800,000-ohm resister (portion of the potentiometer), and that part of the potentiometer between the arm and the tap (assumed at the moment to be 100,000 ohms) no longer have any effect since no audio current flows through them and they can cause no voltage drops. The circuit is reduced to a series resister and capacitor between plate of the first stage and ground, with the first-stage plate connected to the second-stage grid. The effective resistance in the circuit is now made lower as the potentiometer arm is moved downward, raising the frequency at which the resistance and the reactance of the capacitor become equal. Above this fre-

[*Continued on page 4*]

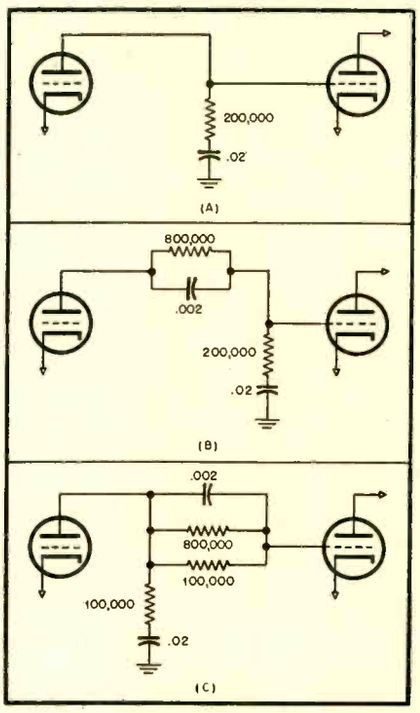


Fig. 2

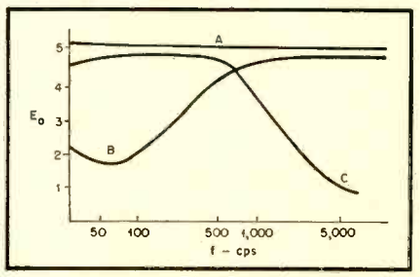
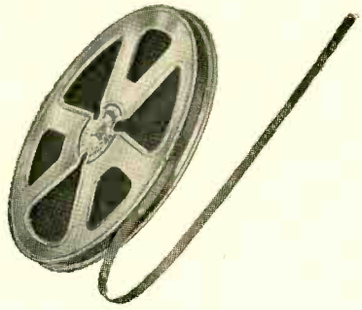
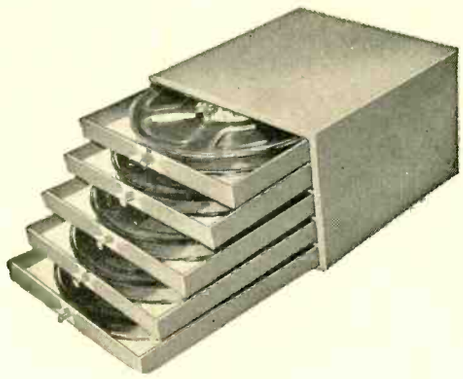


Fig. 3

* *255 West 84th Street, New York 24, N. Y.*

PLUS PERFORMANCE





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quency the net impedance of this circuit across the first-stage plate decreases progressively; because of the plate resistance of the first stage, response in the treble range becomes less and less.

Fig. 3 shows what kind of curves may be expected. Curve A shows measured results with the arm at the tap. Curve B shows what happens when the arm is moved upward. And curve C illustrates response as the arm is moved below the tap.

Anti-Noise Bridging Amplifier

John W. Rieke of Astoria, N. Y., is the inventor of an interesting amplifier for bridging a balanced line and discriminating against noise picked up in the line along its run. The patent, No. 2,547,538, is assigned to Bell Telephone Laboratories.

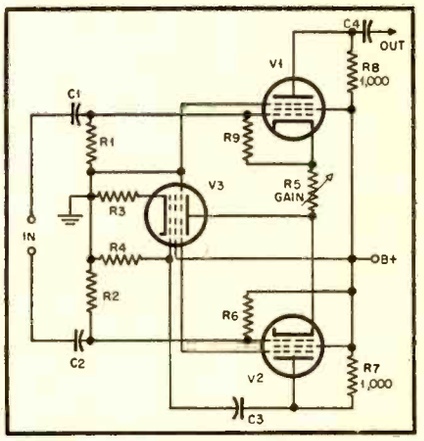

Fig. 4

As shown in *Fig.* 4, V_1 and V_2 are balanced amplifiers, both passing cathode current through V_3. Audio input from the balanced line produces equal and opposite grid voltages on V_1 and V_2. The cathode currents are equal and opposite and there is, therefore, no a.c. component through V_3.

Noise voltages picked up by the line usually tend to be identical on both lines with respect to ground. The resulting noise currents in V_1 and V_2 are equal but in phase; they pass through V_3, the plate resistance of which produces substantial degeneration, greatly lowering the gain of the amplifier for noise inputs of this kind.

The plate load resistors for V_1 and V_2 are R_8 and R_7 respectively. Output for following stages or for an outgoing line from the bridge is taken from the plate of V_1 in the normal manner. The plate output of V_2 is fed to the grid of V_3, which greatly enhances the amplification of V_1 in the following manner:

If we assume an instantaneous positive voltage (from the input) at the grid of V_1 and a corresponding negative voltage at V_2, a resulting positive voltage appears at the plate of V_2 and the grid of V_3. This decreases the plate resistance of V_3, and since the cathode of V_1 is connected to the plate of V_3, the bias on V_1 is reduced. The net effect is to increase the amplification. Reike claims an amplification by this method twice that obtainable without the special circuit.

R_1 and R_9 provide bias voltage for V_1, while R_6 and R_2 do the same for V_2. R_3 is a cathode-bias resistor for V_3; R_4 is the grid leak for V_3. R_5 causes degeneration in V_1 and is made variable for use as a gain control over a limited range.

V_1 and V_2 should have high grid-plate transconductance; pentodes are best, though tetrodes or triodes might work under certain circumstances. V_3 should have high a.c. impedance and moderate d.c. plate resistance. It is also ideally a pentode.

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LETTERS

Horn-Loaded Speakers

Sir:

An article by Meissner and Andrews (Horn Loaded Bass Speaker, AUDIO ENGINEERING, January 1952) includes a reference to the Hypex horn formula. We feel that the comment on Hypex is the result of a misunderstanding, and submit this to clarify the situation.

This formula, developed and patented by Jensen Manufacturing Company (U. S. Patent 2,338,262), forms a family of horn flares in which the rate of flaring is determined by a number called T, which generally is kept between 0 and 1. The formula is a tool used in horn design to achieve the best matching to a loudspeaker or driver unit. By appropriate choice of T, several performance gains can be achieved over the exponential flare, which by the way, corresponds to a Hypex flare of $T = 1$.

In the same way that the exponential horn was an improvement over conical and parabolic horns, the proper Hypex flare used with a given driver offers these advantages over the exponential flare:

1. Higher throat resistance, and therefore higher efficiency, just above theoretical horn cutoff frequency.
2. Greater reduction of the normal stiffness effect of the loudspeaker moving system below its fundamental resonant frequency (i.e., where the loudspeaker is stiffness controlled). Result is higher efficiency between horn cutoff and driver resonant frequency.
3. Decreased air mass reactance loading to the loudspeaker in the first octaves above its resonant frequency. This means higher efficiency, as the air resistance loading still can be maintained at its optimum value. Result is higher efficiency above the resonant frequency.

The authors' statement that "when the Hypex horn cuts off, it *really* cuts off" can be interpreted to imply that cutoff is sharper or that performance is poorer below cutoff.

The throat resistance drop near cutoff can be more rapid, but this is due to advantageous maintenance of a higher value closer to cutoff.

As for performance below cutoff, neither throat reactance nor throat resistance of finite horns actually drops to zero as depicted in theoretical curves. Some output is obtained from all finite horns even below theoretical cutoff.

Philip B. Williams, Senior Engineer,
Jensen Manufacturing Company,
6601 S. Laramie Avenue,
Chicago 38, Ill.

FM Station Faults

Sir:

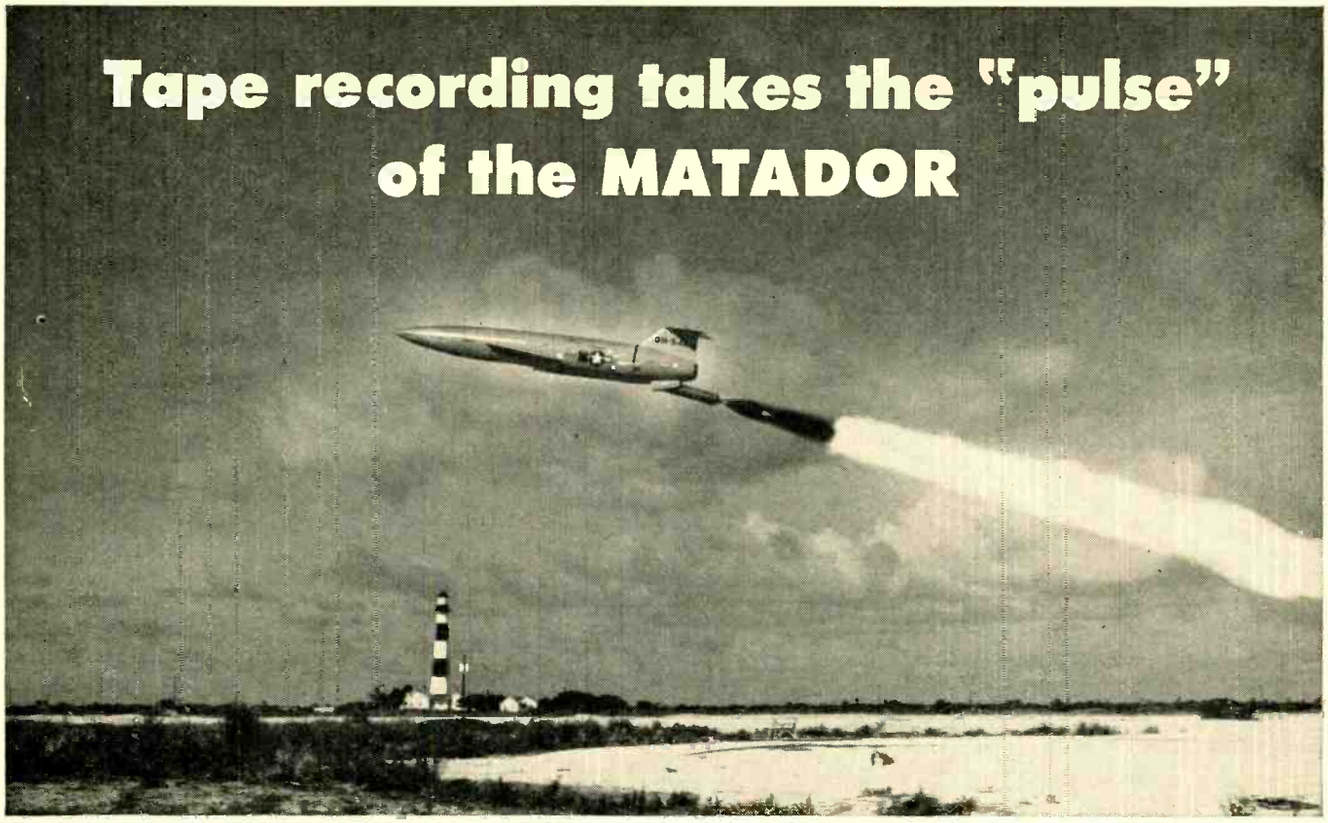
Being an ardent listener of FM 'way back in the old low-band operation, I have been puzzled by the difference of quality of the transmissions of FM stations in any given area, including New York City. According to the F.C.C. they must transmit a frequency range of 50 to 15,000 cps from microphone to antenna (from their principal studio, ED.) and yet we find many varieties of signals evident when tuning across the band. It is amazing how some stations consistently transmit such high-quality signals while others can just as consistently transmit signals full of distortion and hum and like noises. Of course, with a high-quality system, such stations are even more objectionable than when listeners use sets of poorer quality.

Unfortunately these poor signals negate the outlay of large sums of money for amplifiers, speakers, and good tuners, and lead many to believe FM is not what it's been ballyhooed to be. I think it is about time to clean up these poor signals, since they are only hurting the industry as a whole and besmirching the fine qualities of a superior form of transmission.

Harry F. Ellwood,
9023 215th St.,
Queens Village 8, N. Y.

(The major networks, at least, comply with FM regulations meticulously when it comes to equipment and lines, we are advised by those who should know. The best way to "clean up" the situation is to write individually to the offending stations, with the possibility of forwarding copies of such letters to the F.C.C. We agree, of course, that FM can be so much superior to AM that it would be unfortunate — to put it mildly — to have it abandoned, or even curtailed in the slightest degree. ED.)

Tape recording takes the "pulse" of the MATADOR



TESTING OF GUIDED MISSILES like the famous "Matador" (above) involves a complicated job of telemetering. At the Air Force Missile Test Center in Florida, a series of down-range telemetry stations pick up pulsations transmitted by the missiles in flight. These signals are recorded on tape for later decoding.

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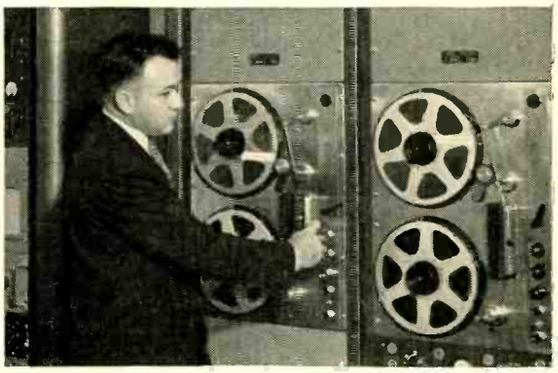

TAPE RECORDINGS of telemetered missile flights are gathered at a central point for study and analysis. By playing back the recordings, engineers can re-create each flight in its entirety.

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Book Reviews

Radio and Television Receiver Circuitry and Operation, by Alfred A. Ghirardi and J. Richard Johnson. 669 + xvi pp. New York: Rinehart Books, Inc., 1951. $6.00.

Written as the corner-stone of an up-to-date radio servicing library, this volume should find a welcome acceptance among many audio devotees, particularly the newcomers. Over one third of the 611 text pages appertain directly to audio subjects, from the generation of the transmitted signal through amplifiers, loudspeakers, pick-ups, record-players and recorders, both wire and tape.

The treatment is clear and easy to comprehend, and a 26-page glossary of technical terms leaves no mystery unanswered for the neophyte. Mr. Ghirardi has always written on the assumption that knowledge of the correct functioning of equipment was essential to proper servicing. To this the present book is no exception. One wishes he had devoted a bit more thorough treatment to some of the newer and more obscure details of circuitry. As an example—the bootstrap flyback circuit for high voltage generation in TV receivers is hardly mentioned, and the inter-carrier system, used in probably 90 per cent of all current commercially-built receivers is allowed less than a page. Conversely, the treatment of antennae, particularly UHF types, is outstanding.

Each chapter has its summary questions, with answers for alternate ones in the appendix. As a reference work for those needing refresher data, and as a source of information to those needing complete explanations, this book acquits itself well, and if the ensuing volumes serve as well in their respective fields the authors have rendered a real service the technical industry should not forget.

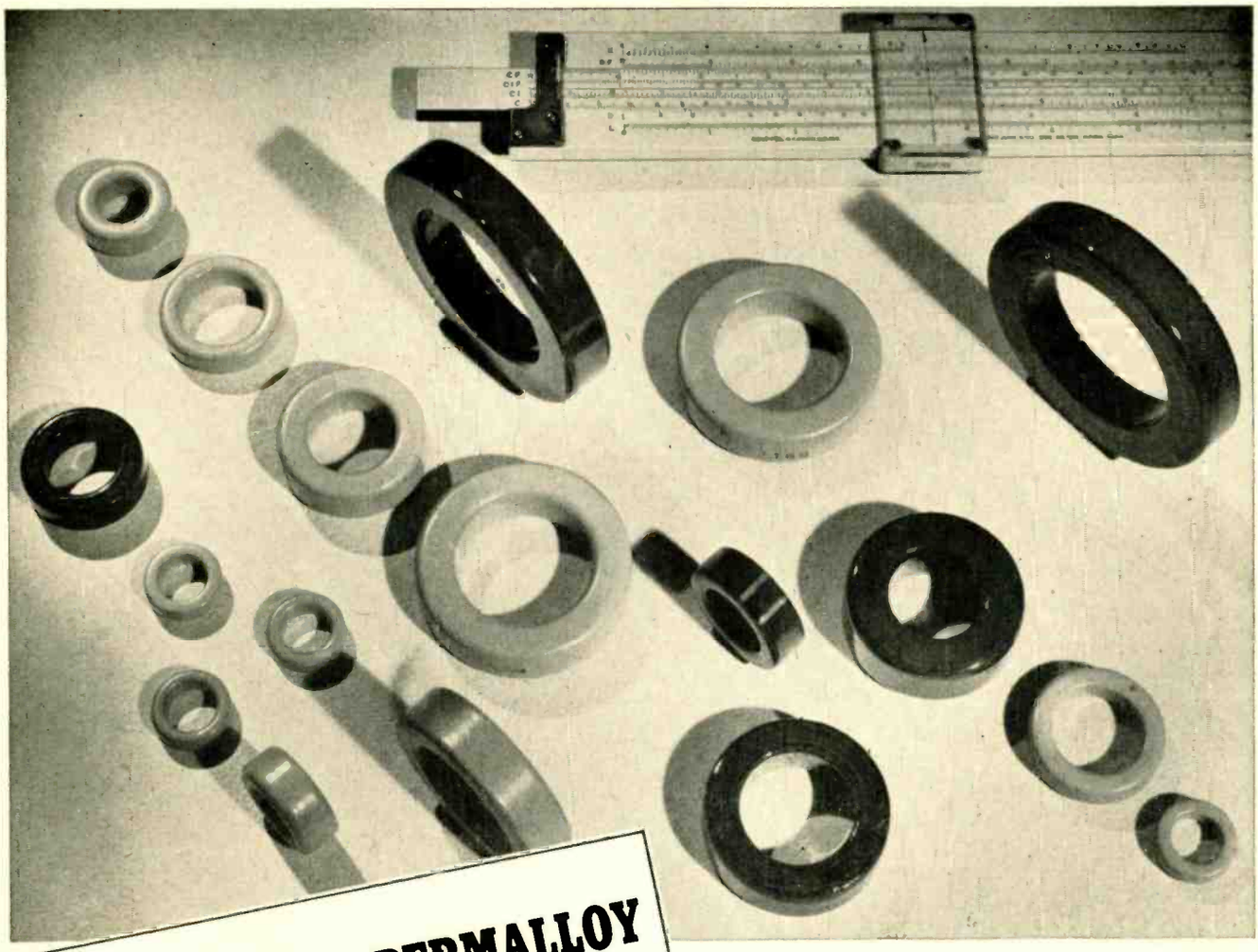
—LBK

Pianos, Pianists and Sonics, by G. A. Briggs. Wharfedale Wireless Works, Idle, Bradford, Yorks., England. (Dist. in United States by British Industries Corp., 164 Duane St., New York.) 190 pp., 102 illus., 10/6.

Somewhat out of the ordinary for the average audio-minded reader is this volume which—while not offered as a thorough treatise on pianos—will nevertheless give the lay reader, and even the engineer, an entertaining evening's reading. Most of us are unaware of most of the history of the piano, and still more unfamiliar with its construction beyond what we can see when we raise the top or remove the front.

This reviewer was especially interested in the requirements of voicing a piano, and the effect of this work on the ultimate tone of the instrument. The author's presentation of charts and graphs serves to point up the differences he describes in various instruments—both individually and by type.

Mr. Briggs' style is far from pedantic, more often becomes thoroughly conversational. It is this characteristic, rather more than the subject matter, which makes the book so entertaining. The reader learns about pianos through Briggs' eyes, and from Briggs' own experience.



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AUDIANA

Azimuth Film Calibration

ANY ELECTRICAL REPRODUCING system needs some test standards in order to check the performance from time to time in routine maintenance operations. For amplifiers and complete transmission systems, the test standard generally is provided by an oscillator covering the entire audio frequency spectrum; a gain set, which is a means of introducing a specific amount of loss; and an output meter, usually a VU meter. Electrically, the circuits are set up with the oscillator feeding into the gain set, with a meter to measure the amount of signal fed in; then comes the amplifier or system under test; and finally, a loading network and the output meter. In use, the gain set is adjusted so that the output voltage is exactly equal to the voltage fed to the gain set. Then, obviously, the gain of the amplifier or system is equal to the loss introduced by the gain set. Since the gain set is accurately calibrated in db, the loss—and consequently the gain of the amplifier—is indicated within tenths of a db.

Similarly, tests of disc reproducing systems are usually conducted by playing a calibrated frequency record through the system and measuring the output. With any measuring system of this sort, it is obviously necessary that the standard be made with as much accuracy as possible.

One of the characteristics of a magnetic tape reproducing or recording system is that the recorded striations of the magnetic material on the tape must be accurately adjusted so that they are exactly perpendicular to the tape motion. If a tape is recorded on one machine, and played back on the same machine, it does not make much difference if the head gap—which locates the magnetic striations—is not so accurately aligned. But if the tape is to be recorded on one machine and played back on another, as is often the case, the two machines must be adjusted to a high degree of accuracy.

Adjustments of the head position or azimuth, as it is called, are made in practice by playing an alignment tape—usually of such a frequency that the wavelength of the signal on the tape is equivalent to the gap width—and adjusting the head position or azimuth to obtain a maximum output. The frequency employed is usually 15,000 cps for a 15 in./sec. machine, 7500 cps for a 7½ in./sec. machine, and so on. This works out to be exactly the same wavelength on the tape regardless of the speed, so that one alignment tape will serve to adjust any tape machine. The figure of 18,000 cps corresponds to a speed of 18 in./sec. which is standard for motion picture recording, where the speed of film travel is 90 ft. per minute, or 18 in./sec.

Since it is necessary to have a standard, it is obvious that such a standard must involve an adjustment of absolute perpendicularity, and standard alignment tapes must therefore be made with as great an accuray as possible. The method of doing this requires an accurate measurement of the gap azimuth, an operation which is impossible to do solely by inspection. The unique head construction described by the author gives a simple and accurate check of the recorded tape with a minimum of effort.

Low-Frequency Reproduction

The design and construction of a loudspeaker which is completely satisfactory for the reproduction of low frequencies is fraught with a number of conflicting requirements. The market demands a high efficiency, low resonant frequency, low distortion, good response to transients, and a uniform sound output to very low frequencies. Any mechanically vibrating device—e.g., a loudspeaker cone—has a natural resonant frequency. Below this frequency, the sound output decreases rapidly, a natural acoustic phenomenon. Furthermore, for a low resonant frequency, a relatively high weight, or mass, is required. Yet when the mass is high, transient response suffers.

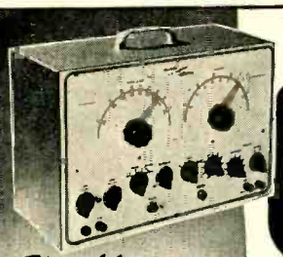
It almost seems as though it would be impossible to build a good low-frequency speaker, yet the speaker art has progressed to the point where exceptionally fine "woofers" are available. Among the elements which must be balanced against one another are cone weight, cone stiffness, adequate freedom for cone motion, sufficient stiffness to provide damping, and high efficiency—which means enough turns of wire on the voice coil.

Most of the characteristics of any mechanical system can be expressed mathematically, and from these equations, the direction the designer should look in perfecting a product can be determined with considerable accuracy. The author has given these equations, with some explanation of their importance. Since the movement of the voice coil depends upon the force acting upon it, it is interesting to note what is involved in these forces—the flux density in the air gap, the length of wire in the voice coil, and the current in the coil. Thus it is seen that it is desirable to have a high magnetic flux density in the air gap, which pinpoints the importance of magnet size and strength. Similar points of importance are also noted from the equation for acoustic output, which shows the part the housing plays in obtaining good low-frequency responses.

The cone excursion, for a given acoustic output, depends upon the diameter of the cone, *and* upon the frequency. In the author's example, a 12-in. speaker can radiate one acoustic watt with a maximum cone excursion of 1/16 in, at a frequency of 200 cps—and such an excursion is well within the ability of the speaker without excessive distortion. But to radiate the same acoustic power at a frequency of 50 cps requires a cone excursion of one inch—which would undoubtedly wreck the speaker completely. As the size of the speaker is increased, the movement of the cone decreases for a given amount of power output.

Not the least important of the conditions which cause distortion is cabinet vibration. If any portion of the cabinet vibrates independently, the cabinet may radiate more sound than the speaker. Therefore, cabinets should be as massive and well braced as possible.

New 1952 HEATHKITS



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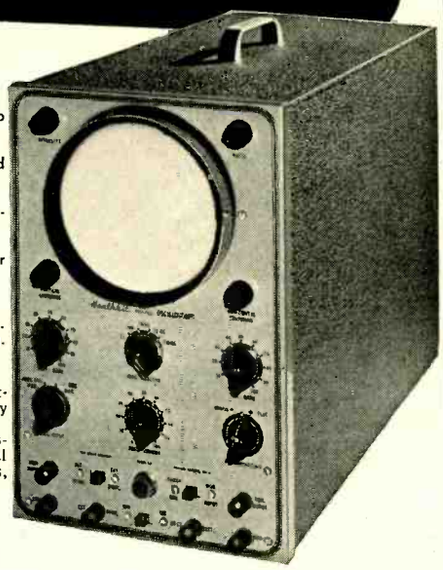

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- Low impedance vertical gain control for minimum distortion.
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EDITOR'S REPORT

LET GEORGE DO IT!

AMONG THE MOST UNIVERSAL of human failings is the tendency all of us have to "Let George Do It." But the time comes occasionally when this tendency is likely to be our undoing. Now is one of those times, it appears.

While the use of phonograph records as a source of high-quality music for home systems has unquestioned advantages, there are times when it is desired to let someone else change the records—partially because we are too lazy, perhaps, and partially because radio stations usually have more records than we have. In addition—and of even greater importance—the live programs obtainable from the better FM stations are capable of exceeding in range and in freedom from distortion even the best phonograph records.

There is no advantage for a high-quality home music system without good music to play on it, and when we run out of records—or tire of those we have—or for any number of other reasons, we can hear still more music from the radio. Most audiophiles (we have avoided this word since a friend of ours in Camden told us he could always recognize one because of the *rasp* in his system) depend on radio for a large percentage of their program material.

The principal reason for these comments is the condition into which FM seems to be falling. Only recently has one New York station fallen prey to listeners' apathy —with several hours per week less good music than we were accustomed to having. WFDR—technically one of the best equipped stations in the city—shuttered during February.

The National Association of Radio and Television Broadcasters—at the 30th Annual Membership Meeting—is devoting one morning session to FM business, with a view to reactivating the interest in FM throughout the country as much as possible. A continuing campaign is in progress—city by city and area by area—to work in combination with set manufacturers so as to increase FM listening time and to increase FM receiver sales. The advantages of FM are known to most of us, but the vast majority of the public is seemingly unaware that there is much gained by listening on FM rather than AM.

How can we help, you ask? And at this point the meaning of the caption above becomes apparent. Most of us are guilty at one time or another of putting off writing a letter of commendation to a radio station for its good work. We justify this procrastination by saying that enough other people will write in so we just don't bother. We let George do it.

If we are to continue to have FM broadcasting, those of us who want it and use it had better stir our stumps somewhat and let the stations know we want them. If you listen to a certain station on FM for three hours a day regularly, let the station manager know about it. If you listen exclusively on FM and want more or better programming, write the station.

The two principal advantages of FM appeal to two different types of listeners. To most of Æ's readers, the superior quality is of principal concern, and we are willing to spend relatively large sums of money to equip ourselves to hear music as well reproduced as we can possibly have it. To *everyone* who listens to a radio at all, the elimination of the effect of static is a very definite advantage, at least for part of the year.

If we all do our duty and tell the FM station management that we're listening and that we're behind them, perhaps we shall be spared the loss of even one more station from the airwaves. If we should happen to lose all of them, we would most certainly become a group of individual disc jockeys in a short time. Let's *all* be George.

THE AUDIO FAIR IN CHICAGO

By now, most readers are aware of the Audio Fair to be held in Chicago on May 23 and 24, at the Conrad Hilton Hotel, immediately following the Annual Parts Show. We are looking forward to a large crowd—many who will come to see what an Audio Fair is like—and to meeting some of our readers in the Midwest area. Æ is always willing to give a boost to any enterprise which will help audio, and the New York Audio Fairs have proved that they help audio in a big way. The Audio Engineering Society is sponsoring the exhibit, as it does the Eastern shows, although there will not be any convention activities at this time. However, it is suggested than any Chicagoans who have a strong interest in audio might well make this the occasion for a local affair, and either Æ or the Society or both would most certainly be willing to cooperate.

ANOTHER ANTHOLOGY

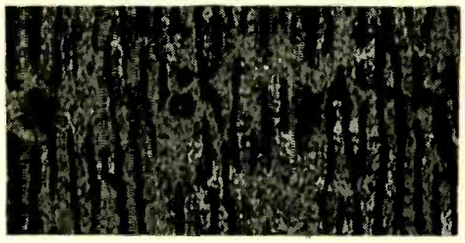
Work has already begun on the Second Audio Anthology, which will take up where the first one left off, and continue up to the present. Publication date has been set tentatively for September 15.

The Second AA will not include any of the material which was in the original, but only such material as would be of interest to the hobbyist which was published between January 1950 and July 1952. Selection will be made in a similar manner to that for the first compilation, but any suggestions from readers will be considered.

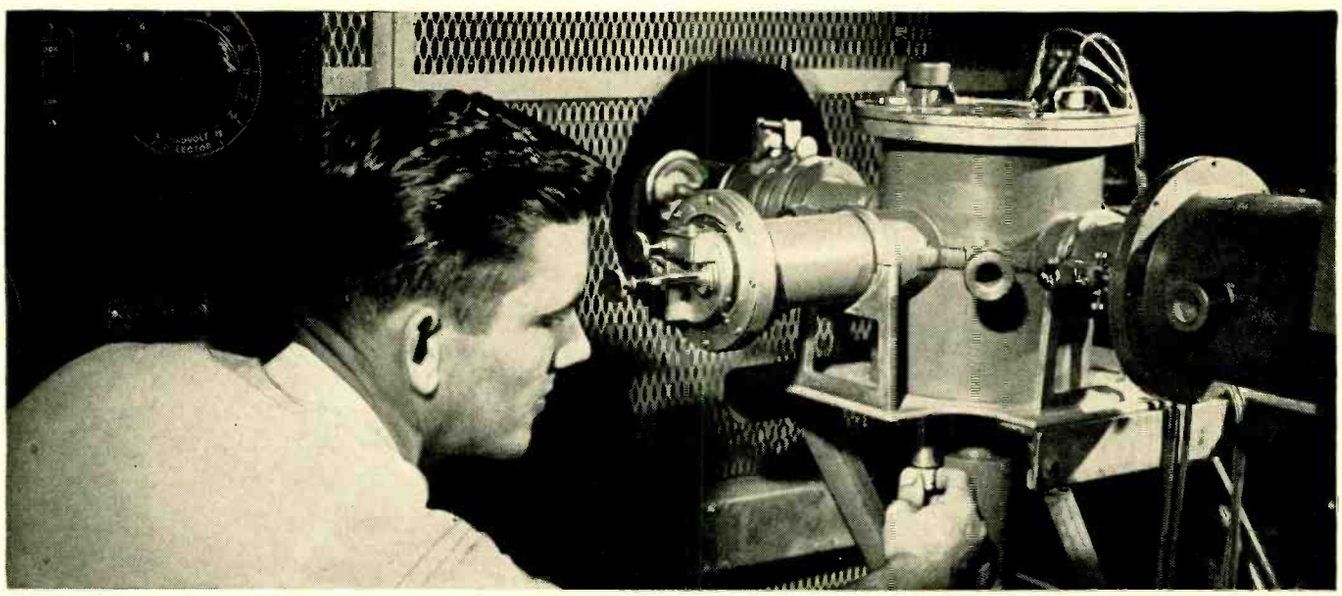
Please do not consider this an invitation for orders —there will be plenty of time, and we will continue to reprint, if necessary, so long as anyone wants the book.

Electrons probe the future

1 Electron micrograph of an alloy of aluminum, nickel, cobalt and iron. Magnification 20,000 diameters.



2 Cooled from high temperature in a magnetic field, the alloy becomes a powerful, permanent magnet. Note changed structure. Black bars reveal formation of precipitate parallel to the applied field. Each bar is a permanent magnet.



3 A Bell scientist adjusts electron diffraction camera. Electrons are projected on the specimen at glancing angles. They rebound in patterns which tell the arrangement of the atoms . . . help show how telephone materials can be improved.

In 1927, Bell Laboratories physicists demonstrated that moving electrons behave like light waves, and thus launched the new science of electron optics.

Now, through the electron beams of the electron microscope and electron diffraction camera, scientists learn crucial details about the properties of metals far beyond the reach of optical microscopes or chemical analysis.

At the Laboratories, electron beams have revealed the minute formations which produce the vigor of the permanent magnets used in telephone ringers and magnetron tubes for radar. The same techniques help show what makes an alloy hard, a cathode emit more electrons and how germanium must be processed to make good Transistors.

This is the kind of research which digs deep *inside* materials to discover how they can be made better for your telephone system . . . and for the many devices which the Laboratories are now developing for national defense.

4 Diffraction pattern of polished germanium reveals minute impurities which would degrade the performance of a Transistor.

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Azimuth Film Calibration

MICHAEL RETTINGER*

Regular maintenance of magnetic film and tape recorders requires a check of the azimuth of the head gaps. The author describes one method of making azimuth tracks with a high degree of accuracy, and explains their use in the field.

IN MAKING LONGITUDINAL magnetic recordings on tape or film by means of a ring-shaped magnetic recording head, and in reproducing these recordings on another head—the so-called reproduce head—it is important that the gaps of both heads make exactly the same angle with the direction of medium motion. If the angles are different, high-frequency losses occur, much as in the reproduction of photographic soundtracks when the light slit is tilted. The effect is known as the gap-tilt effect, or gap misalignment angle effect. Of course, when the same magnetic head is used for both recording and reproducing, the gap angle is of necessity the same, and there occur no high-frequency losses due to this effect.

In practice, the angle which the recording and reproducing head gap makes with the edge of the film or tape is 90 degrees. The angle by which a gap deviates from this normal angle is spoken of as the gap tilt or gap misalignment angle. When recordings of short wavelengths are made, the misalignment angle must be very small, usually less than 10 minutes of arc, to reduce high-frequency losses to a practical minimum. For this reason it has become standard practice to align magnetic record and reproduce heads by means of a so-called azimuth film or tape,[1] which carries a high-frequency recording made on a head, the gap of which has been aligned with a high degree of accuracy to be perpendicular to the edges of the film.

Figure 1 shows the decibel reduction in reproduce head output voltage as a function of the gap misalignment angle. It is seen that a number of secondary maxima and minima occur, at the high frequencies, for the gap angles shown on the curve.

To ensure that the gap of the recording head employed in making an azimuth film was at right angles to the edges of the film, a special head with two recording gaps was constructed. The head employed for the purpose is much like an ordinary recording head, except that the laminations were made symmetrical (see *Fig.* 2), so that the back-gap of the head, when exposed, could also be used, either for recording or reproducing. To ensure that the pole-faces of the laminated cores were in the same plane, the cores were lapped on a diamond lap.

In making the azimuth film, a recording was made by passing the film over the top gap of the head, as shown in *Fig.* 1. The film was then turned over, and reproduced on the bottom gap. By turning the film over, the angle which the sound track makes with the edges of the film is reversed, as shown in *Fig.* 3, and will be the same only if the gap angle is 90 degrees.

During reproduction the head was slightly tilted, first one way and then the other, to observe whether the output of the reproduce amplifier decreased each way. In the first trial, when the head was moved slightly one way from "normal" (the position which the head had when the recording was made), the output increased; while moving it slightly the other way from normal produced a decrease in the reproduce amplifier output. This showed that the gap of the recording head had not been at exactly right angles to the edges of the film. Several more recordings were then made, each at slightly different recording head position, until a head position was found which, during the reproduction of the turned-over film, produced a decrease in reproduce amplifier output for a slightly different head position each way from the normal head position.

Another manner of checking correct azimuth with the azimuth head is to record, on the top gap, short sections of the high-frequency signal at different

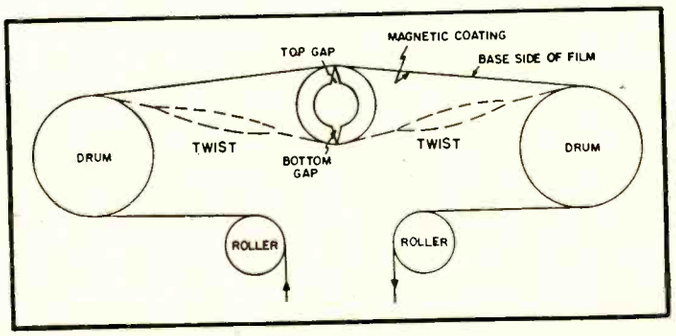

Fig. 2. Two-gap head —with either gap usable for recording or reproduction — in an arrangement for adjusting azimuth accurately for recording of test films.

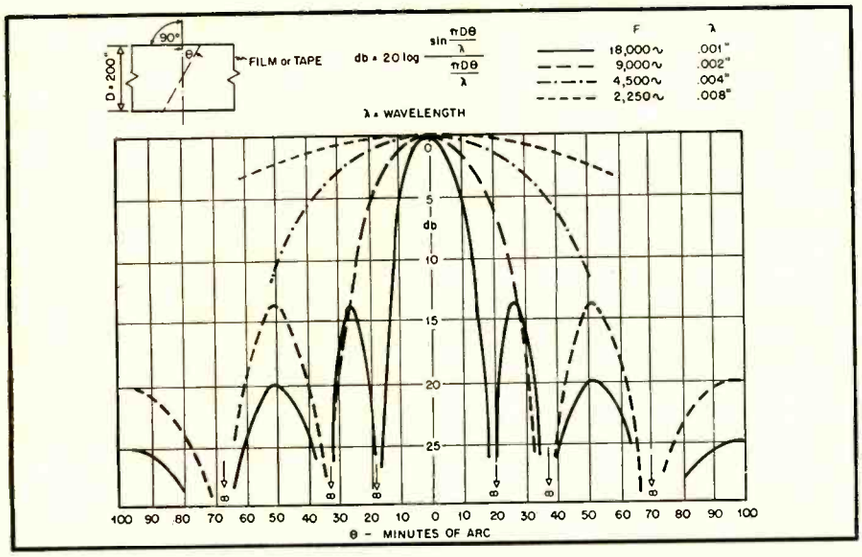

Fig. 1. Curves showing reduction of output signal for varying angles of mis-alignment of recording and reproducing gaps. This chart is based on magnetic film speed of 18 in./sec. For ¼-in. tape, with a 15-in./sec. speed, the frequencies corresponding to the four curves are 15,000, 7500, 3750, and 1875 cps, respectively.

* *RCA Victor Division, Radio Corporation of America, Hollywood, Calif.*

[1] The term "lateral deviation" is sometimes employed for the term azimuth. See "Magnetic tape and head alingnment nomenclature," by N. M. Haynes, AUDIO ENGINEERING, June 1949.

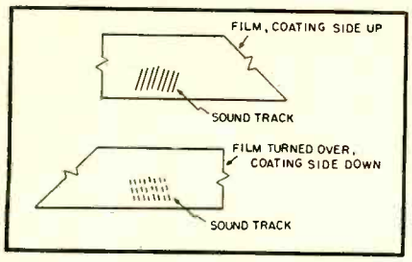

Fig. 3. Tilt of magnetic striations on track is reversed if film is turned over.

head positions, say two one direction off "zero" azimuth, and two the other direction. If the head is set for correct or "zero" azimuth, reproduction of the recording, both on the top and on the bottom gap, should produce the same amount of level change for the different head positions used in recording.

Precautions

Several precautionary measures had to be employed to insure the desired results. For one, the film had to maintain constant position in its travel over the head. This was accomplished by employing slightly tapered drums with a flange, so that the film was forced up against the flange in its travel, and thus was able to assume a constant position in its travel. It is also desirable in making an azimuth film to examine the film to make sure that both edges have the same length, that is, that the film is straight and not curved or "wavy". It may be noted that it is not necessary that the "sensitivities" of the two gaps be alike, although they were made equal for the head constructed by the writer.

There are two ways to check whether a head on a recorder is correctly positioned. By one method, the head is adjusted (while an azimuth film is being reproduced by it) until maximum output is observed on the reproduce amplifier output meter. On the other hand, if the head is not to be disturbed during the check, a so-called step-azimuth film may be used. This is usually made up of five sections of film of approximately equal length each, say 20 feet. The central section consists of a true azimuth film. The first section, when reproduced on a correctly positioned head, will give an output reading approximately 2 db below the reading which the central section provides. The second provides a reading approximately 1 db below that reading. The fourth section also produces a reading approximately 1 db less, while the fifth produces one which is 2 db below the reading which the central section provides. The step-azimuth film sections are usually marked thus: –2 db C.W. (clockwise); –1 db C.W.; 0–0; –1 db C.C.W. (counter-clockwise); –2 db C.C.W. The postscripts C.W. and C.C.W. refer to the fact that the recording was made with the head misaligned clockwise or counter-clockwise respectively from the correct position. Thus –2 db C.W. means that, looking at the gap of the head from the position of the coating on the film to be placed on the head, the gap has been turned in a clockwise direction to such an extent that the output, referred to the correct head gap position output, is down 2 db. If maximum output results while any except the central section of the step-azimuth film is reproduced, the head requires realignment, preferably by means of an azimuth film. The step-azimuth film is therefore merely a tool to check installed heads to learn whether they are still correctly positioned. If maximum output results while the central section is reproduced, the head does not have to be disturbed at all, as it would have to if an azimuth film (not a step-azimuth film) were employed for the purpose.

It is possible to construct a head with a core width of 1" (the distance between the inside sprocket hole edges of 35 mm. film) so that the film can be used for a variety of purposes, such as determining the azimuth for the individual heads of a multiple track recorder, avoiding having to rewind the film, etc. The wider the head, the smaller the angle of gap misalignment must be for an equivalent db reduction in reproducer output voltage. *Figure* 4 shows the reduction of output voltage in db as a function of track width for various angles of gap misalignment.

Alternate Methods of Checking

Two other means are sometimes employed to check azimuth on a film or tape. One consists in making the track visible by applying on the film finely divided iron particles suspended in oil or heptane, and then examining the track under a microscope equipped with cross-hairs or an angle-measuring device. Several sections of the film should be inspected in this manner, to arrive at a good average for the angle of misalignment. There are several limitations to this method, particularly when short wavelengths are used for the signal.

By another method, a "reversed" print of the track may be made on another roll of tape or film, as by laying the print stock on the film carrying the signal track—coating against coating—and exposing the two to a high-frequency magnetic field. When the magnetic head used for the recording was correctly oriented, and when the print made in this manner on a correctly oriented head is reproduced on the same head, moving the head either way from "zero" azimuth should result in a lower reproduce amplifier output voltage than that obtained when the head is in the "zero" azimuth position.

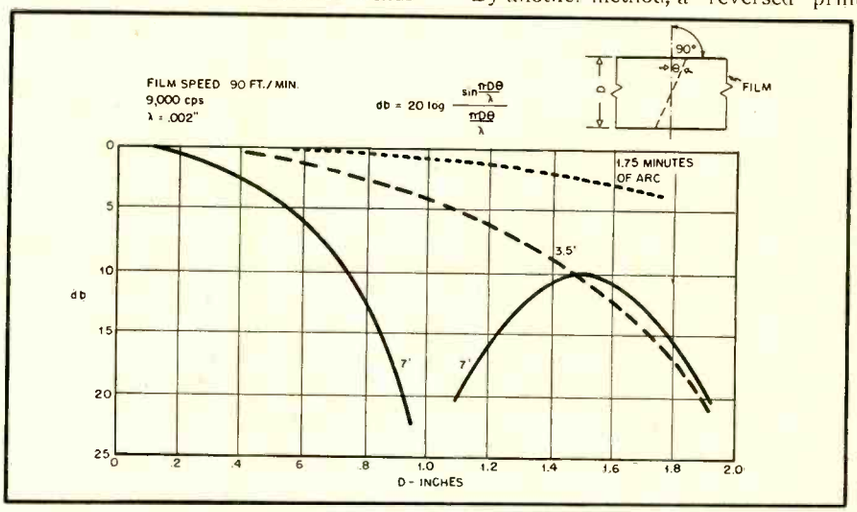

Fig. 4. Curves showing reduction in output for different track widths and three angles of gap tilt.

"Microcheck" — Unmodulated Test Discs

Last June, in an article entitled "Phono Facts," Maximilian Weil proposed a check of the condition of a sapphire playback stylus which involved playing a few grooves of an unmodulated test disc—grooves which had not been played before—and observing the effect the stylus had upon the appearance of the grooves. This is a simple test, one which is readily available to anyone with a phonograph pickup and a turntable and an unmodulated disc—but there's the catch. No such disc is available to anyone without the facilities to make it for himself.

The ease and efficiency of this test was appreciated by many readers—who quite naturally inquired as to where such a disc could be found. In most instances, we have suggested that it could be made for them by a local recording studio, but as it turns out, the cost has always been prohibitive.

In response to a request for help, W. Oliver Summerlin and Leon A. Wortman of Audio-Video Recording Company, 730 Fifth Avenue, New York 19, N. Y., have agreed to make such discs for anyone who wants or needs them. These discs are 12-inch single-face acetates, with one side completely recorded with unmodulated microgrooves, and they are available at the low cost of four dollars each, packing and shipping included.

Since these discs are cut with microgrooves, it is doubtful if they would work satisfactorily on juke boxes for those occasions where a patron was willing to deposit a sum of money to secure a few minutes of silence—an idea which has doubtless occurred to anyone who has ever frequented any establishment where a juke box operated continuously, or nearly so.

A Twin-Channel Utility Amplifier

R. S. HOUSTON*

Designed especially for use by a broadcaster in making remote pickups, this unit would find many applications in the experimental shop of many an audio engineer or hobbyist.

CATALOG SEARCHING for an extremely portable remote amplifier with a dual output for feeding P.A. as well as broadcast lines brought to light many fine units, but none which seemed to fit the primary requirement—small size. Hence it was decided to build one which would combine certain features peculiar to the operation intended, at the same time making it flexible enough to permit general use. The result is described here.

In the original design, it was intended to have two separate amplifier channels available for covering sports pickups where only one mike was needed. The second channel was intended to feed the P.A. with a separate program from another mike, which facility was supplied by the station. Since this setup was used frequently, it was felt desirable to combine the two channels, rather than have several pieces of apparatus to carry and clutter the limited working area. To allow the amplifier to be used for other small pickups using more than one mike, a switch was installed which allowed mixing the two input channels, thus providing a two-channel mixer, with both input signals mixed together and appearing at both output channels. To have a second channel instantly available in case of the failure of one, a changeover switch was installed to permit reversing the line connections to the two outputs. Thus if one line or output channel fails, it is a simple matter to switch over to the other, coordinating the switch with the studio.

* *Chief Engineer, KBNZ, La Junta, Colo.*

Circuit Features

An inspection of *Fig.* 1 shows that all the tubes are of the miniature variety, all chosen for high gain. As a result it is possible to get the necessary gain with only three stages. Though it has never been accurately measured, the calculated gain is around 85 db which is adequate for most ordinary needs, with some gain to spare. The first stage operates in an entirely conventional manner, with the possible exception of the loaded input. While it is a matter for discussion whether or not this is necessary, the response is somewhat improved when working from ribbon mikes, and the stage is stabilized by its inclusion. If the two cathodes of the 6AG5's are to be tied together as shown, it is essential that they be well by-passed, to prevent interchannel coupling through the cathodes. Since the screens operate at the same voltage as the plate, the decoupling filter R_{16}–C_{11} provides sufficient bypassing for the screens.

The second or mixer stage is a standard hi-mu triode with the two units in the tube operating independently. The essential difference is in the grid circuit. When the two stages are isolated, R_8 and R_9 have no function in their respective circuits other than to maintain a fixed minimum impedance in the grid circuit. However, when S_1 is closed, paralleling the grids of the 6J6, isolation resistors R_8 and R_9 are needed to prevent shorting out one input when the other is at minimum. Both grids receive the signal coming from the two input stages, and the signals are in phase through the rest of the amplifier. In later changes, a cathode coupled mixer stage was tried. This was accomplished by merely removing the cathode bypass, thus allowing the cathode potential to rise and fall with the signal. Since a signal on either grid will cause the cathode potential to change, any change will appear in both halves of the 6J6, and thus be amplified in both halves equally. However, the signal on the non-driven half will be out of phase with the driven half. This is of little consequence since the two outputs will not be feeding the same circuit. Another change in the grid circuit to eliminate the isolation resistors along with the modified cathode circuit are shown in *Fig.* 2, although this connection has a tendency to reduce bass at low settings of R_6 and R_7.

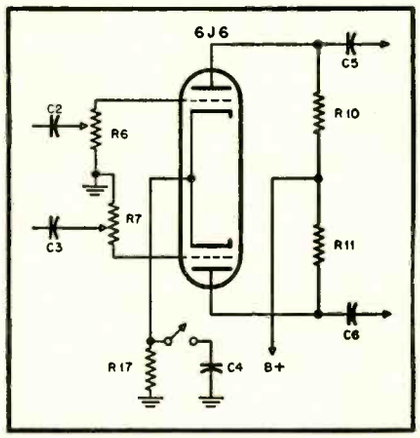

Fig. 2. Revised version of the second-stage mixer.

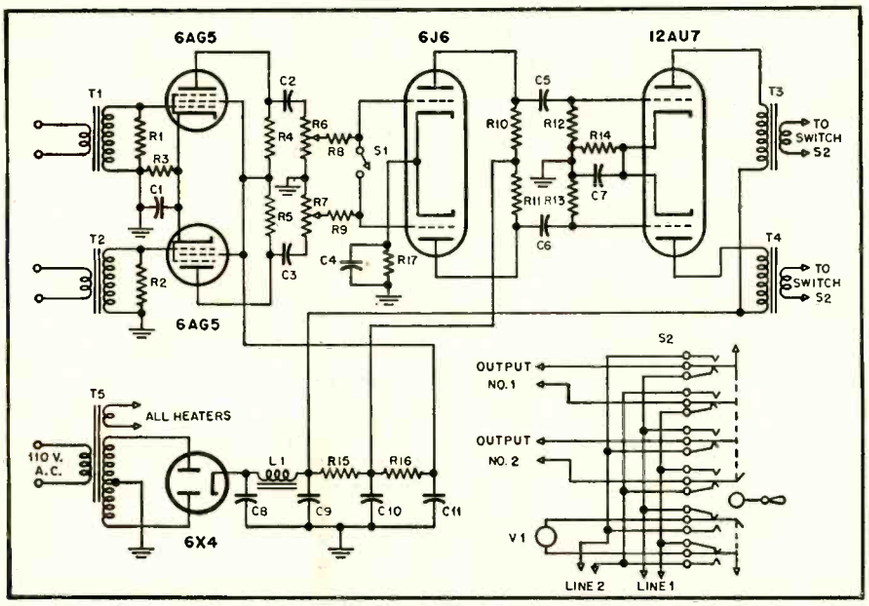

Fig. 1. Over-all schematic of twin-channel amplifier.

The two halves of the 12AU7 output stage operate independently into separate output transformers. The cathodes could have separate bias resistors if desired to insure complete circuit isolation, but sufficient bypassing will prove adequate and saves on parts. The heater of the 12AU7 is connected for 6-volt operation. The output windings are connected to the proper line through the operation of the locking-type key switch. In the

[*Continued on page 44*]

Design and Construction of Horn-Type Loudspeakers

WAYNE B. DENNY*

Part II. Continuing the description of exponential horns suitable for home use in the never-ending search for clean bass. This corner model should be the answer to many a question as to "How to do it."

IN LAST MONTH'S ARTICLE, the writer described a simple cabinet-type horn loaded speaker which is fairly simple to construct, and which provides excellent bass response, in addition to satisfactory high-frequency performance. There is some improvement to be expected, however, from a corner horn employing the same principles of construction, such as the one to be described here.

The second horn speaker to be described is depicted in *Figs.* 6 to 9, with the diagram and photographs showing the constructional features. The horn is vertical and opens into the *upper* corner of the room. This feature has the advantage that sound radiated from the horn avoids acoustic obstacles like chairs and other articles of furniture. Furthermore, the absorption by the ceiling is considerably less than that due to floors with carpeting. The space which is not used for the horn proper is used for shelves and this arrangement effectively hides the horn. The shelves add greatly to the rigidity of the structure.

A 12-inch driver is coupled directly to the throat of the horn and the speaker is entirely enclosed. Experiments over a period of weeks indicated that the low-frequency response was much smoother with the rear of the speaker entirely enclosed. Vents in the chamber resulted in maked resonances and "boom." Ozite and ordinary air filters of the type used in warm air heating systems are attached to the walls of this enclosure and effectively damp out undesirable cavity resonances.

The horn walls of this speaker are constructed entirely of ¼-in. plywood. The shelves, uprights, and the bottom are made of ½-in. plywood. (It is suggested that heavier wood be used for the uprights to aviod warping which has been observed over a period of fifteen months.) Plenty of bracing eliminates undesirable vibration. *Figure* 8 shows one of the two damping plates which were constructed to keep the outside walls from vibrating. They consist of a piece of ½-in. ozite glued to the outside of the walls, covered in turn by pieces of quarter inch plywood screwed to the walls through the ozite. The resistance offered by the ozite under pressure eliminated vibrations in this area. The plates must be large so that the entire area does not vibrate as a unit. No internal cross braces were found necessary.

* *Physics Department, Grinnell College, Grinnell, Iowa.*

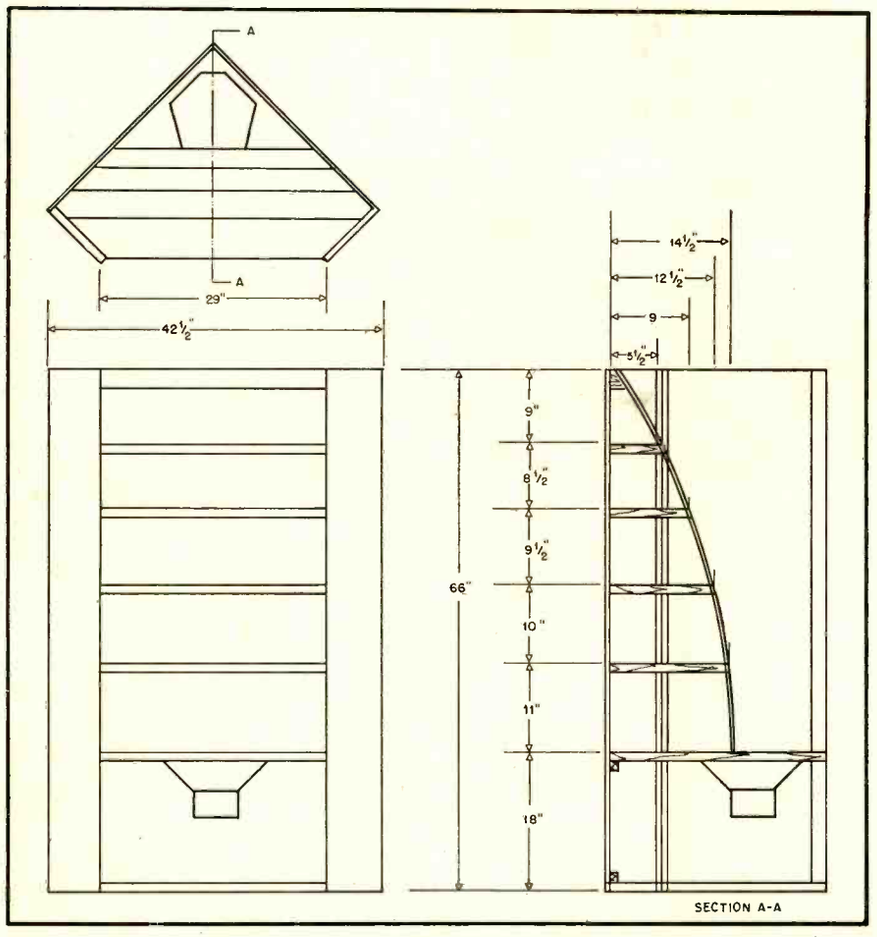

Fig. 6. Constructional details for the vertical corner horn speaker, showing top and front views, together with section through the center of the unit.

Speaker Ranges Required

This woofer is designed to be used in conjunction with additional speakers for the middle and upper frequencies. Tests have indicated that although the response of the woofer continues to rather high frequencies, the "presence" is decidedly enhanced by the use of a low cross-over frequency. The writer uses a cross-over of 300 cps.

An alternative arrangement used earlier by the writer consisted of a two-way speaker in place of the woofer. In order to avoid directional effects, a curved reflector was placed in the upper corner of the room directly above the horn to disperse the middle and upper frequencies into the room. Results were excellent though rather unusual. The apparent source of the sound was, as might be suspected, at the upper corner of the room. The arrangement was finally discarded partly because members of the writer's family objected to the "buzzard's nest" way up in the corner.

It will be noted that the exponential "curve" is obtained by the use of straight boards, each one attached to two shelves.

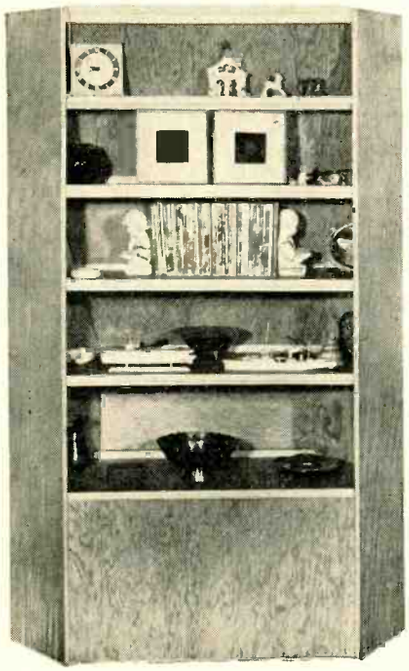

Fig. 7. Corner cabinet with vertical horn. The shelves serve to camouflage the horn and to add rigidity to the entire structure

In contrast to the other speaker described, this one is almost exactly exponential in shape. The results are better at extremely low frequencies. This is attributed to the shape and to the fact that the entire structure is larger.

In order to eliminate leaks, rubber weatherproofing strips were used to seal the corners of the horn. These strips are seen in *Fig.* 9. Their use eliminates the problem of precise fitting and also eliminates the transmission of vibrations from certain members of the structure to adjacent panels. The shelves, uprights, and other partitions are assembled with screws—nearly two gross.

Since this was originally an experimental unit, plywood was used to lower the cost. Obviously, solid woods or hardwood veneers can be used to improve the appearance, but their use would, of course, greatly increase the cost.

Preliminary Model

The two horn speakers described are merely examples of what can be done. There is no doubt that other constructors can make further improvements by added refinements in design and construction. It is earnestly suggested that anyone who desires to construct a horn speaker should first make a cardboard model. The model should incorporate all the main features of the desired structure. Its use permits the constructor to anticipate difficulties and to discard an inferior design before the speaker is started. The writer constructed several such models before building each unit. All but the last models were discarded for reasons of appearance, acoustic difficulties, or difficulties in construction. The added time spent with cardboard, shears, and scotch tape was a small price to pay for the effectiveness of the completed speakers. With one exception noted earlier, no changes were required to achieve good acoustic results. It's much cheaper to make mistakes on cardboard.

The writer's complete speaker installation consists of the two horn units described in this article, one bass-reflex unit, and high-frequency speakers. These several loudspeakers so diffuse the sound that visitors invariably ask, "Where is the sound coming from?" Like many others, the writer prefers diffused sound to that which comes from a point source.

In conclusion, two warnings should be given the prospective builder of a horn speaker. First, the improvement in low-frequency response is invariably accompanied by an increase in motor rumble. That phonograph motor which used to be "quiet as a mouse" is likely to take on the character of a roaring lion unless it is well made or unless some sort of noise suppression is used which is effective at the lower frequencies. As every audio enthusiast knows, improvement in one element of a reproducing system is likely to make deficiencies in other elements the more obvious. The second warning has to do with the fact that the larger of the two units described in this article is assembled with screws rather than with glue. The reason is—well, do you remember the story about the man who built a boat in his basement and then couldn't get it outside?

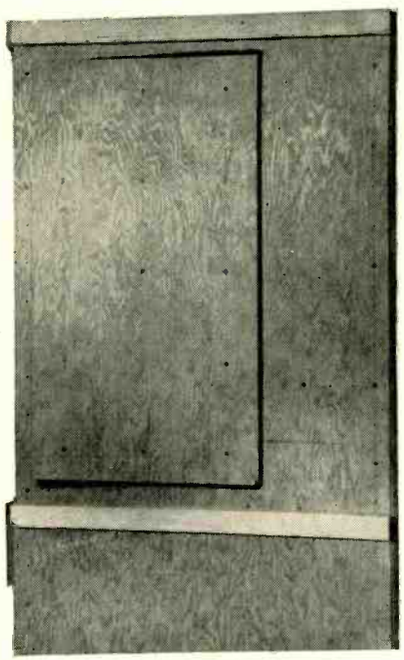

Fig. 8. Side view of the vertical horn. The damping plate eliminates all objectionable vibration from the horn walls.

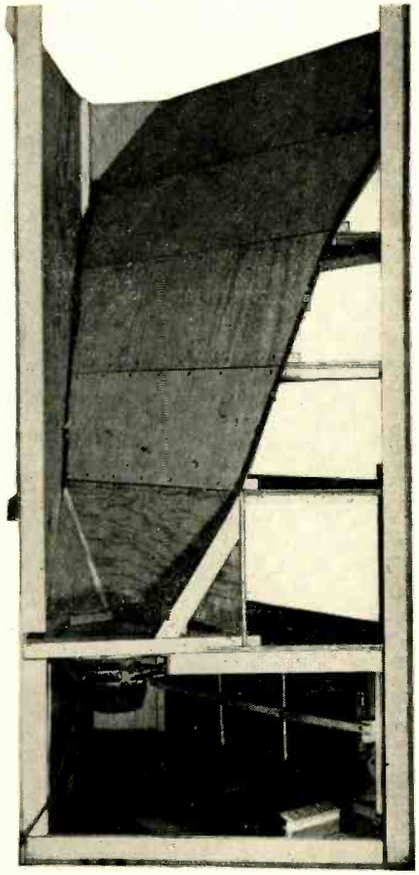

Fig. 9. Vertical horn with side removed. The constructional features of the horn and speaker chamber are clearly shown.

British Radio Component Show, 1952

Grosvenor House, Park Lane, London, is the scene of the Ninth Annual Private Exhibition of British Components, Valves, and Test Gear for the Radio, Television, Electronic, and Telecommunication Industries for three days, April 7 to 9 inclusive.

This exhibit, organized by the Radio and Electronic Component Manufacturers' Federation, will present the products of over a hundred exhibitors, bringing new evidence of research by component manufacturers toward more reliable equipment for rugged atmospheric conditions, and with increased efficiency. The trend toward miniaturization is also shown by this year's exhibits.

Among the improvements to be shown are wire insulations and sleevings which have increased resistance to high temperatures, ceramic insulators of a variety of materials, and several grades of laminated plastics.

The show extends to assemblies, with new three-speed record changers in the forefront of interesting audio items, along with a new magnetic pickup of turnover design—possibly indicating that the British record industry will bring out records in more than one speed for domestic use.

That loudspeakers have an effect upon TV pictures is acknowledged by one manufacturer, who has wisely introduced one model of permanent magnet speaker which employs a totally enclosed magnet to reduce the external field. Another manufacturer is exhibiting a new pressure-type loudspeaker unit, together with vibration equipment for industrial research.

In spite of defense requirements, British manufacturers are still able to meet demands for civilian and export markets, although shortages are experienced from time to time in certain fields, and some items are confined to Government use.

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The Problems of Low-frequency Reproduction

SAUL J. WHITE*

A discussion of the characteristics which must be built into a low-frequency loudspeaker in order to maintain good efficiency with as smooth a response curve as possible.

A LOUDSPEAKER capable of extended low-frequency range without compromise of other values does not exist today. So-called "woofers" are often merely large cone speakers in which the frequencies above about 2000 cps are mechanically attenuated in the moving system, by mass or by compliance in the body of the cone. All that may be expected in most conventional woofers is this high-frequency loss, while a significant downward extension of frequency is rare, hence there is gained only some assistance to the work of the crossover network. This statement, however, excludes certain applications such as motion picture and professional installations, but here, too, there is room for improvement.

There are many antagonistic factors that harass the designer. The ideal low-frequency loudspeaker should fulfill the following requirements. It should have:

1. Uniform acoustic output from 20 cps up to any arbitrarily chosen cutoff.
2. High conversion efficiency throughout this transmission range, i.e., 50 to 100 per cent.
3. High power-handling capabilities.
4. Low distortion.
5. Excellent transient response.
6. Achieve above characteristics in an enclosure of reasonable volume.

While these specifications may appear reasonable to the average listener, the loudspeaker engineer is aware of the intensely conflicting operations of these objectives. No single transducer has been designed capable of satisfying all of the above requirements. As examples of the recalcitrant nature of the problem, consider that high conversion efficiency requires, generally, small mass, large compliance and negligible damping, but these qualities give poor response and poor power handling ability. Small mass demands a small area cone, hence inadequate radiation resistance and poor low-frequency output. Large-mass vibrating systems produce lower values of frequency, but in order to suspend this weight adequately, the suspension is made stiffer, thus partially cancelling the low-frequency trend.

"Reasonable size" means that the speaker and its enclosure can be moved readily through the doors of the average home, yet low frequencies are associated with massive speakers, enclosures, or horns. The dimensions for 20-cps reproduction using a piston or a horn, are fixed by physical law. These dimensions reach terrifying proportions if the instrument is designed for a living room. Other problems and contradictions that stagger the designer will be brought out later, but as implied in the opening sentences, practical considerations impose many compromises upon the present day type of low-frequency loudspeakers.

Despite the low-frequency shortcomings, the speaker art has progressed tremendously in the way of good fidelity, and truly extended high frequencies. It is possible today to obtain 12-in. cones whose response extends to 10,000 cps without the aid of tweeters, whereas not so long ago 5,000 cps was the upper limit. In order to analyze low-frequency performance, it will be helpful to consider several basic formulas and relationships. First let us take up the parameters which establish fundamental resonant frequency.

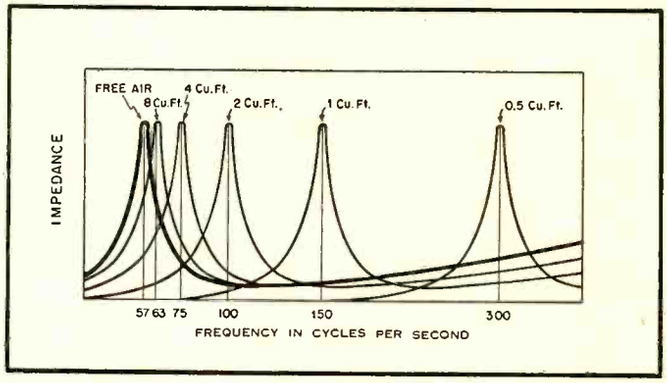

Fig. 1. Cabinet volume vs. resonance, showing typical responses from cabinets of different sizes.

Resonant Frequency

The relationship for mechanical resonant frequency of a diaphragm type moving-coil loudspeaker is revealed by

$$f_r = \frac{1}{2\pi}\sqrt{\frac{S}{M}} \qquad (1)$$

where f_r = frequency of fundamental resonance
S = stiffness of system in centimeters per dyne
M = mass (weight) of moving system in grams.

The term S refers to the restraints against vibration which are developed in the cone-rim beads, and to a smaller extent, in the spider. Thus S denotes the "springiness" of the area which supports the vibrating mass, and is com-

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monly called the stiffness of the moving system. A large value of stiffness means that there is a large mechanical restraint against the movement of the cone in one direction, and a release of a correspondingly large amount of stored energy in the opposite direction. Thus an increase in stiffness, which gives certain desirable qualities to a speaker, raises the fundamental resonant frequency—usually undesirable in a woofer.

Equation (*1*) shows that because of the square root relationship a rather large change in stiffness or mass is necessary to provide a substantial change in resonant frequency.

Cabinet Volume

If the speaker is enclosed in a simple non-vented cabinet, the total stiffness becomes the sum of the cone-rim stiffness and the cabinet stiffness, since the imprisoned air acts as an air spring and imparts additional mechanical impedance to the vibratory action.

Increasing the cabinet volume reduces the degree of this air stiffness, tending to lower the resonant frequency. But this effect grows progressively smaller because the stiffness of the cone rim remains large and is unaffected by cabinet volume. This explains why, beyond a certain cabinet volume, there is insignificant increase in bass. See *Fig.* 1. There can be no lower fundamental resonance than the free air resonance. The writer knows a number of experimenters who removed a speaker from a 4- or 5-cubic foot cabinet and built it into a wall, with disappointing results. The reason for this disappointment is the relatively high stiffness which is built into the cone suspension and over which there is no control. The cabinet stiffness can be relieved by increasing its volume. However, once all the stiffness is removed, as for example by using a true infinite baffle, then only the cone stiffness remains. The low-frequency performance is poor below the resonant frequency.

Force Acting on a Diaphragm

$$F = Bli \quad (classical) \qquad (2)$$

or more practically

$$F = B \times ampere\text{-}turns.$$

From the designer's standpoint,

$$F = B \times \frac{Volume\ of\ copper}{Volume\ of\ air\ gap} \times Amperes$$

where F = force acting on voice coil
B = flux density in air gap
l = engtth of copper wire in voice coil.
i = current through voice coil.

The above formulas show the force acting on the voice coil in the presence of a given signal, but do not yet represent the acoustic output. In fact, they do not necessarily indicate the force that moves the cone because of coupling losses between the voice coil and the main area of the cone. Equation (*2*) expresses a coupling factor between voice coil and gap flux, and is involved in the following equation for acoustic output:

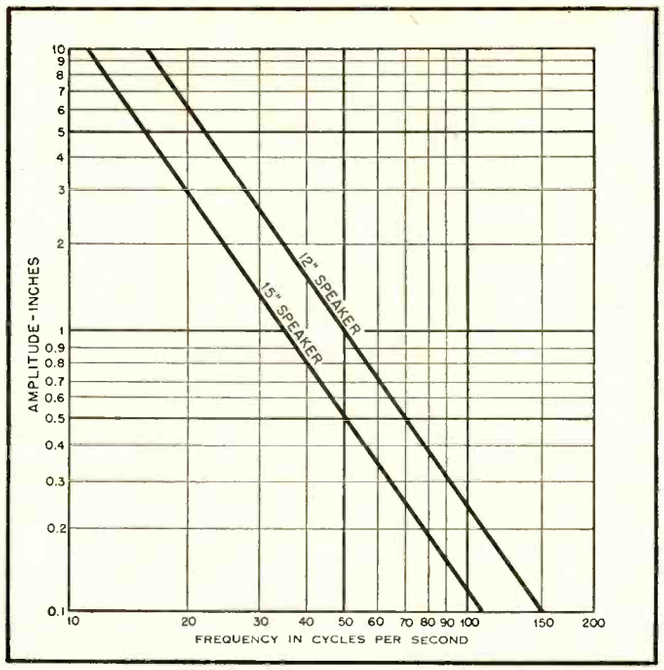


Fig. 2. Peak-to-peak cone excursion required to radiate 1 acoustic watt of sound energy. (Based on Henney: "Radio Engineers Handbook," 3rd Ed. page 889.)

$$P = \frac{D^2 R_r E^2}{10^7 Z_m^2 Z_e^2} \qquad (3)$$

where P = average acoustic output power in watts
D = electromechanical coupling factor
R_r = radiation resistance on cone
E = rms volts across voice coil
Z_m = mechanical impedance
Z_e = electrical impedance.

The term 10^7 converts ergs per second into watts. The term D is similar to the force F in equation (*2*) and involves gap constants such as flux and amount of copper. The term R_r, or radiation resistance, requires some explanation.

Radiation Resistance

Direct-radiator speakers are inherently poor radiators at low frequencies because of the low radiation resistance which is presented by the atmosphere. Although a cone may have a large vibration, it does not follow that it transmits sound energy to the air. It can have an amplitude sufficient to rupture it, yet the sound propagated is negligible.

This is the case when the diaphragm is small compared to the wave length of sound it is trying to propagate. For instance, at 200 cps a 12-in. cone is an efficient radiator, but at 20 cps even a violent movement produces practically no 20-cps fundamental acoustic energy. The listener hears the harmonics generated because of the large distortion present at this frequency. The fundamental frequency is unheard because there is insufficient diaphragm surface acting on the atmosphere.

The diaphragm acts in conjunction with air, which is its load. In order to deliver the necessary acoustic energy to the air it is necessary to employ a definite number of air particles to propagate the energy. This involves a definite reaction between diaphragm and atmosphere and fixes the minimum dimensions of the cone. If a diaphragm is too small for the frequency of its vibration, it has only slight resistance opposing it and it is not possible to impart all the energy of the diaphragm to the air. This is the condition of inadequate or low *radiation resistance.*

The atmosphere is capable of absorbing a large amount of cone energy if the cone is large relative to the wavelength, and efficient transfer of energy takes place. Thus more sound is produced with smaller cone excursions. This is the condition of *adequate or high radiation* resistance. Therefore, loudness at low frequencies can be increased by forcing more air particles in contact with the diaphragm. This is accomplished by using a large diameter cone, in the case of direct radiators, and by using a slow flare and large mouth in the case of horn speakers.

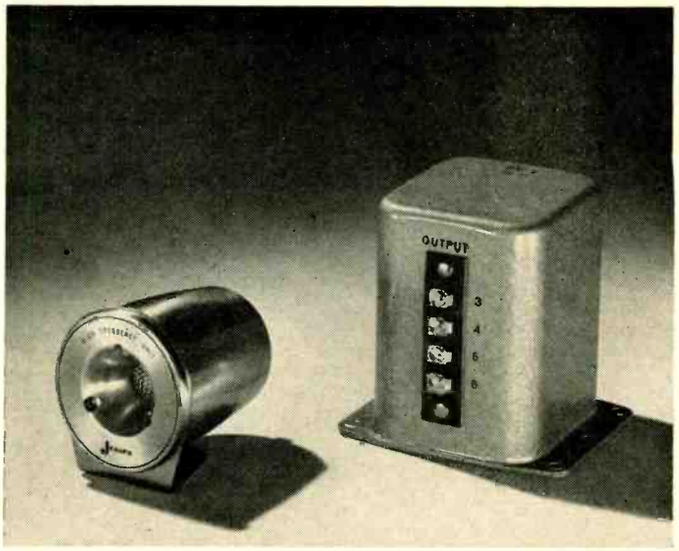
Looked at in another light, the entire atmosphere is the load for the loudspeaker. Where there is no load, there can be no absorption of energy. Incidentally, the listener's ears are a part of, and within this load.

If the acoustic output is to be independent of frequency, which is required for uniform response, it is of course required that the various terms of the expression in equation (*3*) be independent of frequency. Unfortunately, R_r and Z_m are both frequency dependent, and thus the requirement for linear output is difficult to attain at low frequencies. For frequencies *at* and *below* resonance, R_r, the radiation resistance is proportional to the square of the frequency. This term shrinks as frequency drops, hence efficiency falls off rapidly. This is seen from *Fig.* 2, which shows the peak-to-peak excursion for 1 acoustic watt output. The chart indicates that for a given cone diameter, a decrease of one octave increases the excursion by a factor of four.

The Z_m term for mechanical imped-

[*Continued on page 47*]

Fig. 1. The tiny super-tweeter, with its dividing network—a constant-resistance network, nor just a series capacitor.



New!

"The Super Tweeter"

RALPH P. GLOVER* and KARL KRAMER**

Available at last—an accessory unit which provides smooth high-frequency response, including that top octave so hard to obtain, even with a good two-way system.

AFTER TWO YEARS of production and extensive public experience with the G-610 Triaxial[1], a three-way loudspeaker with an unusually smooth and greatly extended high-frequency range, it is possible to draw some definite conclusions, important to everyone interested in truly high quality reproduction, conclusions which have fundamental significance apart from the merits of this particular loudspeaker. They are, as we see them:

Fig. 2. Similar in size and appearance to the Jensen high-frequency control, the super-tweeter may be installed in the baffle as shown here.

1. The reproduction of the middle-to-extreme high frequencies with *smoothness* and *low distortion* is very much worthwhile; the condition is *essential* if we are to take full advantage of the potential contribution of the "highs" to realism in recreated sound.
2. The advantages of using a special high-frequency unit for the top end of the frequency range are very definite and readily appreciated when an opportunity for careful comparison of high-quality systems is presented, being evidenced by the elimination of these shortcomings of high-end extenders which over-reach sound design principles in their attempt to cover too wide a frequency range: Lack of "separation" of orchestral instruments; "smeary" reproduction of vocals; "throaty" or "nasal" coloration of the music; "wiry" roughness in high fundamental and overtone structure; perceptible "ringing" background noise. In the one case there is a definite satisfactory sensation of "transport to the original;" in the other a feeling of the interposition of a mechanical device with superficial attributes of "presence."
3. A perhaps not-to-be-expected dividend of the "clean" high end has turned up in respect to noise and system distortion. A loudspeaker system with a smooth (though well extended) high-frequency range has been found to be substantially more tolerant of distortion and of record, tape, and tube noise present in the incoming signal. Distortion from the source is not magnified and harshened; the noise is more "silky" and less tonally colored.
4. All of these unreal and undesirable effects can be eliminated by substituting a cleanly-extended high-end for the offending one. This can be done with virtually no mechanical difficulties, and with the simplest of wiring changes, by means of the accessory high-frequency unit and network described in this article; cost is only about one-third that of an upper-bracket 15-inch coaxial speaker.

As illustrated in *Fig.* 1, the RP-302 High-Frequency Unit is basically an externally modified version of the top (third) acoustic channel of the G-610 Triaxial, designed into a streamlined case with removable bracket for top-of-cabinet mounting, *Fig.* 3, and arranged so that it can be installed flush on the

* *Product Manager and* ** *Technical Service Manager, Jensen Mfg. Company.*

[1] Plach and Williams, "A new loudspeaker of advanced design," AUDIO ENGINEERING, October 1950.

front surface of a cabinet or baffle, as in *Fig.* 2. The unit is intended to serve (1) as a moderate cost *acoustic* replacement (mechanical and electrical changes in present speaker equipment are unnecessary) for the h-f end of loudspeakers with insufficiently extended, deficient, or distorted h-f response, and (2) as the third or top channel of a three-way divided system being built from "scratch."

Figure 4 is an exploded view of the "super tweeter" showing how the unit comes apart for flush mounting. The three screws are removed from the front, after which the horn piece can be inserted into a 1-11/16-in. diameter hole in the panel. The driver unit is then reassembled to the horn and the cover acts as a clamp from the rear to hold the assembly tight to the panel. *Figure* 3 shows the unit in place, flush mounted on the cabinet.

Electrical Connections

As will be seen from the block wiring diagrams, there are several ways of applying the "super-tweeter" to existing loudspeakers or systems:

1. Eliminate highs above 4000 cps from the existing loudspeaker or system electrically by means of a crossover network such as the A-402; feed the RP-302 from the crossover network, so that it alone is reproducing in the range above 4000 cps. See *Fig.* 5, (A) and (B). (This method has outstanding advantages since it eliminates rough and distorted high-end acoustic output from the original equipment as well as improving the efficiency and extending the range of the h-f response. If you think your present coaxial or divided two-way system is as good as it can be, try this.)
2. The high frequency unit may be bridged across the input to the present speaker with a 1-μf condenser in series with the unit as shown at (C) and (D). (The series condenser is essential here to keep low frequency power out of the h-f unit, which may be damaged otherwise. This method is useful for extending h-f range and improving efficiency and gives good results with many speakers.)

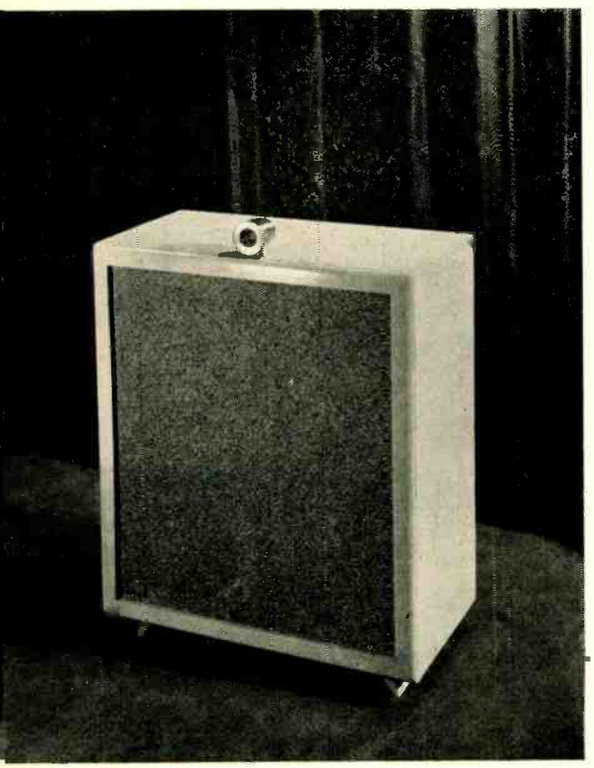


Fig. 3. The simplest mounting—on top of the existing cabinet.

Inconspicuous, yet effective, this unit has been tested for over a year in the original McProud speaker cabinet with exceptionally pleasing results. Now it can be told—

The efficiency of the super-tweeter is appreciably higher than that of most commercial speakers, and an L-pad is usually desirable between the network and the unit to adjust the h-f balance.

Technical Data

The RP-302 super-tweeter has an impedance of 16 ohms, and the voice coil is wound with aluminum wire to minimize mass. The phenolic diaphragm works into a high-frequency horn designed in accordance with the Hypex formula. The frequency range extends from 3500 to 18,000 cps, and the coverage angle is useful over 120 deg. The power handling capacity of the unit is adequate for a system of 30 to 40 watts output, when used with the A-402 Crossover Network. Obviously, if a test signal at this level were applied to the unit over the high-frequency range, damage would result, but with normal power distribution of speech or music, the super-tweeter is capable of handling the output of a high-power amplifier.

The A-402 Crossover Network is of the constant resistance type, in a parallel configuration. It consists of two inductances and two capacitances, and has an insertion loss of less than 0.25 db in the pass band, and with an attenuation of 12 db per octave each side of the 4000-cps crossover in the two channels. Its impedance is 16 ohms, to match the speaker unit.

(Editor's Note: Over a year ago, one of these units was sent to us for our trial in the field. On the evening of the day it was received, it was connected to our present two-way system, consisting of a 15-in. woofer in a corner cabinet, shown above, with an 8-cell high-frequency horn of excellent performance. The super-tweeter adds considerably to the entire installation, providing the extra bit of brightness that aids in establishing the illusion of reality. The improvement is definitely noticeable, and all who have heard it have been anx-

[*Continued on page 52*]

Audio in the Home

William C. Shrader*

Custom assembled home music systems offer better sound quality, provided the various components are selected with a view to their ability to work well together.

soles. One of the reasons we choose these parts in preference to the console is that cabinet shops often charge ridiculous prices. Cabinets represent as much as $200 to $300 in trade-name sets, and this is probably one of the reasons they are so expensive. A custom set, on the other hand, can be housed in utility cabinets for about $100. We are able to choose components that work well together, and because they are separate they adapt themselves more readily to home installations than any mass produced console. Those who demand and can afford fine cabinetry can adapt the equipment to the style of cabinet that best blends wih the decor of their living rooms. It is important to point out, however, that merely picking up an amplifier here, a speaker there, and a radio tuning device somewhere else is not likely to assure satisfaction. It is necessary to obtain an amplifier that is free from hum and that has flexible tone controls that do not induce

Either built-in or as separate cabinet units, a well planned system can still be attractive. Photo at the left by the author; below by Electronic Workshop.

SINCE THESE ARTICLES are intended primarily for a large, new group of readers who are interested in music and high fidelity but who are not engineers, we might note here that certain words commonly used by both have completely different meanings for engineers and for musicians. *Flat,* for instance, means to a musician a half step lower than any given tone or that a certain tone is not up to pitch. The engineer uses it to mean that an amplifier has uniform intensity throughout its range. Another two-meaning word is *resonant.* A voice teacher rejoices upon discovering a singer with resonant timbre, but a sound engineer grits his teeth when a loudspeaker is resonant, because then it makes the loudness of some tones greater than others. A musical tone is produced by regular vibrations of the air. (Irregular vibrations produce noise.) A certain number of vibrations (or cycles) per second are a given tone. If we call 261 cycles per second middle C, more vibrations per second produce a higher tone and less a lower one. It might also be worthwhile to state that cycles have nothing to do with the quality of sound, but effect only its pitch. As an example, middle C has a different character of sound when created by an organ pipe than when it is created by a trumpet, but, in each case, the air vibrates regularly 261 times a second. So much for this month's educational section.

In this article, we shall concern ourselves with a group of components which sell in radio parts houses for about $250 and which equal the performance of most $500 or $600 commercial con-

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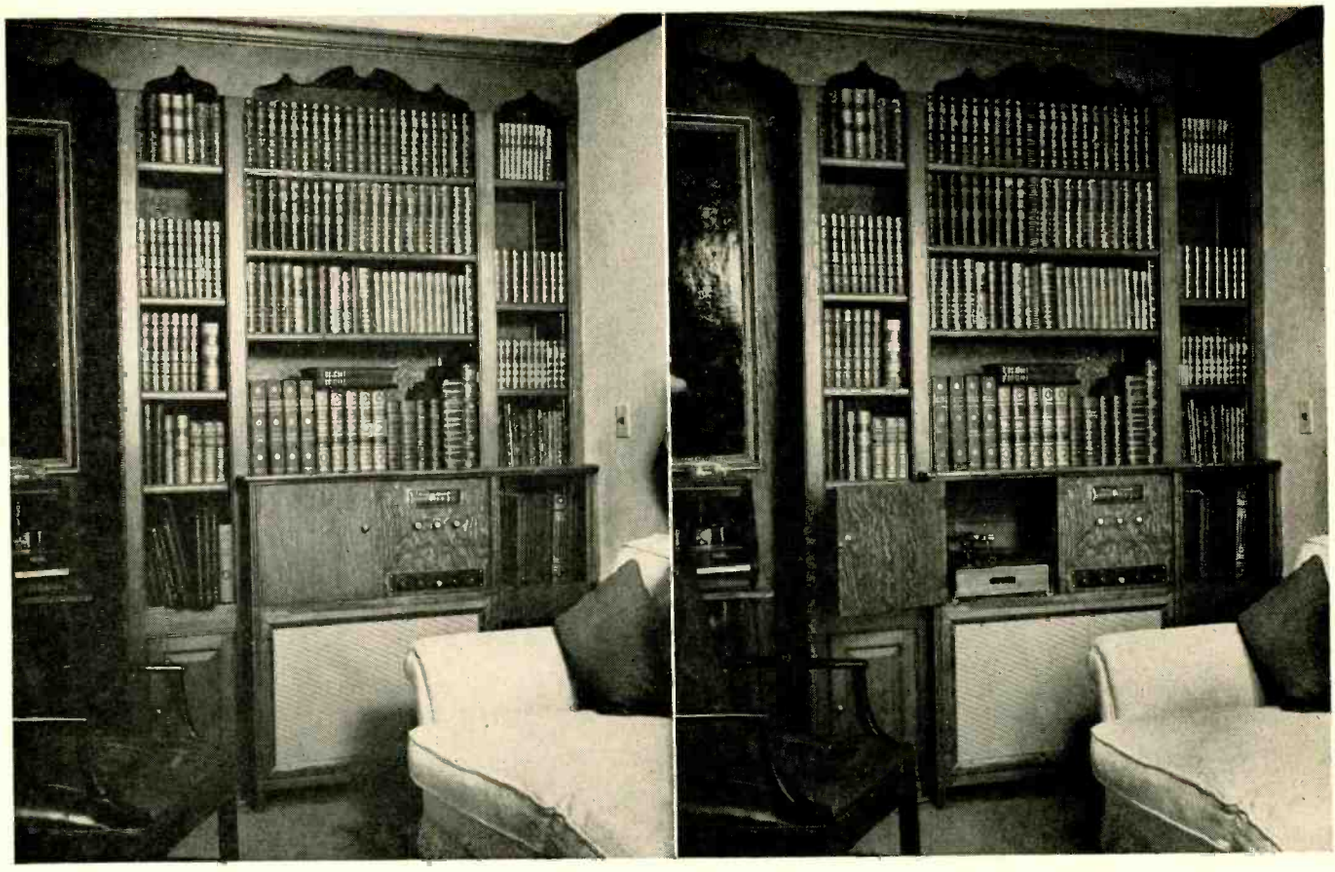


Bookcases are often adaptable—as shown here—for housing all the necessary equipment. Tuner, amplifier, record player, and adequate speaker space are provided in this attractive installation.

too much distortion into the system, and to house the speaker in a proper acoustic chamber. In only one of the presently available commercial consoles has any attempt been made to house the speaker in an acoustically correct manner, and this model starts at $750.

The manufacturer of a conventional console designs his set for the housewife mainly. When she goes forth to buy a radio, she wants one that will look well in her living room, uses space economically, and can be operated with push-button ease. She usually goes home with a gleaming piece of hand-rubbed furniture that cost several hundreds of dollars and which, incidentally, contains a radio which she may or may not have heard. The genuine music lover or high-fidelity fan who, until recently, was thought too small a segment of our economy to court commercially, exactly reverses the housewife's preferences, putting a premium on sound rather than sight. He is not likely to want short-wave, push buttons, or fancy cabinets, and he cares little for a lot of gadgets which often don't work well anyway. His special interest is in equipment that can produce an octave above and below normal radio fidelity, and when he is shown or told about it, his usual reaction is, "Let me hear it."

Cost vs. Quality

In most cases, a high fidelity buyer can purchase a basic system at 40 per cent off list prices, and this is a substantial saving for good equipment. People often wonder, "What is the most important component in a system? Do I want a $150 amplifier and a $20 speaker? Or, do I want an inexpensive amplifier with an expensive speaker? Where can I compromise or where will a few more dollars do me the most good?" The primary consideration is balance. To obtain it, a like number of octaves must be added each way from approximately 800 cps (cycles per second). The addition of a tweeter or high-frequency speaker alone can cause unbalance and impair rather than improve results. Similarly, the addition of a folded horn or large bass-reflex cabinet may cause the speaker to sound dull and dead if a like increase is not made in the high register.

Since music reproduction in the home is far from perfect, there are many conflicting approaches to the selection of components, and there are as many dogmatic salesmen so oversold on particular items that they are not open to other opinions. In visiting your dealer's salesroom, you may find this approach, and you will do well to bring along your own records and insist upon hearing them at volumes more normal to a living room than to a boiler factory. In demonstrations of their own products, manufacturers will use compliments that most flatter them, and these components are accepted by engineers only after having been proven in the field, not through well-known advertising blarney.

We would like to commend the consumer testing laboratories, whose contributions have been a great asset to our field in general. It is obvious that most products recommended by them are good. However, since they buy and test only a few units of a particular brand, these particular units may not necessarily reflect a true picture of that brand. We realize, of course, that they have neither the money nor the time to do otherwise. The performance, over a period of time of hundreds of items gives a truer picture of a product than can be derived from a few isolated units. It is imperative to custom dealers that components be free from excessive servicing requirements, because these dealers work in close conjunction with the customer, even after he has purchased his equipment, and they guarantee its performance. This close contact quickly shows any change for the worse in the quality of a line of equipment. A brand with uniform quality of units, few breakdowns, and ease of installation in the field may be much superior to a recommended component whose frequency is a db better.

Since we are confining ourselves to a $250 system in this article, we can begin with the record player portion, as its price is pretty much a fixed one. Most people prefer record changers. One that is free from hum and rumble and has a constant speed will cost from $35 to $40. With two good,

[*Continued on page 54*]

IRE SHOW REVIEW — 1952

HARRIE K. RICHARDSON

WHEN THE DOORS closed on the night of March 6, signifying the final curtain of the 40th annual convention of the Institute of Radio Engineers, more than 30,000 visitors had passed through the doors of New York's Grand Central Palace to establish the 1952 Radio Engineering Show as the most lavish electronic exhibit of all time.

Displays approaching the four-hundred mark brought the value of equipment on exhibit well into the millions. So much for the affair from a dollar-and-cents viewpoint.

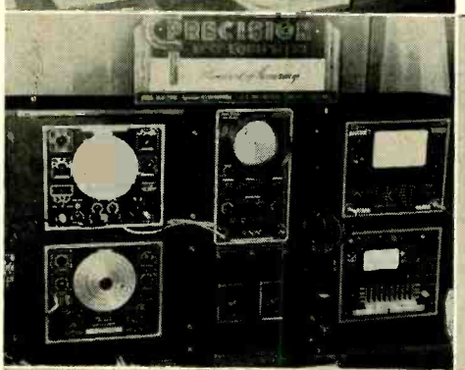
From where this observer sits, the real and lasting value of the I.R.E. get-togethers has always lain in the great amount of technical information available to those visitors whose yearly attendance is based on a sincere desire to become better read and better informed in the industry which provides their livelihood. In the past, the *availability* of such information has been beyond question—however its *accessibility* has been one of those things we don't talk about. This year we not only talk about it—we shout about it to the skies.

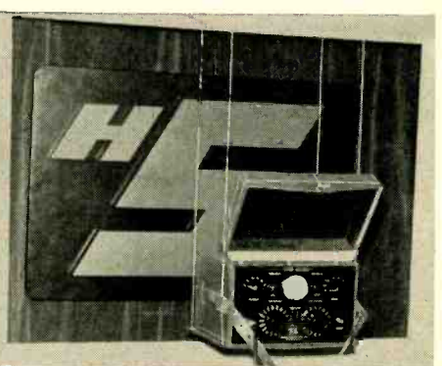
Aside from the increase in exhibitors and in attendance, the 1952 I.R.E. conclave will cement its place in history because of its great advances in the handling of organization in general, with particular emphasis on the manner in which attendance at technical sessions was expedited. Public relations was another aspect of the event which received great improvement over efforts of previous years.

Both satisfaction and reluctance prevail in the mentioning of a few names—George Bailey, Will Copp, Woody Gannett, Haraden Pratt, and Lew Winner—for their part in motivating this creditable move forward. Satisfaction because such mention gives credit where credit is deserved—reluctance because it withholds, consciously but not intentionally, equal credit which is due so many others whose efforts were no less impressive.

A similar conflict brings forth mention of but a few of the hundreds of excellent exhibits:

Altec Lansing Corporation, giving full recognition to the professional aspect of the show, emphasized industrial ampli-





Far left: Audio Engineering, Altec Lansing Corp., British Industries Corp., General Electric Co., Par-Metal Products Corp., United Transformer Corp. Left: Presto Recording Corp., Precision Apparatus Co., Inc., Radio Corporation of America. Below: Hermon Hosmer Scott, Inc., Shallcross Manufacturing Co.

fiers and broadcast equipment in its exhibit. The display was particularly enlightening to persons whose essential interest in audio is based on their activity in the field of home equipment. A lot of folks were surprised to discover that Altec is not engaged solely in the production of 604B's, 820A's, and 755A's. If the truth of the matter be known, Altec was a name of prominence in the professional field long before audio had achieved standing as a national hobby.

Amperex Electronic Corp., occupying the same prominent main-floor display space as in previous years, gave full meaning to the familiar slogan—"Something new has been added." Recent additions to the Amperex line have broadened it to the point that it now includes power tubes for almost every transmitting and industrial application. No company in the industry has shown greater growth than Amperex in recent years.

Ampex Electric Corp. chose to de-emphasize the interest which would normally be accorded the Ampex tape recorders for music recording, and centered attention of viewers in the new Ampex units for telemetering and for various forms of instrumentation. In this connection the Company experienced a fortunate coincidence in the fact that the Show's military exhibit, ably and sensibly co-ordinated by Llewellyn Bates Keim, also featured one of the new Ampex models.

Amplifier Corporation of America clearly exemplified the extent to which the company has entered the world of tape recording. Extremes were represented by a rack-mounted slow-speed tape recorder which permits 24 hours of recording for such installations as airport control towers, and by the tiny Magnemite, a miniature recorder which uses built-in battery power supply for filaments and plates, and a spring-wound precision-built motor for tape drive. Of the two, the Magnemite created greatest attention, being by far the smallest self-powered tape recorder available. The attractive sign which proclaimed "It's New — It's Tiny — It's Sensational" was not guilty of overstatement.

Audio & Video Products Corporation featured in its display the Ampex Type 400A tape recorder. Although restricted against using audio equipment in display booths, personnel of the A-V exhibit did well by the 400A by showing its mechanical features. Its audio performance is too well established with those "in the know" to require actual demonstration.

Audio Devices, Inc., taking a cue from last year's successful showing, repeated the interesting sound movie which both illustrates and explains the various processes involved in manufacturing Audio-tape. Produced in color, this film is thoroughly fascinating and should be seen by everyone with an interest in tape recording.

Barker & Williamson, Inc. attracted attention with a complete display of B & W test equipment and in the extensive line of unique coils and components which the company makes available to manufacturers of electronic equipment. B & W, because it offers test equipment of excellent quality at moderate price, has assumed a position as one of the country's leading suppliers of precision instruments.

Berlant Associates, Inc., was represented by the new Network Model Concertone tape recorder. Although the unit was shown at last year's Audio Fair, this was its first appearance before an IRE group. The hit it made in both instances leaves no doubt that Berlant has created another winner. Also on display was the Network model's famous forerunner, the original Concertone for home and professional use. Both models were demonstrated in conjunction with the new Fisher "laboratory standard" amplifier (see Fisher review).

British Industries Corporation captured the interest of audio hobbyists and production engineers alike with a varied display which included Garrard record changers, the Leak "Point One" amplifier, Wharfedale speakers, and Ersin Multi-Core solder. Although Garrard, Leak, and Ersin are pretty well established in this country, Wharfedale is just beginning to win its spurs. Present indications are that those spurs, when won, will place the name Wharfedale in a position of unquestioned prominance in the high-quality speaker field.

The Daven Company, as might be expected, came through with an impressive display of attenuators and test instruments for a limitless variety of applications. Clearly established was the fact that Daven, today as in years gone by, is unsurpassed in the manufacture of precision components.

Fisher Radio Corporation devoted the bulk of its display to an introductory showing of the new Berlant Concertone network-model tape recorder, for which Fisher is exclusive Eastern distributor. Another new item shown was the recently-announced Fisher "laboratory-

Far right: Audio Devices, Inc., Audio & Video Products Corp., Barker & Williamson, Inc., Amplifier Corporation of America, Berlant Associates, Inc., Fisher Radio Corp. Right: Ampex Electric Corp., Gates Radio Co. Below: Amperex Electronic Corp.

Left, top to bottom: Jensen Manufacturing Co., University Loudspeakers, Inc., Racon Electric Co., Inc., Magnecord, Inc. Center, top to bottom: Standard Transformer Corp., James B. Lansing Sound, Inc., Terminal Radio Corp. Right, top to bottom: Sylvania Electric Products, Inc., Waterman Products Co., Inc.

standard" audio amplifier. Together the Concertone and the new Fisher amplifier provided an impressive example of high-quality audio in action.

Gates Radio Co. came up with an exhibit that was a broadcast engineer's dream — everything from an FM relay transmitter to a sound effects console. The latter—a three-table job with all the known trimmings, not to mention a few that were shown here for the first time, will permit a single sound-effects man to perform 99-99/100 per cent of the acting on the average Western.

General Electric Company, following through on the foothold it has established in the high-quality audio field, devoted an impressive portion of its comprehensive exhibit to the GE variable-reluctance pickup and the GE 1201 loudspeaker. Both of these items, the VR pickup particularly, were among the first to result from the demand for fine audio performance in the moderate-price range. They still create more than casual interest wherever exhibited.

Hermon Hosmer Scott, Inc. chose the occasion of the show to introduce an advanced version of the company's well-known Sound Level Meter. Although its original prominence was in the audio field and was based largely on the Scott Dynamic Noise Suppressor, the Scott organization today is expanding rapidly in the field of industrial electronics.

Jensen Manufacturing Company made full concession to the fact that its products must be heard as well as seen in order to be fully appreciated. In a sound room adjoining the Jensen display space, company representatives conducted a continuous demonstration of the famous Jensen G-610 Triaxial speaker. High-quality tape recordings, amplifying equipment of matching caliber, and the G-610 combined to produce an over-all audio performance that was truly magnificent.

James B. Lansing Sound, Inc., Magnecord, Inc., and McIntosh Engineering Laboratory conducted a joint display which was built largely around a demonstration of binaural recording. Great indeed is the loss of those who missed this exhibit. Impeccably recorded tapes were fed from a binaural Magnecorder through McIntosh Type 50-W-2 amplifiers into two Type 1004 Lansing corner speakers, creating an aura of reality that surpased illusion. This display also was the introductory scene for the new MagneCordette (see New Products, page 42)—a home-music-system version of the professional Magnecord series.

Par-Metal Products Corporation emphasized once more the reasons for the company's eminence in the field of metal chassis and enclosures for electronic equipment. On display was an impressive variety of solidly-built, handsomely-finished cabinets for every type of housing problem—from chassis for tiny amplifiers to enclosures for complete transmitters.

Precision Apparatus Co., Inc., in addition to showing its complete line of test instruments for radio and TV servicing, introduced a new 5-inch oscilloscope which will have many applications in the laboratory and on the service bench. Excellent electrical design and rugged construction combine to make the new Precision 'scope one of the finest in the moderate-price range.

Presto Recording Corporation dramatized graphically the extent to which its line of recording and playback equipment has been expanded to meet the demands of today's market. Presto, not too long ago a leader in the disc field only, is now one of the major manufacturers of tape equipment. Engineers and audio hobbyists alike were deeply impressed by Presto's newest developments in the science of tape recording.

Racon Electric Company, Inc. fascinated industrial sound engineers with a display of speakers for every conceivable type of paging and public-address application. Design features and constructional details of various Racon models were clearly shown by means of cuta-

[*Continued on page 53*]

Why Not Use Your Present Tuner?

Ulric J. Childs*

Simplified instructions which will make it possible for you to attach that new amplifier to an existing tuner as one of the first steps in assembling a high-quality home music system.

THE FIRST STEP in the audio education of the average individual comes when he hears music at the home of a friend who has already graduated from the ranks of ordinary radio-phonograph listeners. If the friend (and it is more likely to be friends these days) has a separate amplifier and speaker at least —and probably also a high-quality magnetic phonograph pickup—our individual may very well come to the conclusion that his own home would be a pleasanter place if his records and radio sounded a little more like real music and didn't pall in so short a time.

Right at the beginning most of us are not willing to spend a great deal of money, but a little inquiry quickly establishes the fact that the first requisite is a separate amplifier. A visit to the nearest dealer with a sound showroom removes any doubt that even a moderately priced amplifier is an improvement on the usual radio-phonograph's audio section, especially when a separately housed speaker is added. Commercial all-in-one instruments are made and purchased more as furniture than as musical instruments; our hero is one of the growing number of people who have decided that the ear is as important as the eye.

Not wanting to spend anything more than necessary, it is a logical decision to use at least the tuner portion of the present radio instead of buying a new tuner. As long as the radio tunes in stations satisfactorily and has no other glaring faults (except inadequate sound), there is nothing wrong with the idea. But then the question arises: How do I connect the output of the receiver to the amplifier input? In this article we shall give several good methods. All of them are equally useful for connecting television receivers to an amplifier—an especially good idea since most TV sets have very poor built-in sound sections—and whether the set is AM, FM, or both makes no difference.

* *1601 First Avenue, New York 28, N. Y.*

Fig. 1. Method of preparing a piece of shielded lead before connecting it between radio set and amplifier.

The first requisite is to discover whether the receiver is a transformerless type. To do this pull out one or two of the tubes. If the others do not light, the set is transformerless. Another good clue is to note the tube numbers. If any of them begin with numbers over 14 (50L6, for example, or 35Z5), the set is transformerless. If so, do nothing until you buy and install an isolation transformer from your radio parts supplier. This makes connecting the set to an external amplifier safe; otherwise you may get a nasty shock each time you touch the amplifier, or you may damage it. The transformer is inexpensive and easy to install according to the directions that come with it or the advice of the salesman.

Whatever method used for the connection, you will need a length of shielded, insulated single-conductor cable. Obtain from your radio parts dealer a piece long enough to reach from the radio to the amplifier, with a few inches to spare. At the same time buy a plug of whatever type is needed to plug into the amplifier input. Solder the plug to one end of the cable and prepare the other end by removing about two inches of the outer insulation and about an inch of the shielding and a half-inch of insulation on the wire. The cable end will now look like *Fig.* 1.

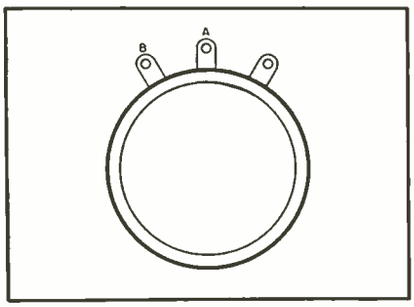


Fig. 2. Rear view of a typical volume control. Other terminals may also be present, but the important ones for this use are the three close together.

The quickest and easiest way to make the connection is to use the volume control of the receiver as the connection point. When the chassis is removed from the cabinet, the volume control appears as in *Fig.* 2, looking at it from the back, the shaft facing into the paper. There may be additional terminals, but we are interested only in the closely grouped set of three.

The center terminal (A in the figure) is ordinarily connected to one end of a capacitor (condenser), the other end of which is soldered to one terminal of a tube socket. There is also usually a resistor soldered to the same tube-socket terminal. Unsolder the capacitor lead from the socket terminal and let it hang free temporarily. Now, with a short piece of wire, connect the tube socket terminal to some point which is obviously touching the chassis metal. This silences the radio's built-in speaker.

Twist together the bare wire at the end of the prepared cable and the free wire of the disconnected capacitor. Flow some solder over the joint, then tape it up with electrical tape. Next, find a way to anchor the cable as it leaves the chassis to prevent it from moving too much and breaking the capacitor lead. Use tape, string, or any other insulated method of anchoring to some chassis hole or secure terminal.

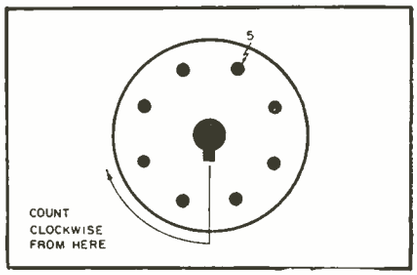
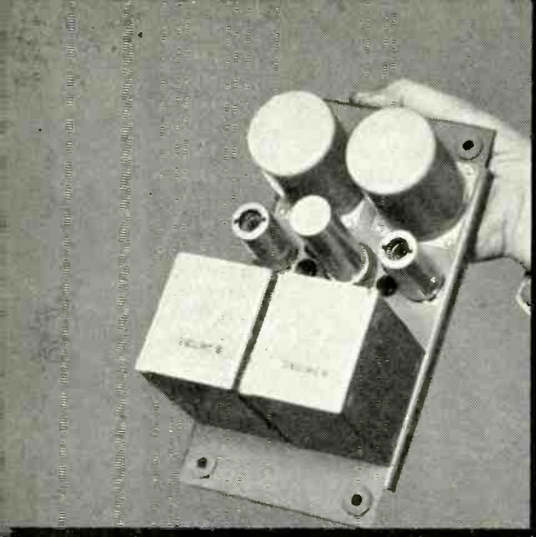


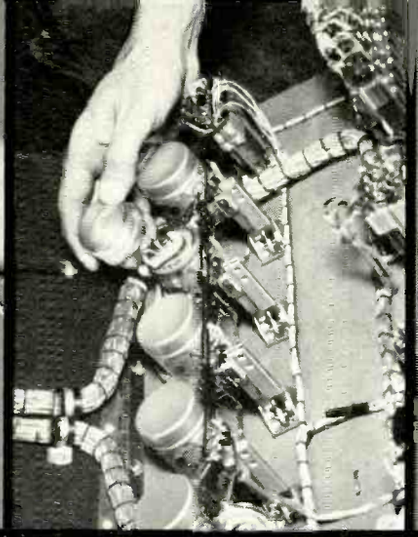
Fig. 3. Bottom view of octal tube, and consequently of a plug to fit into an octal socket. Terminal 5 is the grid terminal on such tubes as 6K6, 6V6, 6L6, and others of similar types.

The last operation is to connect the exposed shield of the cable to the volume control terminal marked B in *Fig.* 2. Use ordinary hookup wire but be sure it is well soldered to the cable shield; do not remove whatever is already connected to the volume-control terminal. Be sure to find the right one—the terminals may not be pointing up as in the drawing, so orient the paper until the drawing agrees with the fact. Probably this terminal is connected to the chassis. Tape up the connection as necessary to make sure the shield and the wire will not touch any other point of the circuit. The receiver will now operate as usual, but if the amplifier has its own volume control it is best to use it only and leave

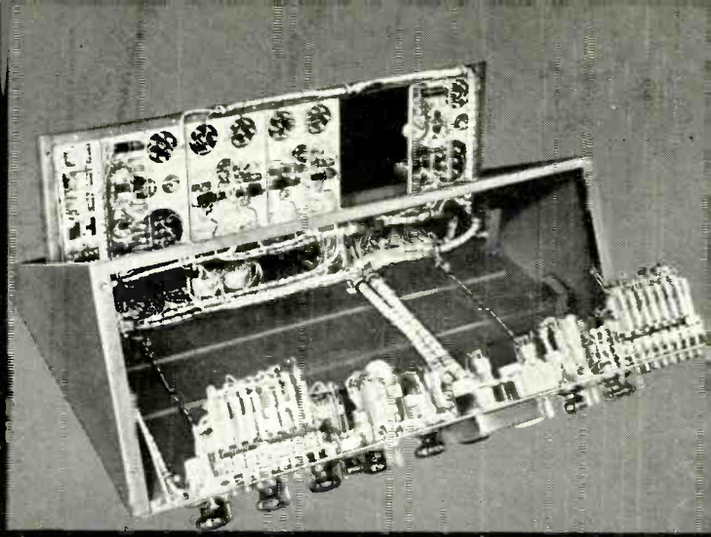
[*Continued on page 45*]



New compact amplifiers—use low-noise, long-life, miniature tubes.



Every component is easy to get at for inspection and maintenance.



Accessibility, plus! New hinged control panel swings down: amplifier frame swings up.

9 EXTRA FEATURES of the

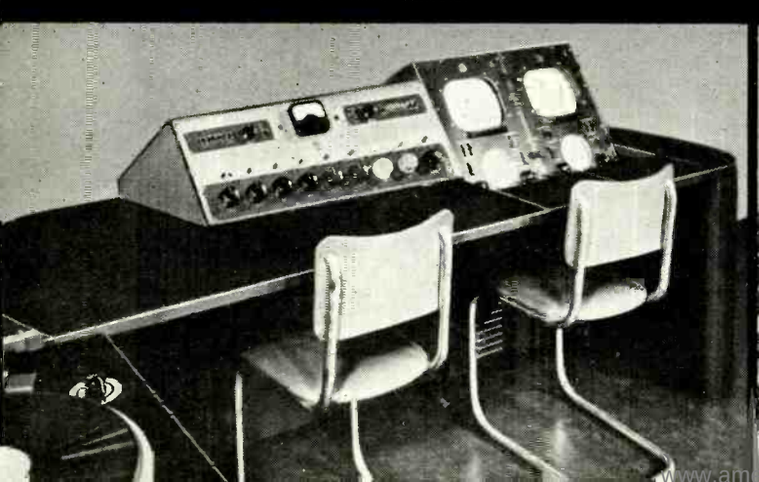
THE EASY WAY the BC-2B Consolette handles is due in great measure to the careful attention RCA engineers have given to construction details—and to a number of unique operating features (not found in their entirety in any standard consolette). Some of these advantages are pictured on these pages.

For example, see how easy it is to get at the amplifiers and components. Note how every inch of wiring can be reached without disturbing the installation. See how the consolette fits snugly into the control room—unobtrusively. See how the styling matches other RCA audio and video equipments.

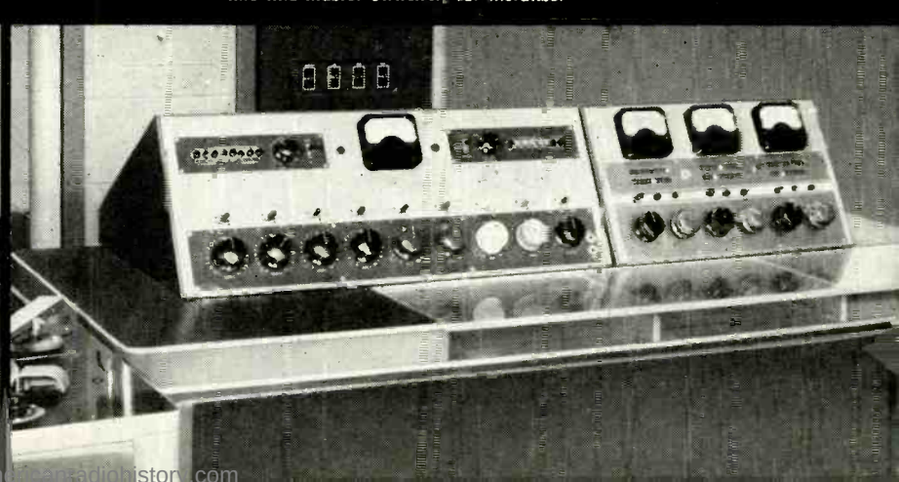
Based on more than 25 years of experience in building studio consolettes, type BC-2B is in our opinion a high point in consolette design. The instrument includes all essential elements needed by most AM-FM and TV stations. And every feature has been operation-proved—many in RCA de-luxe custom-built equipment. *Type BC-2B is available at a "package" price!*

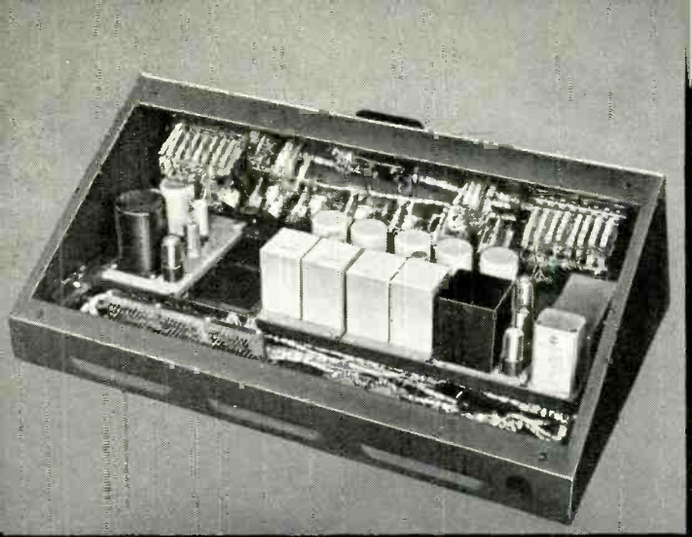
For details, call your RCA Broadcast Sales Representative.

Type BC-2B is styled to match RCA video equipment—like this familiar video console.

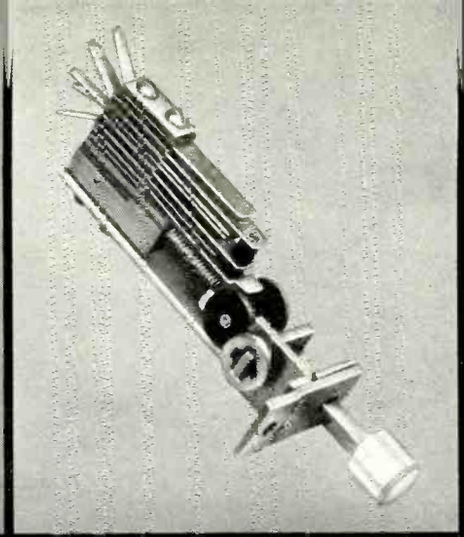


. . . and it's styled to match other RCA audio equipment, too—like this master switcher, for instance.

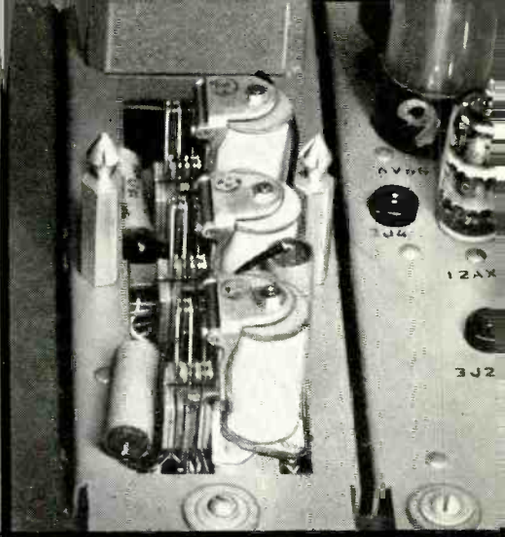




All external connections are made to two terminal blocks. To get at them, just lift the cover.



New, reliable interlocking push-button switches are leaf-type and cam-operated.



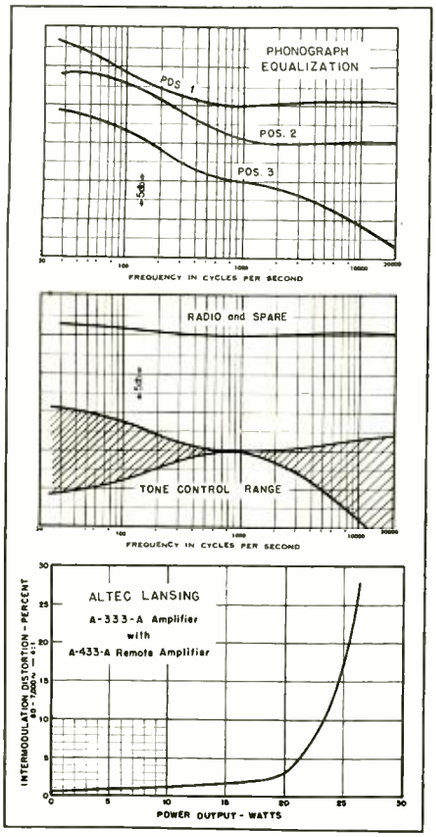
Improved, faster-operating speaker relays eliminate key clicks and audio feedback.

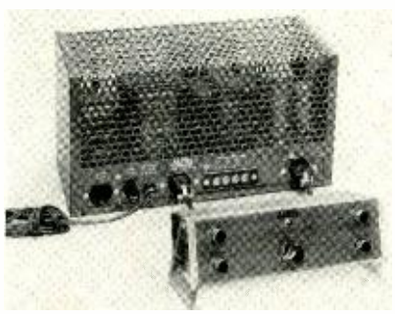
new consolette

Low height, and 30-degree sloping front and top offer maximum studio visibility. You can install the BC-2B tight up against your studio window. There are no rear connections.

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT **CAMDEN, N.J.**





Equipment Report

Altec Lansing A-333-A Amplifier with A-433-A Preamplifier and Control Unit

CONTINUING THE TESTS upon commercially available home music system equipment, the second of this series is the two-unit combination built by Altec Lansing under the numbers A-333-A and A-433-A. The former is a three-stage power amplifier, using a 6SJ7 as a voltage amplifier stage, followed by a direct-coupled 6J5 cathodyne phase inverter, followed in turn by a pair of 6L6's as tetrodes. Probably because of the unique method of maintaining the screens at a fixed potential *difference* below the plate supply, this amplifier measures with the lowest distortion encountered to date, arriving at 8 per cent IM distortion at a power output of 22 watts, and with less than 2 per cent IM distortion up to an output of 15 watts.

On the debit side of the report must be listed the difficulty of removing the protective screen cover on the power amplifier for such purposes as changing tubes, and the fact that it is difficult to use the amplifier with the screen cover removed because one apron of the chassis is actually a portion of the cover. However, amplifiers serve most of their time working, rather than lying on the service bench, so this difficulty is of minor importance.

The preamplifier-control unit is well designed, and the equalization provided for magnetic pickups appears to be well chosen, particularly in view of the present general popularity of LP records. Three positions of equalization are provided—the first with a turnover frequency of 300 cps and the second with a turnover frequency of 800 cps. Both of these positions are provided with a "flat" high end—that is, with no roll-off. The third position has a turnover of 500 cps, and in addition has a roll-off designed to match the LP curve. Thus it is not necessary to adjust the tone controls to achieve the roll-off required for LP records, although the tone controls may be used to modify the curve as desired, as well as to introduce the required roll-off to match records being played on positions 1 and 2.

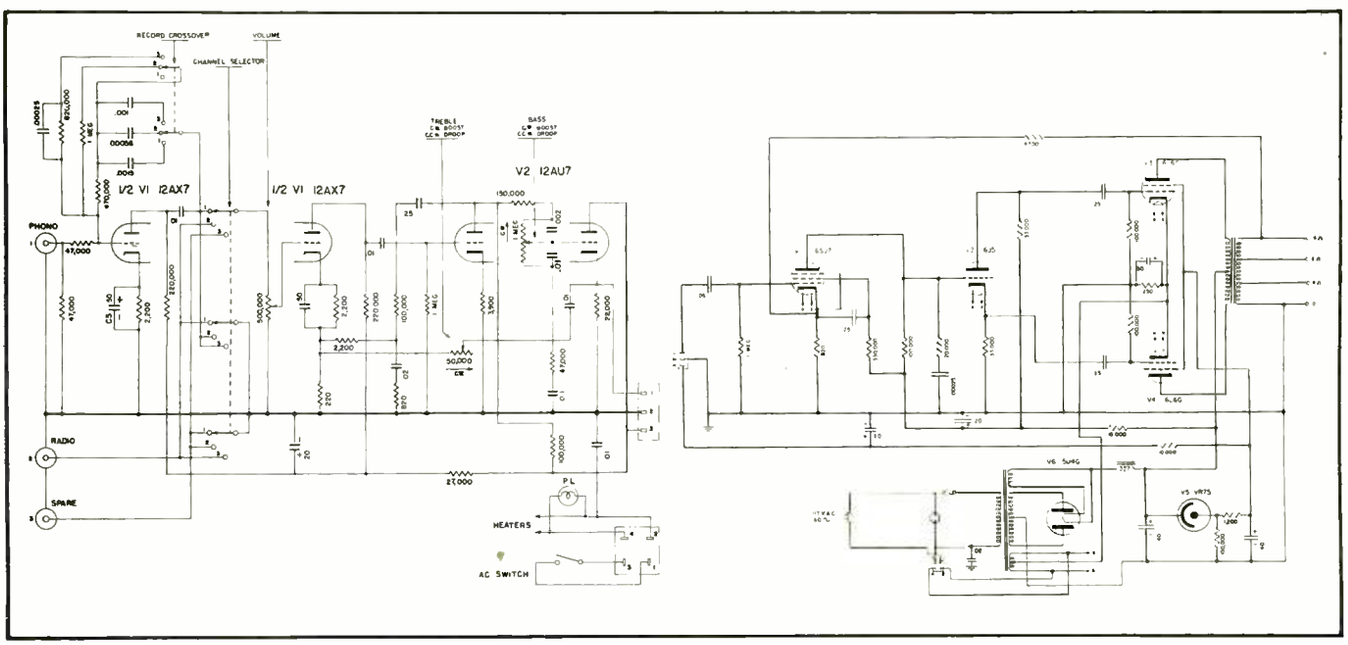
Gain is adequate for any standard magnetic pickup, and for any tuner likely to be used with a home system, as shown in the table of input signal voltages.

SIGNAL INPUT VOLTAGES

for 1-watt output

(1000 cps, volume control maximum, tone controls "flat")

Input	Voltage
Radio	.0157
Spare	.0157
Phono	.0024
Pwr. Ampl.	0.58

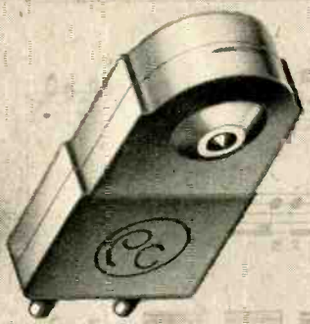


Schematic of entire Altec amplifier. Unit at left is the A-433-A preamplifier and control unit; at right, the A-433-A power amplifier. The two units are connected by means of two cables, with a.c. circuits in one, d.c. and audio circuits in the other.

PICKERING

RECORD PLAYING EQUIPMENT

For flawless reproduction of the works of the masters



Pickering diamond stylus pickups and related components are the exclusive choice of musicians and lovers of music who insist upon the finest. Engineers acknowledge Pickering audio components as the best available. In every test and performance comparison, they demonstrate their superiority; recreating all the music pressed into modern recordings with the fidelity and realism of a live performance.

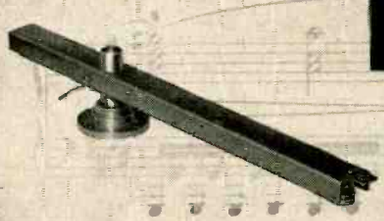
Pickering components are created for listening pleasure by Audio Engineers who know music and who know the tastes of discriminating listeners.

Pickering diamond cartridges have no equal. The wear and fracture resistance of the diamond styli in these cartridges is many times greater than that of styli made of sapphire, the next hardest material. Because resistance to wear preserves the precise shape of the stylus point, the life and quality of your valuable record collection is insured.

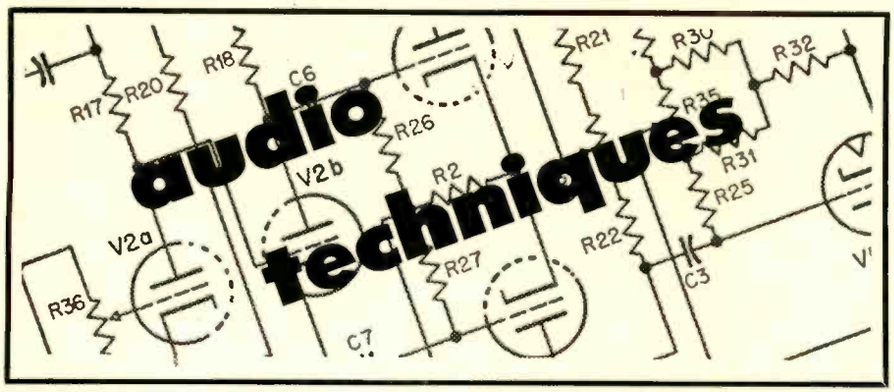
Don't impair the musical quality of your priceless records.

Use Pickering diamond stylus cartridges . . . they not only wear longer *but, more important,* they preserve the musical quality and prolong the life of your record library.

By all measures, Pickering diamond stylus cartridges are—more economical.



PICKERING & COMPANY, Inc.
Oceanside, L. I., N. Y.



Broadcast Short-Cuts

A series of simple but useful suggestions as to methods of solving day-to-day requirements for "new inventions" in a broadcast station.

IN STATIONS using standard speech input consoles, it is generally necessary for the engineer to operate the mike switch for the announcer. Obviously this means extra work for the engineer, who in many cases is already pressed with other work, even if only turntables. It is also desirable from a production

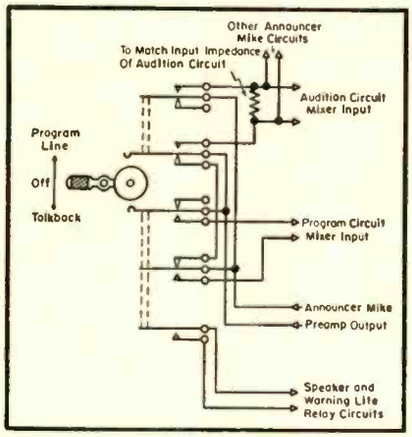


Fig. 1. Switching arrangement to permit microphone to feed program or talkback circuit under control of announcer.

standpoint to have the announcer operate his own mike. In many cases it is difficult to install such a switch or control without mutilating the console circuits and without resorting to a relay. The circuit shown in *Fig.* 1 will give the desired control, and in addition will provide a positive talkback to the control room to enable the announcer to give instantaneous instructions.

If desired, a mike socket may be installed on the announcer's table, and the mike plugged into that, then another cable would plug in to the mike socket in the wall. In an alternative plan, a lead from the socket could be run out to the switch, which can be mounted either on the wall, or on the table, or even placed in a box, so as to make it semi-portable. On one throw of the key switch, the mike shorting contacts are opened and the speaker relay and warning lights are energized. On the other throw, the mike is transferred to the talkback circuit. This will need a preamplifier or other high-gain amplifier to operate into the audition system of the station. All of the mikes from other studios can be brought in parallel to this input, since they are all terminated by resistors, rather than being shorted. If desired, the shorting contacts can be connected into the console right at the output of the pre-amp. This would eliminate some of the noise attendant with switching, and also eliminate much of the stray pickup from a long unbalanced line to the shorting switch. The audition circuit can be connected as above, or the output of the preamplifier can be run out to the switch and used in the circuit as shown, in which case there will be no need for the pre-amp in the audition circuit.

In the operation of remote studios in a city near the main studio, it was discovered that the line loss was too great to permit efficient program transmission. By coincidence, the transmitter was located approximately half-way between the two locations. A booster amplifier was installed at the transmitter, and the lines run from the remote location to the transmitter, and from there to the studio. For various operating reasons, it was more efficient to handle the line from the studio, rather than mix it at the transmitter. Since the line was used for transmission of programs in both directions, as well as for talking, there was the problem of reversing the booster amplifier.

To simplify the problem of switching, a simplex arrangement was used to operate a reversing relay, as diagrammed in *Fig.* 2. The control voltage was placed on both lines, and grounding

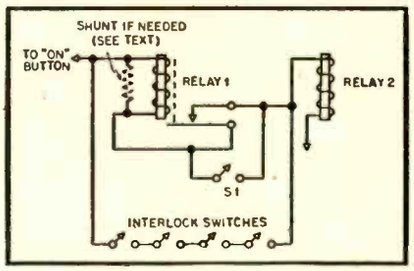


Fig. 3. Simple but effective method of by-passing interlock circuits with a minimum of continued hazard to operating personnel.

at either end would reverse the direction of transmission. The relay was arranged to have the normal direction of transmission toward the studio from the remote point. This would ensure continuity in case of control-voltage failure. To use the line as a talk circuit, it is merely necessary to install a switch accessible to the phone, and then use it in the conventional "push-to-talk" manner.

Oftentimes while doing work on high-voltage circuits, it is necessary to operate with the doors open for observation or adjustment and, of necessity, the interlocks are shorted out. In many cases this is done with merely a couple of clips across the switch or contact on the door. Or, in the event it is necessary to open several doors, the whole interlock string is shorted. Such devices, if they do not prevent the doors from being closed

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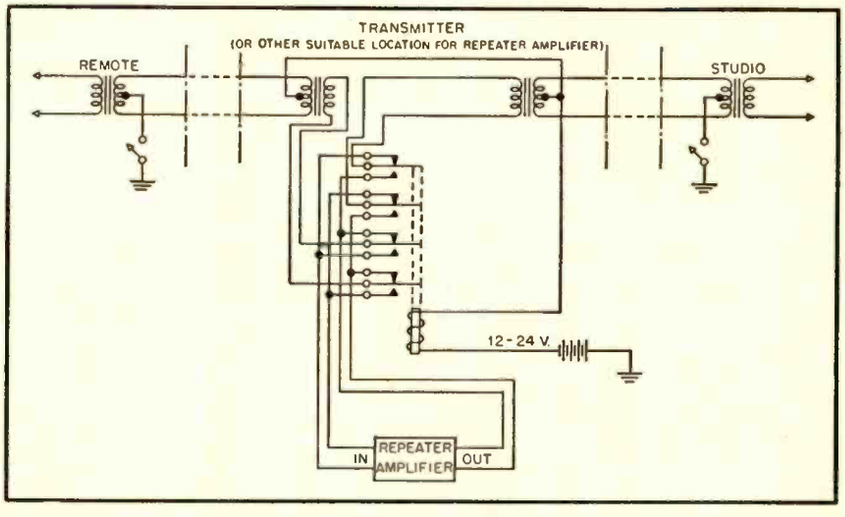
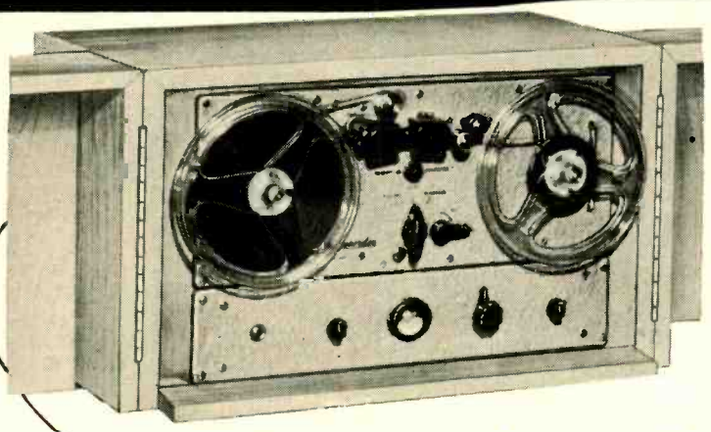


Fig. 2. Reversing circuit for repeater amplifier which permits two-way transmission under control of either end of circuit.

HARVEY *again leads the field with the* FINEST *and* NEWEST



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Magic eye volume indicator.
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Can be attached simply and easily to all MAGNECORD and MAGNECORDette Professional Tape Recorders. Adapter extension arms fit under thumb screws securing the front panel. Simple belts drive the adapters from pulleys which snap on to the existing reel hubs. Complete record playback, rewind and high speed forward is possible with 10½-inch reels.

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REWIND SPEED:
Full 7½ inch reel (1200 ft. of tape) rewound in approx. 40 seconds.

FREQUENCY RESPONSE:
At 15 inches/sec.: from below 50 cps. to 15 kc ± 2 db. At 7½ inches/sec.: 50 cps. to 7 kc ± 2 db. when the proper equalizer for the specific speed is used in the amplifier.

MOTORS:
Synchronous 117 V 60 cycle AC drive motor. Shaded pole motor for rewind.

FLUTTER:
Max. 0.3%.

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117 volts 60-cycle single-phase AC 70 watts.

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Built in. Uses single 12AU7 tube. 6.3 at .3 amps and 300 V at 40 ma supplied from amplifier.

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EDWARD TATNALL CANBY*

I Fall Further into Audio

LAST MONTH'S TALE of personal history is hereby continued and amplified—the account of the zany (but very logical) way in which this musician, trained officially in the arts but unofficially endowed with a gadgeteer's heart of sorts, was deposited in the midst of "audio." Mainly, as I pointed out last month, a matter of drawing interesting and possibly significant conclusions from everyday happenings.

1938—Math and Physics Dinners

It was 1934 when I quit last month, after discovering the wonders of a mail-order 16-tube radio plus extra-fancy super-speaker ordered separately, the whole hooked up to an early RCA 2-speed record player attachment, about the first of the sort ever made. That outfit followed me away from college to New York for a year, then to Princeton where I set it up in a fine room in the Graduate College, a stone pile where graduate students live and eat. There wasn't any graduate department in music; I was an undergraduate instructor. Each department ate, by custom, at its own table; where was *I* to eat? A vital matter—for after a brief and fruitless experiment with English and History at my meals—I love 'em both but not their grad students—I somehow found myself at, of all unlikely spots, the math-physics table!

Now I never did pass my college algebra course and that was that and still is. But, to my astonishment, the conversational atmosphere at these tables, lunch and dinner, was a delight to me. They liked music. They liked records, and they were most of them amateur or professional electronics men. Hardly a one that didn't walk off with occasional lab equipment to make a nice little amplifier for musical purposes. They liked gadgets, in and out of study hours, and I sopped up a load of delightfully useless information about everything in the Lord's scientific heaven, exchanging the same for a modest outlay of musical info.

It was at this table one day, maybe 1938, that I heard of the exciting experiments with something called U-235. Not a bomb, mind you; merely a chain reaction, which would, they thought, produce atomic power, some day. Never heard the term again—until August, 1945. These men were in the middle of things, whether U-235—or amplifiers for music. Couldn't help picking up a thing or two from them.

Amplifier and Baffle

And so I got as fine a working background of random scientific knowledge as you could ask for. And in no time at all, a mathematical genius and avid collector of Science Fiction named The Tuke (Dr. John Tukey) decided I ought to build me an amplifier. Tear up my old 16-tuber.

Phew! I did, with his very, very extensive aid and comfort. Natch, he had to teach me how it worked, too, and did I suffer. I couldn't get anything straight and I couldn't bore a hole in metal or solder a wire to save my neck. I felt awful dumb, surrounded by all that aggregation of brainpower, there. But I guess I absorbed a bit of radiation. My amplifier worked, even if it did look like a tin can opened with a blunt axe.

So the radio had a separate new beam-power (wow!) amplifier for its audio. New pickup, too. A fine Astatic model D, flat to almost 4000 cps and chrome plated. (But then we didn't have any pickups in them days.) And then, came a baffle. Took the speaker out of the radio and mounted it in a perfectly enormous sheet of celotex that practically filled up my room. I suppose the idea was a sort of infinite baffle, but all I can say is that aside from being a rather breathtakingly radical innovation for an old console man like me, the new baffle did wonders for that old speaker—the same old one. To be sure, I was forced, month by month, to saw off more and more of that monstrosity until it ended up as a four-foot-square midget with hinges in the middle so I could get it in and out of the door when I moved away for the summer. But for some years thereafter I made a practice of removing friends' radio speakers into flat baffles, to their utter delight. And I never heard of a case where there wasn't considerable improvement. Laugh if you will.

Best of all, somebody showed me the trick of standing your baffle in a fireplace (unused). What a bass *that* gives. A really good bass, too, since a proper chimney produces a kind of horn which, though hardly exponential, is almost infinite.

Phonoconcerts

That was off-hours and meal times. In 1936 the Princeton Music department got the Carnegie set. Some thousands of records (78 r.p.m.) plus a "phonograph" that was absolutely unbelieveable. An 18 in. woofer, two tweeters, marked to 15,000 cps on separate controls, and a bass reflex cabinet that weighed about 800 pounds at a guess. A separate 16 in. table and long-arm pickup, mounted in another heavyweight box. 1936! That thing could blow any roof off and it almost did when I got my hands on it. We had an AM tuner built and in the Fall of 1937 we "broadcast" the famous NBC Symphony concerts into a huge lecture hall, at perhaps 1.5 times the volume of the original orchestra. Some people, strangely enough, were not impressed, but then this was only 1937 after all. As for me, I was falling into hi-fi with quite a dizzy speed, I rolled in it.

On that fabulous machine I gave phonograph concerts. "Phonoconcerts," I called them, trying to kill the highbrow sound of it all. We got almost a half dozen students interested. Chummy little parties. Music didn't appeal, it seemed, even via an 18 in. speaker from Federal Telegraph. (I have often enough since then been furious at the blithe disinterest of those wealthy and half-educated youths. Plenty of others would have been delighted at the chance to hear the tremendous range of music we had on records then.) Anyhow, maybe our students didn't approve, but I did, and I got to learn a great deal about making proper—and improper—use of a good machine. Tried a million tricks, including indirect lighting and even no lights at all. Sometimes helps with mood-making.

During those summers I tried outdoor concerts in a club house at the edge of a moonlit Connecticut lake. That worked all right. People sat in canoes and listened across the water.

Record Library

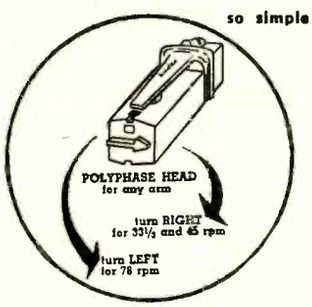
Meanwhile, we had the happy problem of organizing our thousands of records into a lending library, and the devising of

[*Continued on page 38*]

* *279 W. Fourth St., New York 14, N. Y.*

In music, listening quality is everything

that's what the man says...



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". . . your ingenious AUDAX for playing all records is a great convenience, to be sure. But, it is the outstanding musical quality that finally sold me on your CHROMATIC POLYPHASE—easily the finest I have every heard. I have just about every pickup on the market, all with high kilocycles, and know from costly experience that the NBC Symphony violinist* is right—*listening quality is everything*. Thank you for making this remarkable instrument possible. . . ." *(from a letter)*

** See February issue.*

For years, Weil has been preaching that in reproduced music, listening quality is everything, just as it is at the actual concert. If the quality is present, you may be sure the range is there also. The reverse, however, is not always the case.

Never before such EAR-QUALITY, such FAITHFUL REPRODUCTION, but . . . after all the reams are written about kilocycles and other laboratory data—when the chips are down—YOU and only YOU can decide what sounds best and most pleasing. Therefore . . . SEE and HEAR POLYPHASE and—YOU be the judge.

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RECORD REVIEW

[*from page 36*]

a cataloguing system. I haven't been in that still-existing library since 1940 and I'd be scared to go back; the "system" I worked out was so complicated that nobody but me could ever find any records. You have to sort of memorize it all—if you saw a label marked *W20 vOp colTrst*. You'd know of course that it read "Wagner: vocal opera, Columbia Tristan." Simple. The system almost collapsed when I started putting in dummies for the back sides of records, with cross-references. You had to read *two* labels, then. Gave that up, luckily.

High Fidelity? Our rule sheet specified —at my insistence—that *only cactus or fibre needles were to be used*. We gave them away, to be sure. For all I know, that rule still stands! Later on I found that the novel Recoton needles from Switzerland were ideal for the purpose. The steel points are set in a shank; when you dropped a 5-ounce pickup the point snapped off—the only damage was a single hole in the record. Best of all, the needle was automatically unplayable; it wouldn't even track. You just *had* to change it. (Believe me, if there was any sort of jagged edge that would stay in a groove, our fine customers would go right ahead with the old needle. Powdered "shellac" filings was a substance I got to know quite well.)

Engineers' Hi-Fi

We had a fine professor at the head of our Princeton Music Department who was as unmechanical as a good professor of music should be. He was enthused over our new records and over the Carnegie phonograph too. You could run it with only one control (ignoring the 15,000-cps tweeters which never did get to produce anything, from our pickup and AM tuner, over 5000).

Alas, the Engineering Department discovered our record library and immediately decided that the Professor needed a "better" and more versatile system for his popular lectures, with records. He was game (not knowing engineers as some of us do) and so they barged ahead with glee. Couple of months later the great day came.

A delegation arrived with what must have been the Original Hi-fi system itself. Chassis after chassis, a big suitcase turntable (with the usual Astatic straight-arm pickup) and—pride and joy—a super-control console with Everything. Don't remember the details, but I'll never forget the results.

Came the lecture, 250 students. The professor had been coached by all hands, simultaneously of course, and he was somewhat shaken. This stuff was all new to him. The engineers had, of course, forgotten to put labels on half of the knobs, and others had cryptic words like GAIN meaning nothing whatsoever to a good musician. All went well at first. No music, just talk, and quite inspired, too; the machine was for the moment forgotten.

Finally, the music was wanted. Professor turned quickly to his new gadget. Instantly a horrid blat came forth. (Yep, a loose ground on the pickup connection.) He jumped like a deer and an engineer rushed up and stopped the hideous noise but the poor man was already as white as a sheet. Bravely, he approached the record again —he was after a theme along about dead center of the grooves. Alas, someone had left the volume on full (GAIN) and he had already forgotten which knob to try. The needle touched the record with a screetch, the Professor's hand jumped, and the pickup sqawked all its 5 ounces straight across. Fifty watts (at least) of audio practically ploughed the first ten rows of audience into the concrete floor. But Professor was now desperate—this thing had to work. So he grabbed the arm and went after that theme, with a vengeance. It *had* to be somewhere on the record so he tried everywhere—GAIN still being at the top. . . .

The "system" was removed forever, the next day. And that, children, was how I learned that sometimes it's a bit hard to reconcile the viewpoints of engineers and musicians as to what is a *good* machine! I've been doin' my little bit to help, ever since.

Key

* Outstanding recorded sound for the type of music. [a]Unresonant, deadish acoustics. [b]Big bass. [bb]Big Brass. [d]Some distortion in highs. [f]Flattish high end; needs boost over normal LP playback. [l]Live, rather distant pickup. [o]From older 78 originals. [r]Violin solo very close-to. [s]Some surface noise. [x]Will need bass boost over normal LP playback.

Alphabet Soup and Hi-Fi

London started it even before LP, with the famous "ffrr"—it was Decca ffrr then. Now, the alphabet idea is spreading, along with other terms indicating quality of some special sort. Remington now uses CARR, "Complete Audible-Range Recording;" Westminster, on another tack, uses "Natural Balance," (a phrase just possibly borrowed from this writer's constant use of it these dozens of times). American Decca's "Gold Label" pushes another angle, the relatively old one of general musical excellence—Gold Label Deccas include both new and older recordings (thereby generating confusion with RCA's gold label, reserved for reissues of technically under-par material of value). Mercury, with the "Olympian" series, makes its bid for over-all excellence in all phases; now Capitol has joined the parade with FDS, "Full Dimensional Sound."

The urge behind all of this is clearly a growing public awareness of over-all good quality, on a larger scope than the over-used word, "high fidelity" can now cover. This leads, naturally, to a desire by Publicity to capitalize on the over-all musical-engineering excellence for legimate advertising purposes. (The engineers and recording directors have been doing fine all along, but their work hasn't been spotlighted in quite this way before.)

There are two technical slants to all of this. (a) Recording curve, tonal range, processing excellence—the record itself. (b) Good recording acoustics and microphoning. You'll note that behind the flowery verbiage the makers are pointedly "boosting" one or the other or both, along with the usual boost for the music and performance. London and Remington speak mainly of tonal range—though general excellence is implied. Westminster's "Natural Balance" means, apparently, a natural balance or cooperation between all elements, musical and technical (though this writer uses the same phrase to apply to a specific volume and perspective balance between, say, a solo violin and its orchestra). "Gold Label," in practice merely an indication of good "classical" material on Decca, is outdistanced by "Olympian," which Mercury uses specifically to indicate all-over high quality, as with Westminster.

Capitol's FDS follows similar lines. It "establishes a unique collaboration between artist, producer and engineer"—again stressing the collaboration of all forces. A reasonably accurate generalized idea of what it really takes to produce a fine record. "High fidelity," at bottom, is all of this, plus the chain of reproduction too.

Capitol did not at first specify any recording curve, except a "proper" one—a fine word to avoid argument! But later, a curve was sent out which looks quite conventional to me, as it should. It would have been good, I think, if Capitol had stated in so many words that its "proper" balance of highs and lows does in fact fall within the AES playback curve.

* **Glazounov, "The Seasons."** French Nat. Symphony Orch., Desormières.

Capitol P-8157

* **Ravel, Introduction and Allegro. Debussy, Danses Sacrée et Profane.** Ann Mason Stockton, harp; Hollywood Quartet and others.

Capitol L-8154

These two first official FDS recordings (others, older, will be put in the category) are in truth excellent. The Glazounoff, familiar ballet stuff, is not only exquisitely played but has a superbly natural "hi-fi" sound, not so much stunty as what is best called "open"—an effect, especially in the highs, of closeness and good perspective, resulting in fine immediacy and presence. This will rate top in any hi-fi collection.

The Debussy and Ravel are delicately effective hi-fi material, never loud, atmospheric where shimmering strings and harp transients are the hi-fi materials. Good specialized "demonstration" stuff as well as music very well played. A good debut, in terms of actualities, for FDS.

* **Moussorgsky-Ravel, Pictures at an Exhibition.** Chicago Symphony, Kubelik.

Mercury MG 50000

Bartok, Music for Strings, Percussion and Celesta, Bloch, Concerto Grosso for Strings and Piano. Chicago Symphony, Kubelik.

Mercury MG 50001

These are the debut records of Mercury's "Olympian" technique, and they rate very high, too. Somewhat different effect here—the single (Telefunken) mike gives exceptionally clean sound, but the liveness is a bit off for the Bartok and Bloch recording; a slightly narrow sound, not quite as broad and full as some. The Moussorgsky, however, is tremendous. I would guess that, rather than any engineering difference, it is sharper, brassier orchestration of Ravel—this being one of the world's masterpieces of instrumentation. Anyhow (if you haven't heard), this one is the hi-fi highlight of the season, to date. And best, it is superbly performed as I have never heard the piece before; dramatic, tense, taut. Mercury jumps here from a trailing position in hi-fi to the very forefront. Good.

Ravel and Debussy

* **Debussy, Three Images for Orch. (Gigues; Iberia; Rondes de Printemps).** San Francisco Symphony, Monteux.

RCA Victor LM 1197

* **Debussy, Iberia.** Phila. Orch., Ormandy. **Debussy, La Mer. N. Y. Philharmonic, Mitropoulos.**

Columbia ML 4434

The unusual collection of "Images," joined by Debussy through the separate items were composed at different times (Iberia first of all) is seldom heard complete. Too long and unwieldy for concerts and the two outside items don't stand by themselves. On LP the whole is ideal (as also the three Nocturnes, including the seldom heard Sirènes, with chorus) and this is an excellent playing, luminously recorded for RCA, a bit distant-miked but appropriately so. Enough bass so you won't be bothered musically by any lack. The separate Iberia on Columbia is a hot competitor—a more spectacular recording with sharper, closer highs, more depth and presence, an excellent performance too; La Mer, on reverse, is fine too, but I'd take Toscanini's on RCA here (though it has a Mendelssohn item with it). Can't split LP's in half, alas; I'd suggest: stick with RCA throughout for the music; for hi-fi, try Columbia's stunts.

[*Continued on page 40*]

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  6. Treble switch calibrated from — 18 db. to + 15 db. (10,000 cps.).
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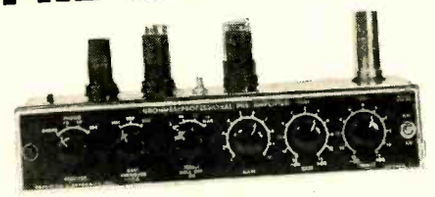

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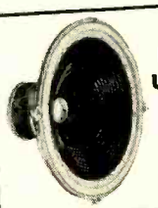

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Ravel, Quartet in F. Pascal String Quartet.
° **Ravel, Sonata for Violin & Cello.** Oscar Shumsky, Bernard Greenhouse.
Concert Hall CHS 1123

[1] **Ravel, Quartet in F. Debussy, Quartet in G Minor.** Stuyvesant Quartet.
Philharmonia PH-104

Concert Hall's two Ravel items make a good pair; the quartet, ultra-French in its coloristic, impressionistic atmosphere, is well played by an older French team, though my favorite version is the other, the Philharmonia LP along with Debussy's quartet. If you choose Concert Hall, the Ravel Sonata, violin and cello alone without piano, is an extraordinarily modern late work (1922), with astonishing harmonic and instrumental color—hard to believe that these two alone could produce such varied sounds. Top playing, the recording OK. (Re-issue of earlier "limited" ed. 78's).

[s] **Debussy, Cello Sonata. Franck, Cello Sonata in A.** Marcel Hubert, Harold Dart.
Allegro AL 110

The only LP recording of the first of Debussy's three late sonatas—utterly unlike the late Ravel work (and nejther is at all like the familiar impressionist work of both younger men). This is a curiously fragmentary, episodic piece, growing on you as you adjust to its strange pace. The Franck is the familiar violin sonata, "said to have been written originally" for cello. It makes fine cello music but this is a rather pale-colored playing.

[1*] **Debussy, Six Epigraphes Antiques; Petite Suite.** (Piano, Four Hands) Caroline Norwood, Eleanor Hancock, pianists
Lyrichord LL 21

A late work and a familiar early work in the same medium, the always interesting, seldom-seen four-hand piano team, two people at one piano. These young pianists play the simple suite, melodious, now a familiar sort of music, with excellent feeling, a quiet, non-percussive touch. The late Epigraphes are tougher stuff, not unlike the cello sonata (above); here there is more trouble establishing the mood, more awareness of piano and finger mechanisms. Very fine piano recording, steady as a rock and ultra-natural.

[b] **Debussy, Twelve Etudes for piano.** Charles Rosen.
R.E.B. #6

This is a major LP offering in the piano field. Debussy's last big piano set, like other series of etudes nominally study material, actually brilliant pieces each "taking off" from some technical problem—thirds, fourths, repeated notes, compound arpeggios, etc. These are masterfully played by a gifted and knowledgeable pianist (also instructor in Romance Languages at Princeton) who writes most interesting notes for his own playing. Tough stuff, again, but makes up for it in brilliance of sound. Fine recording, the bass very big (mike under piano perhaps?).

[ofa] **Debussy, Pelléas et Mélisande.** Irène Joachim, Jacques Jansen, Etcheverry, etc. Orchestra, cond. Roger Desormières.
RCA LCT 6103 (3)

RCA's Gold Label Treasury series is reaching forward to include—quite honestly—recordings such as this that are only a few years old, yet already technically out of date. (In spite of its advantage in good older recordings, Columbia will sooner or later have to adopt some similar measure for its undoubted 78 treasures.)

This all-French performance of the great Debussy opera is a stunning job; the strange, otherworldly character of this unique opera is ideal for records, the singers are those perfect French voices we can so easily envy, the whole production is unified musically and dramatically in rare fashion. Recording is "adequate" . . . i.e., done via disc with a 5000-cps. top (just enough to get a trace of s sound) in a French anechoic chamber— or at least a studio draped with layers of velvet and foam rubber! Can't spoil the music for those who like it.

Song Cycles—Fauré, Les Mélodies de Venise; Debussy, Ariettes Oubliées. (Ver-

laine). Hugues Cuenod, Jacqueline Blancard, pf.

Vanguard VRS 414

The interest here centers about the parallel settings of the same poems of Verlaine by each of these composers; also the fact that—for once—it is a tenor who sings, not the usual wobbly and enthusiastic soprano! Cuenod, Swiss, has the somewhat nasal voice required for good French singing, plus excellent musicianship. Blancard, also Swiss, lacks the Gallic piano-feel that is best for this music but her accompaniment is more than competent. A good LP for singers to study.

Modern—dissonantly hi-fi

* **Martinu, Concerto for String Quartet and Orch.** Vienna Konzerhaus Quartet, Vienna State Opera Orch., Swoboda.
* **Martinu, Serenade; Partita (Suite #1) for Orch.** Winterthur Symphony, Swoboda.
Westminster WL 5079
* **Martinu, Sonata, Sonatina for Two Violins and Piano.** Willy and Margarete Schweyda; Jan Behr.
Urania URLP 5004 (10″)

Martinu's dissonance is slick, fluent, Bach-jazzy, not hard to take, thanks to strong rhythm, lack of heaviness. Frothy in its way.

* **Prokofieff, Scythian Suite; Lt. Kije Suite.** Vienna Symphony, Scherchen.
Westminster WL 5091
* **Milhaud, La Creation du Monde.** * **Copland, El Salon Mexico.** Columbia Chamber & Symphony Orchs., Bernstein.
Columbia ML 2203
* **North, Music from "Streetcar Named Desire."** (From the film sound track.)
Capitol L 289 (10″)
* **Bartok, Two Rhapsodies for Violin and Orch. (1928).** Emanuel Vardi; New Symphony, Autori, Serly.
Bartok BRS 306 (10″)

All the above share the snazzy, dissonant, often humorous-bitter feeling of the 20's and early 30's—to varying extents depending on the composer; except the "Streetcar" music which is a kind of reflection in popular terms of the earlier era. All are stunningly good recordings.

* **Bloch, Schelomo** (cello and orch.). (With Saint-Saëns Cello Concerto.) Leonard Rose; N. Y. Philharmonic, Mitropoulos.
Columbia ML 4425 (½)
x **Walton, Violin Concerto.** Heifetz; Philharmonia Orch., Walton (With Vieuxtemps Concerto #5)
RCA Victor LM 1121 (½)
a **Hartmann, Symphony # 4 for Strings.** INR Symphony, André.
Capitol L-8146
(d) **Hindemith, Symphonic Dances** (1928). RIAS Symphony, Fricsay.
Decca DL 7520 10″
*bb **Schuman, Symphony III.** Phila. Orch., Ormandy.
Columbia ML 4413
* **Respighi, Trittico Botticelliano** (Botticelli Tryptych). Vienna State Opera Orch., Litschauer. (With Locatelli, Conc. da Camera.)
Vanguard VRS 418 (½)
(d)lv **Bartok, Violin Concerto** (1938). Tibor Varga; Berlin Philharmonic, Fricsay.
Decca DL 9545
* **Bartok, Viola Concerto** (completed by Serly). Wm. Primrose; New Symphony, Serly.
Bartok BRS 309

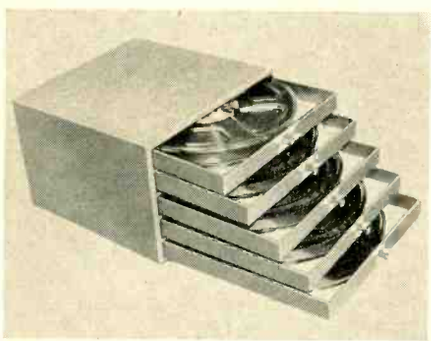
The above group shares, to greater or lesser degree, aspects of earlier Romantic music; a serious, non-snazzy approach, a big orchestra, colorful in the older manner, sometimes a pictorial "tone painting"—as in Bloch and Resphigi, plenty of expressive solo melody, non-folk style. Good for you, if you prefer a less "popular" sound.

NEW PRODUCTS

● **Home-Model Magnecorder.** Music lovers and audio hobbyists alike will find distinct interest in the MagneCordette, a new tape recorder for use with existing high-quality music systems. Designed to meet N.A.B. audio standards, the new unit is composed of a professional Type PT6-AH tape transport mechanism and a newly-developed amplifier, both housed in a blonde or mahogany table-top cabinet. High-impedance input has sufficient gain

for either microphone or tuner. Output level is designed for feeding into low-gain input of any high-quality amplifier. Recording speeds of 15 or 7½ ins./sec. are interchangeable without use of tools. Rewind speed permits rewind of full 7½-in. reel in 40 seconds. Frequency response at 15 ins./sec. extends below 50 cps and beyond 15,000 cps within ±2 db. Maximum flutter is 0.3 per cent. Amplifier panel controls include magic-eye volume indicator, gain, record-playback switch, and equalizer-speed selector. Headphone jack permits monitoring. Priced moderately, the MagneCordette brings professional audio performance to the average living room. Magnecord, Inc., 360 N. Michigan Ave., Chicago 1, Ill.

● **Tape Storage Chest.** An innovation in the merchandising of magnetic tape is the new "Tape-Chest," a 5-drawer filing system given free to consumers upon purchase of 5 rolls of Reeves Soundcraft tape. Each drawer, for a single roll of tape, has a polished brass knob and a label for identifying program material.



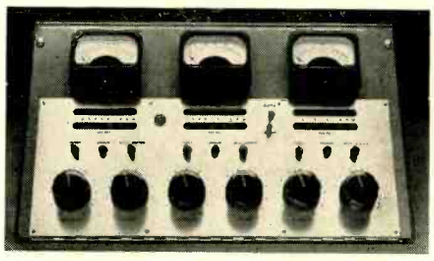
The unit is made durable lined boxboard and is attractively finished in royal blue. Available in two sizes, to accommodate 625 or 1250-ft. rolls. Undoubtedly, the Tape Chest will accomplish the objective stated by Reeves in introducing it—to stimulate the hobby of building tape libraries of memorable events, sound effects, and fine artists. Reeves Soundcraft Corp., 10 E. 52nd St., New York City, N. Y.

● **Portable Tape Recorder.** Designed for use with high-quality home music systems, the new tapeMaster Model PT-121 is built to RTMA standards. It consists of a tapeMaster transport mechanism and matching self-powered preamplifier with push-pull ultrasonic bias-erase oscillator, fully wired and ready to plug in. When used in conjunction with any high grade audio amplifier, the PT-121 provides a complete high-quality tape recording and playback system at low cost. Operates at standard speed of 7½ ins./sec. Dual-track head. Fast-forward and rewind ratio is twenty to one. High-impedance inputs for both radio tuner and microphone. Frequency is 70 to 8000 cps ± 3 db. Signal-to-noise ratio is 42 db. Neon-type level indicator. The PT-121 is supplied in a sturdy, portable case covered with water-resistant leatherette. Over-all dimensions are 12" × 12½" × 9½" high. Weight complete with two reels is 21½ lbs. Further information is available in Bulletin No. 101. For free copy write to the manufacturer, tapeMaster, Inc., 13 W. Hubbard St., Chicago 10, Ill.

● **Phono-Top Mobile Amplifier.** Carnivals, sound trucks, resorts, and the like, will find many uses for the new Newcomb Model E-25MP mobile amplifier. The unit provides 25 watts audio output and uses either 6-volt d.c. or 117-volt a.c. power supply. Has two microphone inputs in addition to phono. Equipped with standby switch which conserves battery, at the same time keeping tubes warm. Separate turntable and amplifier-power switches. Heavy-duty Jones plugs provide dependable power connections. Cabinet is finished

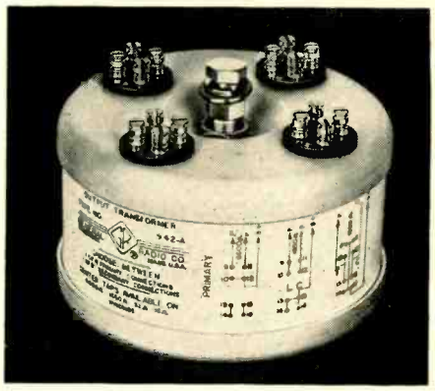
in two-tone gray enamel. Control panel is etched metal. The E-25MP is ruggedly built to stand rougher-than-normal usage. Available also as Model E-25M without phono top. Manufactured by Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.

● **Audio Control Console.** Many features usually found only in custom-built equipment are inherent in the new RCA Type BCS-11A master switching consolette, which provides complete control of as many as ten program sources feeding into three outgoing lines. Equipped with stepping relays, the consolette permits preset program source selection for all outgoing channels. Bridging-type input affords operation from any line of 600 ohms or lower. Separate master gain control and VU meter is supplied for each channel. Failure of power supply to relay cir-

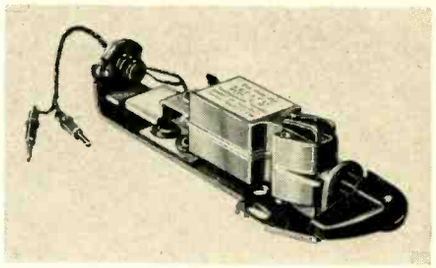


cuits does not cause program interruption, nor does restoration of power require resetting. Top panel is removable and front panel is hinged for easy access to all components. RCA Victor Division of Radio Corporation of America, Camden, N. J.

● **Toroidal Output Transformer.** Excellent frequency response, low distortion, high power-handling capacity, and flexibility of impedance ratios are combined in the General Radio Type 942-A output transformer. In addition to its use in regular audio amplifiers, it is well suited for use in high-power modulators, in amplifiers for electronic musical instruments, and in constant-voltage audio distribution systems. Eighteen impedance ratios can be obtained covering a wide range of values. Primary windings can be separated as required in certain single-ended push-pull amplifier circuits. Although weighing only 7 lbs. and measuring but 3¾ in. high by 5½ in. diameter, the 942-A has a continuous power rating of 90 watts. Distortion is less than one per cent above 30 cps. Upper frequency limit is 100 kc. General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.



● **Turnover Cartridge.** Two complete cartridge assemblies mounted back-to-back on a single plate, make up the new Astatic Model Twin CAC. Interaction between styli, usually present where two needles are used to drive a single motor, is thus



eliminated. A unique switching arrangement, operated automatically as the turnover knob is manipulated, serves to connect the cartridge in playing position with the amplifier input, at the same time disconnecting the remaining cartridge. Output of the new unit is approximately 0.7 volt at 1000 cps, and frequency range is 30 to 11,000 cps. The cartridge is furnished complete with turnover bracket and knob assembly, with standard ½-in. mounting holes. Astatic Corporation, Conneaut, Ohio.

● **Anti-Static Compound.** Eliminating the effects of static on plastic sheets, molded parts, or phonograph records, the Compound No. 79 produced by Merix Chemical Co. 1021 E. 55th St., Chicago 15, Ill. is again available. Particularly valuable for either records or plastic meter cases, this product prevents collection of dust—particularly useful on the former—and avoids erroneous indications of the latter due to rubbing of the case. Merix Anti-Static Compound No. 79 is applied by dip, spray, or brush, and is required on only one side of any plastic up to ½" thick.

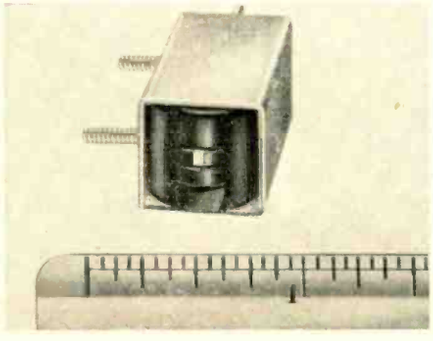
● **Wireless Microphone.** Complete mobility for TV, motion picture, and stage performers is afforded by the new Stephens Radio Link, a tiny transmitter which, complete with microphone, can be concealed in the clothing of the user. When in use, the transmitter emits a wave which is picked up by a receiver located near a convenient microphone outlet. Output of the receiver is at microphone level, consequently it can be fed into a mixer position exactly as a wired microphone. Transmitter range is approximately 125 feet. Audio frequency range is 35 to 16,000 cps, thus suiting the unit for pickups of even the most demanding nature. No larger than a pack of cigarettes, with battery case to match, the Radio Link has been used in a number of motion pictures and TV programs to record sound

under circumstances where use of a boom would not be feasible. Battery life is three hours of continuous operation. Receiver is a.c. operated. Transmitter contains two Raytheon sub-miniature tubes operating in a modulator-oscillator circuit at 50 mc. Manufactured by Stephens Manufacturing Company, Culver City, Calif.

● **Binaural Headset.** Designed especially for listening to binaural tape recordings, the new Permoflux dynamic headsets are manufactured to exceptionally close tolerances to assure identical characteristics of individual phones. Frequency response

obtained is capable of reproducing the full instrumental scale within the range of average human hearing. The phones are of the moving-coil type, and are similar in construction to the Permoflux high-quality headsets for conventional application. Permoflux Corporation, 4900 W. Grand Ave., Chicago 39, Ill.

● **Low-Cost Magnetic Recording Head.** Good reproduction in even the most moderately-priced tape recording equipment is made available to manufacturers by the new Type TR-16 tape recording head recently announced by Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill. Features of the TR-16 include excellent frequency response, compactness, precision controlled track width, and flexibility of mounting. Equipped with mu-metal shielding which permits simplification of placement of hum-producing components. Recommended for use in dictating or low-cost playback equipment, the TR-16 is designed to provide economical production assembly and to simplify field replacement.



UTILITY AMPLIFIER

[*from page 17*]

normal position, Line 1 is connected to Output 1 and Line 2 is connected to Output 2. When operated to one position, the lines are reversed. The other throw of the switch connects the volume indicator, normally connected to Line 1, to Line 2. The volume indicator operates at a fixed level, although a variable resistor could easily be installed to vary the output signal over a small range.

Since the output of each channel is the same when operating with the channels tied together, it may be desirable to install a master control for each output. This can be put after S_1, in the grid circuit of each channel. This will allow free mixing of the input channels, and still give independent control of output level. When feeding a P.A. from one channel, this would help to prevent feedback while maintaining level on the broadcast circuit. In the power supply, the circuit shown in *Fig.* 1 is the one included in a second model of this amplifier that was built. Although the original operated well, it was felt that it did not have the gain necessary for all applications. The first model has a transformerless supply for the plate voltage, and uses a single-section selenium rectifier. The output from this arrangement is only about 120 volts, and did not provide the power necessary for long-line operation. A small transformer was mounted under the chassis for the filament supply and no hum was encountered with this arrangement. In the second model, the power transformer introduced some hum, but it was reduced to almost zero by putting it in its own shield can and mounting it at the side of the chassis next to the output transformers.

In the original model, the intent was to keep the size down to a minimum. Two 12AX7's were used in the first two stages, and a 12AU7 in the output. The gain of this unit was only about 50 db, and the output was quite low, but in its original use, the lines were quiet and short, so no trouble was encountered. This might be sufficient if the unit were to be used in a small town. The chassis was 3 in. wide, 12 in. long and 2 in. deep, and was mounted in a $3\frac{1}{2} \times 6 \times 12$ cabinet with a hinged top. The leads to the two gain controls were brought out from the chassis in shielded leads, and mounted on the front of the cabinet. It is desirable to keep the controls close to the paralleling switch S_1 to prevent stray pickup. The original model did not need any extra shielding around S_1, but it would not do any harm to include it, lest one get caught with a pickup in a location with high electrical noise.

While this unit is admittedly designed primarily for a specific application, so much use has been made of it that it was felt that other stations may have had similar problems. It is presented therefore, not with the intention of establishing a policy of operation for a station, but merely as a suggestion as to the possibilities of deviating from standard practice to accomplish a specific problem.

Parts List

C_1, C_4	1.0 μf, paper
C_2, C_3, C_5, C_6	.01 μf, mica
C_7	100 μf, 15 v. electrolytic
C_8	40 μf, 450 v. electrolytic
C_9	20 μf, 350 v. electrolytic
C_{10}, C_{11}	10 μf, 350 v. electrolytic
L_1	8 Hy, 50-ma, a.c./d.c. choke
R_1, R_2, R_8, R_9 R_{12}, R_{13}	0.47 meg, ½ watt
R_3	180 ohms, ½ watt
R_4, R_5	0.1 meg, ½ watt
R_6, R_7	0.5-meg potentiometer, audio taper
R_{10}, R_{11}	15,000 ohms, ½ watt
R_{14}	390 ohms, ½ watt
R_{15}	3300 ohms, 1 watt
R_{16}	2200 ohms, 1 watt
R_{17}	51 ohms, ½ watt
S_1	SPST toggle switch
S_2	4PDT and DPDT locking-type telephone key
T_1, T_2	Microphone to grid, miniature type input transformer
T_3, T_4	Plate to line, miniature type output transformer, 20,000 ohms to 600/150
T_5	350-0-350 v. at 50 ma; 6.3 v. at 2 amps.

USING YOUR TUNER

[from page 29]

the radio volume control at one setting. Tone controls will probably not work but it is far better to use those on the amplifier if any.

If the radio includes a phonograph it may be left as is but if a magnetic cartridge is to be added, the plug at the end of the cable coming from the pickup must be removed from the socket on the chassis. The plug can be cut off and another piece of shielded cable may be spliced to the pickup lead—bare wire to bare wire and shield to shield—and led to the amplifier. The distance between radio-phonograph and amplifier should be as short as possible to avoid a loss of highs.

This technique of obtaining audio output is useful not only with radio receivers but also with tuners which have audio amplification stages. The audio stages in most tuners are not as good as those in most separate amplifiers, in addition to which it is usually best to bypass the built-in tone controls, especially on FM tuners.

TV Set Connections

Television receivers present a somewhat tougher problem because few owners like to remove the chassis from the cabinet for fear of damaging the cathode-ray tube. The solution with most TV sets is to remove the power-amplifier

Fig. 4. Bogen DB-10 amplifier, typical of the smaller units used in unit-type systems.

tube (usually the receivers do not have push-pull outputs) and substitute an octal plug, obtainable at the parts dealer.

Output tubes are fairly easily identified even without a circuit diagram. Common ones are: 6V6, and 6K6, which are full-size, octal (8-pin) tubes. Most TV receivers are not transformerless so removing the audio output tube does no harm, and an isolation transformer is not needed. Again prepare the shielded cable leading to the amplifier and solder the inner conductor to pin 5 of the octal plug. Pin 5 is indicated in *Fig.* 3, a view of the plug looking at the prongs. Connect a wire from the cable shield to any point obviously touching the chassis; often the end can be terminated under a screw head.

The method of connecting to the amplifier varies with the amplifier. *Figure* 4 shows the Bogen DB10 amplifier, which has provision for radio or

tuner input and phonograph input, though not both at the same time. A simple switch must be provided if both phonograph and radio are to be used. The method of connection is illustrated in *Fig.* 5. Any single-pole double-throw switch is suitable—even an ordinary toggle switch. The arm of the switch is connected through a shielded cable to a plug which fits into the jack marked AMPLIFIER INPUT. One point of the switch is connected in the same way to the jack marked PREAMP OUTPUT. The other point is connected to the end of the cable coming from the radio or TV receiver. The phonograph, if it includes a magnetic-type cartridge, is connected to one of the two magnetic phonograph jacks on the amplifier. Try the one labeled HIGH OUTPUT MAGNETIC first. If there is not enough volume change to the one titled LOW OUTPUT MAGNETIC. Be sure to connect all shields together and the shield of each cable to the outer shell of its plug.

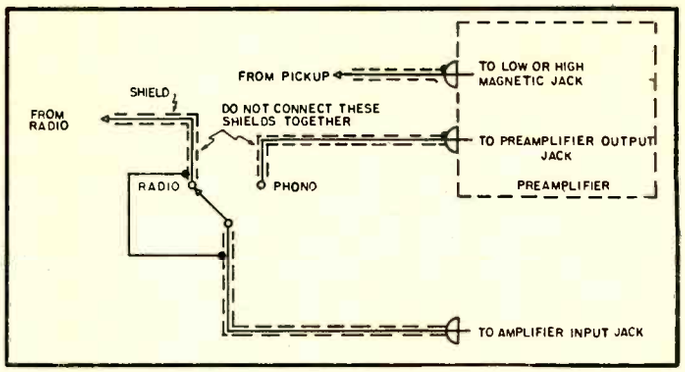


Fig. 5. Wiring of the single-pole-double-throw switch to permit selecting either phonograph or radio input for an amplifier which is not equipped with a built-in selector switch.

The Bell Model 2145 amplifier pictured in *Fig.* 6 has its own switching system in the small control unit. The left control selects either phonograph or radio, with five degrees of equalization for phonograph records or two for the radio input. The connection requires only that the plug which has been placed on the end of the cable coming from the receiver be placed in one of the jacks marked RADIO. If the radio output has been taken directly from the volume control, plug into the LO RADIO jack. If the last tube has been removed and a plug substituted in the set as described above for TV, use the HI RADIO jack.

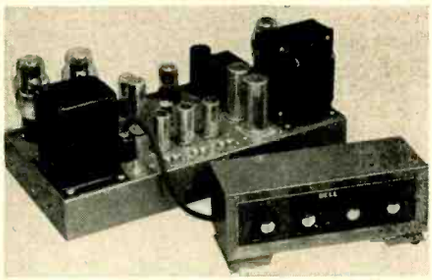


Fig. 6. The Bell 2145-A amplifier, which was described in the Equipment Report last month.

Turning the selector switch on the Bell control unit to FM connects the amplifier to the radio input jacks and the signal goes straight through without change. When the switch is turned to the AM position, the treble response is reduced somewhat to remove some of the noise and distortion common in AM broadcasting.

Other amplifiers have similar arrangements and the connection method is usually well described in the instruction leaflet which comes with the amplifier.

LOW FREQUENCY REPRODUCTION

[from page 21]

ance grows larger as frequency is lowered, being inversely proportional to frequency below resonance. This quantity further cuts into efficiency at low frequencies. Z_m increases as frequency is lowered because the stiffness of the suspension system is operating close to its elastic limits. The suspension is the source of much low-frequency distortion.

One method of increasing the output at very low frequencies is to increase the radiation resistance, R_r, by increasing the diameter of the cone. R_r increases as the square of the cone area and raises the weight of the cone. The effect is in the right direction since the mass is increased, and resonance lowered. But in order to carry this additional weight and permit movement over a long period of use, the compliant rim is made stiffer, or stronger, thus increasing Z_m, and offsetting to some degree the full benefit of the larger diameter. Thus performance does not confirm the theoretical improvement attainable with the increase in diaphragm area.

At this point the designer attempts to lower the stiffness of the rim; that is, to make it more compliant. This would be a simple and excellent aid to low-frequency improvement if it were possible to disregard high power, long life, and good transient performance. Therefore, the best that can be attained is a compromise at the point where no further distortion can possibly be tolerated at the rated maximum input power. The proud owner of the most expensive speaker system would be staggered at the amount of harmonic and inharmonic distortion in his speaker at, say 40 cps, a full octave above the low limit of our ideal speaker.

With a large cone and a compromise suspension, a lower resonant frequency is reached resulting in a larger displacement for a given input signal. Here is the antagonism between the displacement and the restoring force. At moderate excursions there is insufficient reaction or stored energy in the suspension to drive the cone back to rest quickly at the termination of the signal. This becomes a source of distortion. Under extreme excursion, the displacement close to the elastic limits of the suspension is small for a given signal increment. However, the displacement is great in the relaxed direction for the same signal as a decrement, because of the release of the stored rim energy in this extreme position. This develops enormous harmonic distortion, and the dubious satisfaction of preserving some power handling ability and reasonably long life.

Suppose there had been no compromise with the suspension, and this permitted extremely free movement to wide limits by making the rim corrugations

deep and the paper stock very thin. The cone is flabby and delivers a satisfyingly deep thump when struck with the fingers. But, unfortunately, a new set of problems arises. The thin rim will soon wear through by the action of friction among its fibres. Insufficient physical support is given to the body of the cone, which may go out-of-round at the edges where it blends into the thin compliant rim. This causes distortion and possible loss of annular centering within the air gap. Further, there can be no assurance that the rest position will always accurately align the voice coil axially with the gap. Because the forces in the rim are removed, the cone lacks tranquil stability and may fail to find a definite rest position. The cone becomes sensitive to external mechanical vibrations. A shift of voice coil position with respect to gap alignment seriously lowers the conversion efficiency and introduces further distortion. Varying humidity conditions may cause an axial shift of the voice coil with respect to gap alignment since paper cones are hygroscopic to a certain extent. The freer the rim compliance, the greater is the amount of voice-coil shift. These are some of the conflicting effects of attempts to reduce mechanical impedance, Z_m, by varying rim freedom.

Peak-to-Peak Excursion

Figure 2 shows the length of path which a cone must traverse in order to radiate one acoustic watt. While this is much more power than a person needs in a living room, it is about right for an average theatre. For a 12-in. speaker to radiate one acoustic watt at 200 cps requires a maximum displacement of 1/16 in., which is easily attainable. But to deliver the same acoustic watt at 50 cps requires a total displacement of one inch. This is *not* easily attainable. However, with larger cones, the movement becomes smaller. A 15-inch cone must move 0.6 in., and an 18-inch cone (not shown) must move only 0.4 in. These excursions are within design possibilities. But at 20 cps the problem is formidable. Notice the distances involved for the 12- and 15-inch cones. These displacements are for direct radiating cones, and are not affected by the baffle or cabinet, except when fitted to horns.

Other Causes of Distortion at Low Frequencies

1. Input distortion at *high signal peaks.* Radio transmitter and receiver signal peaks of 100 per cent modulation contain significant distortion. Similarly, high-level peaks on phonograph recordings contain large values of distortion. The non-linear conditions characterizing loudspeaker distortion at large cone amplitudes, likewise exist in recording heads, microphones, and some pickups. By adding to this the fact that the amplifier may be operating close to maximum output, it is seen that the loudspeaker is not the only offender.

2. *Cabinet Vibration.* A poorly constructed cabinet asserts its independence by taking over the function of the loud-

speaker through a limited frequency range; various flexible members are excited into resonance. The lower the desired operating frequency, the more solid and massive must be the construction of the cabinet.

3. *Lack of Cone Homogeneity.* Although there is usually a smooth reduction in cone thickness from apex to periphery, there must be a similar density and unit mass at any given radius from the center. If there are irregular spots of heavy and light areas, inharmonic distortion may result. This is usually serious because the driving frequency is then unrelated to these harmonics. The effect of a heavier mass in one spot would be to act independently of the remainder of the cone by failing to keep up with it during the accelerating portion of the cycle and to push ahead during the deceleration periods. At high signal levels it may introduce its own resonance.

4. *Irregular Response Due To Low Efficiency.* Aside from some of the previously mentioned shortcomings of poor conversion efficiency, another important disadvantage must be mentioned, namely that of irregular and erratic frequency response. A run-of-the-mill speaker, such as used in commercial radio sets, may have a conversion efficiency around 2 per cent. Such a speaker may easily have a number of spiked resonances at various frequency points, where the efficiency can rise to a theoretical maximum of 100 per cent. This means a possible variation of 20 to 1 in output along its spectrum or a change of 13 db. This does not consider any dips or cancellation effects which may give sharp holes with zero output. A quality speaker with an average efficiency of 50 per cent, also may possess resonant peaks and spots where the efficiency suddenly hits 100 per cent. But this is only a 2 to 1 change in output, or a 3 db variation in pressure. This is a very small change indeed and the speaker may be considered almost flat.

ERRATA

The Simple Preamplifier and Tone-Control Unit described under that title by David H. O'Brien in the November, 1951, issue has occasioned several inquiries from readers, and Mr. O'Brien has provided a few suggestions, which are here presented.

R_{20} should be connected to the junction of C_{13} and R_{16}, rather than to the plate of V_3. This occasions the need to reverse the polarity of C_6, since the cathode of V_2 is positive with respect to the output lead, which is normally at d.c. ground potential. Since C_{13} is then included in the feedback loop, its effect is nullified by the feedback and the low bass frequencies are improved.

R_{16} should be increased to 0.1 meg; R_9 should be changed to 330 ohms, which would decrease the tendency for over-equalization of the high frequencies when the tone controls are set for "flat." In some constructions, there has been a tendency to "motorboat," and this may be eliminated by changing R_{23} to 0.1 meg, R_{23} to 39,000 ohms, and by changing C_{15A} to 80 μf, C_{15B} to 40 μf, and C_{15C} to 40 μf.

With the new value of R_{16}, closing the switch S_2 will provide the correct roll-off for LP records without the necessity of adjusting the treble tone control to effect this correction.

The Best British Records of 1950-1951

H. A. Hartley

Concluding the compilation of the author's preferred selections from the catalogs of English record manufacturers, chosen for good performance and technical excellence.

EARLY ENGLISH KEYBOARD MUSIC

This extremely fine collection should not be missed. The set includes twelve records, which may be acquired separately, and the following are the contents. All are Decca 78's. The record number is given first.

X540 Wm. Byrd. Variations—The carman's whistle. T. Dart (harpsichord). Earl of Salisbury's Pavan & Galliard. E. Goble (virginals).
X541 John Bull. Walsingham variations. Thurston Dart (harpsichord).
X542 P. Philips. Pavana Dolorosa & Galliarda Dolorosa. Dart (harpsichord).
X543 R. Johnson & others. Irish ochone & Almain. Dart (harpsichord). The Lord's Masque & New Noddy. Dart (harpsichord) and R. Donington (viola da gamba).
AX544/5 John Bull: Queen Elizabeth's Pavan & The King's Hunt. Tompkins: Pavan in A minor. Elizabeth Goble (harpsichord).
AX546/7 Wm. Byrd: Pavana bray & Galliarda bray. Gibbons: Fantasy. Farnaby: Woodycock variations. Elizabeth Goble (harpsichord).
X548 John Bull: In nomine. Geraint Jones (organ).
X549 T. Weelkes: Two voluntaries. Gibbons: A fancy in re. Wm. Byrd: Praeludium. Geraint Jones (organ).
X550 Gibbons: Lord Salisbury's Pavan & Galliard. M. Pearson: The Fall of the leafe. Elizabeth Goble (virginals).
X551 Gibbons: Prelude. Farnaby: Masque, His dreame, His rest, Tower Hill, A toye. Elizabeth Goble (virginals).

OPERA

Bizet	Carmen. Principals, chorus & orchestra of the Opera Comique, Paris. (Wolf). Complete.	**Lon. LLP435/7**
Lehar	Count of Luxemburg (abridged).	**Lon. LLP379**
	Der Zarewitsch (abridged).	**Lon. LLP219**
	The Merry Widow (abridged). All the above by principals and chorus and Tonhalle O. Zurich. (Reinshagen).	**Lon. LLP380**
Mozart	Die Entfuehrung aus dem Serail. Principals and chorus of Vienna State Opera & V.P.O. (Krips) Complete recording on 3 records, but the balance between voices and orch. is not entirely satisfactory throughout.	**Lon. LLPA3**
Strauss, J.	Die Fledermaus. Caste as above. (Krauss) complete recording, except for dialogue.	**Lon. LLP281/2**
Weber	Der Freischutz. Caste as above. (Achermann) complete recording on three records.	**Lon. LLPA5**

Gilbert and Sullivan — All these comic operas are well performed and well recorded. If they cannot all be included as best buys it is simply because some of them do not seem to "come over" with complete satisfaction, The best are Mikado and Gondoliers, then Yeomen of the Guard. At the time of writing Iolanthe and Patience have not been heard, but ought to be good. See the London catalog for numbers.

OPERATIC ARIAS

Beethoven	Fidelio: Recit. & aria—In des Lebens Frühlingstagen. Patzak & V.P.O. (Böhm).	**Decca X489**
Borodin	Prince Igor: I hate a dreamy life. Sadko: The roaring waves besiege our shore. Christoff and Ph.O.	**H.M.V. DB21127**
Donizetti	Elisir d'Amore: Quanto e bella. Gigli & Ph.O.	**H.M.V. DB21138**
Granados	La Maja y el Ruisenor (Goyescas). de los Angeles and Ph.O.	**H.M.V. DB21069**
Mascagni	L'Amico Fritz: Cherry duet. Hammond & Schoch.	**H.M.V. DB21098**
Moussorgsky	Boris Godounov: In the town of Kazan & Hark 'tis the funeral bell. Christoff & Ph.O.	**H.M.V. DB21097**

[*Continued on page 52*]

NEW LITERATURE

● **American Relay & Controls, Inc.,** 4939 W. Flournoy St., Chicago, Ill. has recently issued a new relay catalog. Attractively printed in two colors, the new booklet contains twelve pages of information of value to users of relay of many types. Included is a section on the selection of relays, giving the method and data required to choose a relay for any specific application. Exceptionally well illustrated. Copy may be obtained by writing on company letterhead.

● **The Heath Company,** Benton Harbor, Mich. is distributing a new catalog which covers the entire line of Heathkit test equipment and amplifiers. Included in the detailed listings are schematics, inside photographs, applications, specifications and circuit descriptions of the various instruments. Copy may be obtained free by writing direct to the Company.

● **Haines Designed Products Corporation,** 117 N. Findlay St., Dayton 3, Ohio, is circulating a 4-page technical bulletin titled "Instrument Shock Testing Theory and Measurement," describing in detail the use of the Haines Shock Testing Mechanism. Calculations, operation, and instrumentation are fully delineated, and oscillograms of a complete range of shock tests are shown. Will be mailed free on request.

● **Chicago Telephone Supply Corporation,** Elkhart, Ind. illustrates and gives detailed descriptions of its new military line and regular civilian line of composition and wirewound resistors in a new 38-page catalog which is now being distributed. Section titles in the book include: "Resistance Tapers for Variable Composition Resistors;" "Locking Bushing, High-Torque Feature, and Mounting Hardware," and "Water-sealed Bearing and Mounting." Descriptive material includes electrical and mechanical characteristics, special features, and dimensional drawings of each resistor.

● **Cannon Electric Company,** P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif. is distributing Bulletins LS5-1951 and GB4-1951, covering type LS laboratory and switchboard conectors and type GB battery connectors, respectively. Advanced technical data has been incorporated in these new editions, as well as listings of a number of new types of connectors. Both Bulletins set an exceptionally high standard for publications of their nature. Will be mailed upon request.

● **Insulation Manufacturers Corporation,** 565 W. Washington Blvd., Chicago 6, Ill. describes a wide range of insulating materials in a new 12-page booklet which will be mailed free upon request to the Company's Publications Department. Among the materials covered are rag, part rag, wood pulp, rope papers, pressboards, and electrical fibre. Information on the advantages, properties, and applications for each material, is supplied. A thoroughly interesting technical publication.

● **General Electric Company,** Schenectady 5, N. Y. describes the application and operation of equipment used for measuring magnetic properties in an interesting new book prepared by the Company's Meter and Instrument department. Designated Bulletin GEC-777, the publication describes the GE gauss meter, indicating fluxmeter, recording fluxmeter, and fluxmeter calibrating unit. Also included is a great deal of worthwhile information on such items as flux density, flux direction, and total flux measurements. Copy will be supplied on request.

● **The Sonocraft Corporation,** 115 W. 45th St., New York City, N. Y. is the latest of the country's major distributors of audio equipment to announce a new 1952 catalog. The Sonocraft catalog is an excellent directory of sound and recording equipment and accessories. Copy may be had without cost by writing to the Company.

● **Coated Coil Corporation,** 501-551 W. 30th St., New York 1, N. Y. graphically illustrates and describes Enamelstrip, a metal coil pre-coated in color, in a 4-page folder which will be mailed on request. Enamelstrip permits manufacturers of small devices using stamped sheet-metal for decorative exterior surfaces to save considerable time, labor, and money, by minimizing or eliminating finishing processes.

BEST BRITISH RECORDS of 1950-1951

[*from page 50*]

Mozart	Cosi fan tutte: Donne mie. Zauberflöte: Ein Mädchen. Rothmuller & Ph.O.	**H.M.V. C4054**
Puccini	Turandot: Nessum donna. Gigli & Ph.O.	**H.M.V. DB21138**

VOCAL

Brahms	Vier ernste Gesänge, Op. 121. Ferrier.	**Lon. LLP271**
Debussy	Twelve songs. Susanne Danco acc. Agosti.	**Lon. LPS336**
Moussorgsky	Night. The Star. Fredit (Soprano) piano acc.	**H.M.V. DB21144**
Schumann	Frauenliebe und Leben. Ferrier.	**Lon. LLP271**
Tchaikovsky	At the ball. The Gipsy. Fredit. piano acc.	**H.M.V. DA1941**

MISCELLANEOUS

The numerous "recital" LP records cannot easily be accommodated in a list such as this, for the quality can be variable within the confines of one record. One or two of these consistently good have been included above, but in the main they have been ignored. The following, however, are brilliant examples of playing and recording:

Famous overtures	Zampa, Caliph of Baghdad, If I were king, The White Lady. L.P.O. (Martinon).	**Lon. LLP351**
	Poet & Peasant, Pique dame, Morning Noon & Night, Light Cavalry. L.P.O. (Solti).	**Lon. LLP352**
Music from Spain	De Falla, Granados, Turina, Albeniz. O.S.C.C. (Jorda).	**Lon. LLP191**

THE SUPER TWEETER

[*from page 23*]

ious to obtain such a unit for their own use—which to date they haven't been able to do. In the original test connection, a 2-μf capacitor was used in series with a 25-ohm potentiometer, with the super-tweeter connected from the arm of the potentiometer to one end, to permit adjustment of volume. It has been found that the optimum adjustment is about 6 db down from the maximum. *C.G.McP.*)

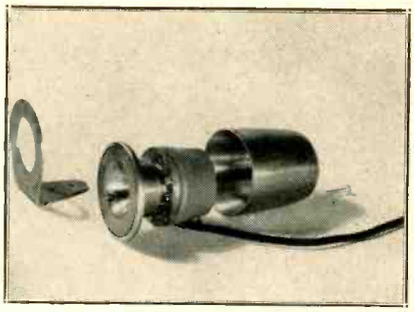


Fig. 4. For mounting in cabinets or on baffles, the unit comes apart readily.

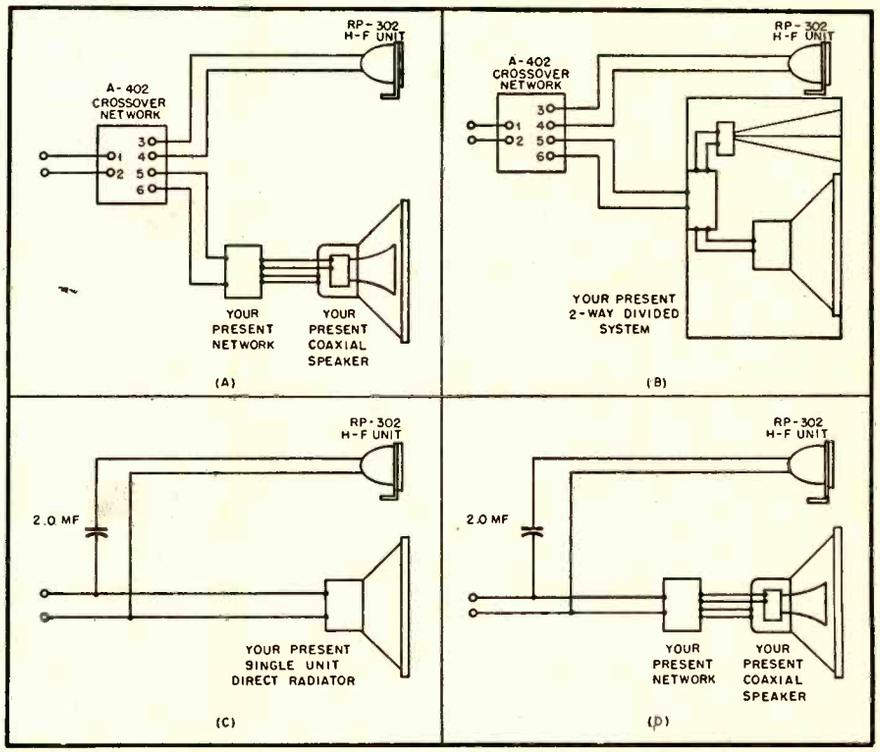


Fig. 5. Typical methods of connecting the super-tweeter—(A) and (B), using the associated network; (C) and (D), using a series capacitor.

IRE SHOW REVIEW

[*from page 28*]

ways. Interest of audio hobbyists was centered in the Racon tweeter for home music systems.

Radio Corporation of America had the distinction of presenting the show's only exhibit in which transistors were featured. Although the little tube displacers were not shown in action, there was no room for complaint in view of the excellent job that was done in showing just how transistors are made and what they are capable of doing. This display was, by all odds, one of the highlights of the entire show. RCA is to be highly commended for staffing the transistor exhibit with men who were obviously experts on the subject at hand. Of specific interest to sound engineers who visited the RCA exhibit was a new high-power audio tube. Designated Type 6146, the new tube offers many interesting potentials — you'll be hearing a lot about it in the months to come.

Shallcross Manufacturing Company offered an interesting exhibit featuring an extensive selection of precision measuring devices as well as a wide variety of precision-built rotary switches. The latter items, produced especially for manufacturers of fine equipment, are available in single- or multi-deck types with contact resistance as low as 0.001 ohm.

Standard Transformer Corp. stimulated attention in its exhibit with a dramatic showing of various types of Stancor transformers for a wide variety of audio, power, and TV functions. Enlightening were the Stancor catalogs which dramatized the full extent of the company's growth in recent years.

Sylvania Electric Products, Inc. came through with one of the show's more popular and informative displays—an interesting showing of stamped circuit assemblies and germanium diodes. Even as it pioneered fluorescent lighting, Sylvania is now pioneering the use of germanium diodes. The effectiveness of this spade work is shown by the many new uses for the little crystals that are being discovered almost daily.

Terminal Radio Corporation lived up to its reputation as one of the country's most progressive jobbers of electronic equipment with an enticing display which featured portable transmitting and receiving equipment. Although those of us in the audio field have come to associate Terminal entirely with the distribution of sound equipment, the company's reputation is just as impressive in all the other phases of the electronics industry.

United Transformer Corporation had as the focal point of its exhibit an excellent showing of transformers, chokes, toroids, and kindred items — ranging from tiny "ouncer" units for miniaturized mobile equipment to oversized types for meeting the critical demands of fixed military installations—a display which was both attractive and informative.

University Loudspeakers, Inc. displayed its complete line of speakers, ranging from high-power industrial units to the tiny Model 4401 tweeter. Interest of industrial sound engineers was naturally centered in the big re-entrant assemblies, while broadcast engineers and audio hobbyists found greatest appeal in the Type 6201 coaxial system. University is one of the most alert and aggressive companies in the audio industry—and the reasons therefor were clearly evidenced in this impressive display.

Waterman Products Company, Inc. displayed a tiny rectangular cathode-ray tube which makes possible even further reduction in size of the company's famous Pocketscopes. Also shown were several new models of the 'scopes themselves — miniaturized instruments capable of doing the jobs normally expected only of full-size equipment.

AUDIO IN THE HOME

[from page 25]

separate cartridges—one for LP and one for standard records—at about six dollars each, the total will then be about fifty dollars for the record player. A few dollars more will provide a dual cartridge which plays both LP and standard records. The necessary requirements in the radio section are sufficient sensitivity, freedom from background noise, and freedom from drift. It may be AM-FM or FM only. In areas like New York and Washington, FM is all that is necessary, as most good music programs are broadcast on FM exclusively, and the programs of the better AM stations are duplicated on FM. The cost of a good FM turner will begin at around seventy dollars. AM-FM tuners cost approximately thirty-five to fifty dollars more. It might be noted that several tuners contain tone controls and preamplifiers along with the tuning knob. This would normally be an ideal arrangement for simple installations. However, we have found *no* tuner of this type with adequate preamplifier gain or lack of hum and noise when used with GE or Audax pick-ups. The tone controls, though they may be satisfactory for extreme low-cost installations, would be considered completely unusable in a high-quality, extended-range system.

Amplifier

Amplifiers, the heart of a system, may be divided into two groups: those that require approximately one volt input to drive them and have no tone or volume controls, and those that have the preamplifier and tone controls as an integral part of them. Some have the controls as a remote unit for convenience in mounting. With a tuner that has its own tone controls, an amplifier without them is used. However, THE BEST RESULTS ARE OBTAINED WHEN THE TONE CONTROLS AND THE PREAMPLIFIER ARE PART OF THE AMPLIFIER. With regard to price, amplifiers are again grouped in two distinct brackets: those selling for around fifty dollars, and those for $150 and up. Those in between may have more power, which makes them suitable for PA work, but are no freeer from distortion and hum at room volumes.

Speaker Housing

The exact choice of a speaker may depend a lot on the housing, the amplifier to be used with it, and the quality of the source material, whether radio or records. Among the characteristics of the speaker chamber, which determines frequency response, are its size, its shape, the material of which it is made, and how it is braced. The rigidity of the chamber is a prime consideration, and some people have even gone to the trouble and expense of making them of

brick or concrete. This is an extreme, of course, but those who can afford it are amply rewarded by the results. Today there are many moderately priced speakers that have gained respect. In choosing any of them, the housing must be considered simultaneously, and the size of the cabinet that is available may determine the speaker chosen. For example, if only 2 cubic feet of space are available, a Western Electric 755A, which is specifically designed for small spaces, is best, but this must be tightly closed and completely padded, or the bass will be unnatural. It is also necessary that the amplifier have sufficient power and low distortion at frequencies below 100 cps, and this is generally not true of any amplifier in the fifty-dollar bracket. Most such amplifiers, when used with an 8-in. speaker usually do not have sufficient bass. To balance this, a 15-in. speaker good in the bass register is often the choice with an inexpensive amplifier. Many people, upon hearing this, ask the question, "But isn't a 15-in. speaker too big for my little room?" We have always felt that because we must play music at low volumes and need as much bass as possible to compensate for hearing losses, the intensity of the bass spectrum must be increased, and this can be done more successfully with a 15-in. speaker than with a smaller one. Even though most people will not house the speaker in a large enough enclosure, the larger speaker will have better bass response, despite the small cabinet. The volume at which we play our system will also make a difference in the power handling capacity of the speaker selected. Here, efficiency plays a big part. For example, one speaker that is 10 db more efficient than its competitor will require only 1.5 watts of power to give the same acoustic loudness in a room as will 15 watts driving the other. It can be seen readily from this that, with the less efficient speaker, the amplifier must be capable of much higher powers on peaks. This, again, is a shortcoming of low-priced amplifiers, and it might be said from this that more efficient speakers will sound better with inexpensive amplifiers than will cheaper and less efficient speakers.

Distribution, whether dispersed or beamed, is another factor in choosing a speaker. High frequencies have a tendency to beam and consequently would not be satisfactorily heard with certain speakers unless a person sat in front of them. Smaller speakers have better dispersion than the larger ones, and generally speakers in corners give better dispersion and better low frequency response, as the walls of the room act as a large megaphone. In catalogs, one sees a claimed frequency response of 40 to 15,000 cps, ± 5 db. We do not believe that a speaker could be made with such a response that would cost less than several hundred dollars. More than extended frequency response is important in a speaker. Freedom from peaks or annoying resonances is also desirable. Good transient response,

or the ability to stop vibrating the instant after the sound has ceased, is essential. Poor transient response gives an effect which is analogous to blurring or "out of focus" in photography. It is important to choose a speaker and amplifier that are compatible. Where standard components are used, one must choose between an expensive amplifier with an inexpensive speaker, properly housed, or the more usual inexpensive amplifier with a heavy 12- or 15-in. speaker.

The placement of components with relation to one another, ventilation, and so on, will affect the results obtained. Poor ventilation will cause excessive heat in tubes which, in turn, will cause FM tuners to drift excessively. Magnetic pick-ups of variable reluctance type are susceptible to stray magnetic fields from power transformers, chokes, and motors. This can be checked by setting the pick-up on a record, removing the power cord of the turntable, and moving the amplifier around it to see where the minimum hum occurs. This problem is more acute with some pick-ups than with others.

Employment Register

POSITIONS OPEN and AVAILABLE PERSONNEL may be listed here at no charge to industry or to members of the Society. For insertion in this column, brief announcements should be in the hands of the Secretary, Audio Engineering Society, P. O. Box 12, Old Chelsea Station, N. Y. 11, N. Y., before the fifth of the month preceding the date of issue.

★ Positions Open ● Positions Wanted

★ **Sales Manager,** Audio-Visual Aid Department. Excellent opportunity with large organization in New York area. State experience and salary desired in first letter, Box 401, AUDIO ENGINEERING.

★ **Radio and TV Engineers,** for administrative engineering. Attractive salary with escalator clause. EE degree or BS in Communication required, but no experience necessary. For appointment, contact Mr. James Anderson at CIrcle 7-8300, Ext. 494. National Broadcasting Company, 30 Rockefeller Plaza, New York 20, N. Y.

★ **Engineers and Scientists** urgently needed for work on highly important projects of interest to national defense. Chemical, Electrical, Electronic, Industrial, and Mechanical engineers required. Physicists and Metallurgists also needed. Projects involve research, development and manufacture of artillery ammunition, small arms ammunition, electronic fuzes, fire control instruments, etc. Salaries range from $3410 to $7040 per year. For further particulars, write to Mr. K. E. Yocum, Director, Civilian Personnel, Frankford Arsenal, Philadelphia 37, Pa.

A MONTHLY SUMMARY of product developments and price changes of radio-electronic-television parts and equipment, supplied by United Catalog Publishers, Inc. 110 Lafayette Street, New York City, publishers of Radio's Master.

These REPORTS will keep you up-to-date in this ever-changing industry. They will also help you to buy and specify to best advantage. A complete description of most products will be found in the Official Buying Guide, Radio's Master—available through local radio parts wholesalers.

BOOKS & MANUALS

RIDER, JOHN F. Increased price of Cat. #102, FM Transmission and Reception, 2nd Edition to $4.95.

SAMS, HOWARD W. CTB-1, Cyclopedia of Television, out of print.

MISCELLANEOUS RADIO, TV AND ELECTRONIC PARTS

ACOUSTI-CRAFT Decreased prices on "Deluxe" Bass Reflex Cabinets #512 and #515 to $60.00 net each . . . added #705.0 at $2.70 net.

ELECTRO-MECHANICAL INSTR. CO. Withdrew a. c. ammeters #6106 and 6206, while adding meters 2103A, 2137A, 2203A and 2237A.

ERIE RESISTOR Added #413 (500 mmf), completely universal Hi-Voltage Ceramicon at $1.35 net and extra terminals for above at $.06 net.

GON-SET CO. Added VHF adaptor with squelch at $79.50 net.

HALLDORSON CO. Revised their entire line on transformers to include new items, discontinued items, price changes, and new catalog numbers.

NATIONAL CARBON Added #729, "Eveready" "A-B" packs for portable receivers; #4351, "Eveready" Flashlight; and #715 "Eveready" lantern battery and emergency lighting battery . . . withdrew ten other items in their line.

POTTER & BRUMFIELD Withdrew Synchronous Utility Timer and Signal Indicator from their line.

SANGAMO ELECTRIC CO. Added approximately 263 new TV replacement capacitors.

WIRT CO. Withdrew #SW711 and SW711A from their line of Dim-a-Lite Sockets and Resistors.

RECORDING EQUIPMENT, SPEAKERS, AMPLIFIERS, NEEDLES, TAPE, ETC. . . .

DUOTONE CO. Added 36 new Diamond Replacement needles to their line.

JENSEN INDUSTRIES Added Jensen cutting needles #WG-65, Wilcox Gay (Stellite) cutter playback combination for 78-r.p.m. records and WG-652, Wilcox Gay (Stellite) cutter playback combination for 33 1/3, 45, and 78 r.p.m. records.

MASCO (Mark Simpson) Decreased prices on approximately 101 items on their line . . . discontinued nine items and added MA-77, Amplifier . . . MA-77R, Remote Control Amplifier . . . MC0-77, Outdoor System . . . MB-77, Booster Amplifier and MB-77P, Booster Amplifier with panel.

PERMOFLUX CORP. Increased prices on Monaural Headsets #DHS-1B, DHS-15B, DHS-17B and DHS-28B . . . added three new speakers, 4CM and 45CM to their "Champion" line and 15WP-8-1 to their "Royal" line.

PFANSTIEHL CHEM. CO. Added PA-62A, PA-63MG, and PA-66U, Pfanstiehl Replacement needles (Shure Whisker-type for Std. groove, Microgroove, and All Purpose). Also added RT-10, replacement tone arm for V-M changer #400 series and RT-11 for 900 series at $3.00 net.

PICKERING & CO. Withdrew #161L and 161M, 78-r.p.m. pick-ups; and #165L, Equalizer Pre-Amplifier Unit.

RECOTON CORP. Decreased prices on four "Recoton" replacement needles #305, 306, 307 and 310 . . . added "Recoton" replacement Phoneedle Kits No. 150 and 550 . . . added 11 "Recoton" replacement needles.

SHURE BROS. Reduced prices on microphone cartridge (carbon) #101C and 102C to $16.50 net . . . reduced price of microphone replacement cartridge (carbon) #R10 to $4.80 net.

VIBRALOC CORP. Decreased prices on "G", "E", and "K" series of loudspeaker baffles.

TEST EQUIPMENT

ELECTRONIC MEASUREMENTS CORP. Added Model 205 and 205P, Tube Tester; and HVP, High Voltage Probe.

RADIO MFG. ENGINEERS, INC. Discontinued Model NBF-4, Ratio Detector.

TOOLS AND HARDWARE

PLYMOUTH RUBBER CO. Decreased prices on their Slipknot friction tapes, Double Rubber tape and their splicing compounds . . . also Slipknot Friction in Display Cartons.

VANCLEEF BROS., INC. Reduced prices on Dutch Brand friction tapes . . . Dutch Brand rubber insulating tape and Dutch Brand "Hippo" shop package rubber tape.

TUBES—RECEIVING, TELEVISION, SPECIAL PURPOSE, ETC. . . .

ELECTRONICS, INC. Decreased prices on 26 items on their line of rectifier tubes and grid-controlled rectifiers (Thyratrons).

G. E. Decreased prices on two 10", two 12", and two 16" TV Tubes.

NATIONAL ELECTRONICS Added Ignitron Type #NL-1001 at $37.50 net.

R. C. A. Revised prices on receiving tubes to show 191 price increases and 19 price decreases. All decreased prices of electron tubes 2BP11, 2C43 and 931A . . . increased price of 4E27A/5-125B to $35.75 Sugg'd User . . . added electron tubes type 6146 and 6159, VHF beam power amplifiers; and 6161, UHF power triode.

RAULAND CORP. Decreased price of picture tube 21EP4A to $43.50 net . . . withdrew picture tubes 10RP4 and 16AP4B . . . increased prices on picture tubes 17HP4 and 17LP4A to $27.80 net each.

RAYTHEON Increased price of special purpose tube type CK 1006 to $5.85 Sugg'd user. (Full-wave-GAS) . . . added receiving tubes 6BK7 at $3.20 list, a twin-triode of miniature construction designed primarily for use as a cascode amplifier at frequencies below 300 megacycles . . . also 6V3 at $3.90 list, a nine-pin miniature, heater-cathode type diode, designed for use as a damper diode in television sweep circuits. Introduced picture tube 21FP4A at $43.25 available from your serving warehouse.

SARKES TARZIAN, INC. 17 TV tubes decreased in price.

SYLVANIA Decreased prices on 35 receiving tube types . . . decreased prices of special purpose tubes 6X5WGT to $1.57 net, 6SN7WGT to $2.75 net . . . Gas pressure measuring tube R-1111 (Pirani tube) to $5.50 net . . . Klystrons 6BL6 and 6BM6 (Velocity-modulation reflex oscillators) to $100.00 net. Added Germanium crystal diodes 1N82 (UHF diode) and 1N78 (16,000 mc mixer).

TUNG-SOL ELECTRIC INC. Increased price of receiving tube 12K7GT to $2.20 list.

B'CAST SHORT CUTS

[*from page 34*]

while they are in place, are often forgotten, and the protection of the interlocks is lost. In the case of equipments where the interlocks are directly in series with the main power breaker, the protective circuit shown in *Fig.* 3 can be used to eliminate positively any forgetfulness on the part of the operator.

The protective relay, Ry_1, should have a 6- to 12-volt a.c. coil that will operate on approximately the same current as the power relay, Ry_2. If the impedance is too high, a shunt can be used. In operation, push-switch S_1 which is mounted near the ON button, is pushed simultaneously with the latter. This temporarily shorts out the contacts on Ry_1, which closes and locks up, closing the circuit shorting out the interlock string and completing the circuit to the power contactor. When the OFF button is pushed, the circuit is de-energized, and the protective relay opens. In order to operate again, the same procedure must be followed. This will prevent the high voltage being applied while one has his hands inside the equipment. Also, the shunt is automatically removed each time the power is removed. In the event the doors are closed while power is still on, the protective relay is shorted out, thus releasing its contacts, and returning the protection of the interlock circuits. If desired, for operation with the doors open during emergencies, a second contact on Ry_1 can be used to operate an indicator.

CLASSIFIED

Rates: 10c per word per insertion for noncommercial advertisements; 25c per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

THE AUDIO EXCHANGE, INC. buys and sells quality high-fidelity sound systems and components. Guaranteed used and new equipment. Catalogue. Department AE, 159–19 Hillside Avenue, Jamaica 32, N. Y. Telephone OL 8-0445.

PRESTO 6NM regular and microgroove recorder and 90B amplifier. Excellent condition, $900. R. Woodburn, 8 College St., Iowa City, Iowa.

FOR SALE: Meissner 1-1091C AM-FM tuner. One year old, used very little. Perfect condition, superb performance, $149.50. Save $50 over net price. Herbert Louis, 3914 Elfin Rd., Louisville, Ky.

FOR SALE: Twin-Trax 15-in. per second tape recorder mechanism. ACA Model 808C, in excellent condition, $55. Donnie Brown, 1305 Watson, Moberly, Mo.

WANTED: Used recorder—Concertone, Magnecorder, or similar. S. Yalcin, 210 Linden Ave., Ithaca, N. Y.

WILL TRADE my 18-in. Electro-Voice, 8-in. Jim Lansing, Stephens Hyson, 4-way E-V network, Pickering arm and .001 diamond cartridge, weighted turntable. Want especially 15-in. JL 130A speaker, Racon COB-11 horn, good driver, Weathers pickup, Audax Chromatic, and what have you part or all. $280 worth for $195 cash. Williams, Virginia Lane, Springfield, Ill.

NEW Williamson amplifiers, $87.50. Hallicrafters S-47-C, best offer. New, cartoned Peerless S-265-Q output trans, $23. Dr. Nicely, Kenton, Ohio.

FOR SALE: Tuners AM-FM—Brooks ST-14, $80; Browning RJ-20, $90. Amplifier—Altec Lansing A-323-B, $75. Speakers—Jensen JAP-60, $35; General Electric S-1201D, $14; Altec 600, $20; Electro-Voice SP-15, $60. Tweeters—University 4402, $16; University 4409, $16; Electro-Voice T10, $35. Crossover Network—University 4410, $16; University HP filter 4405, $4; Electro-Voice X35, $9. All in good condition. Ralph Ashworth, Charlton City, Mass.

FOR SALE: Altec Lansing Model 603B speaker, $55. C. M. Carr, 341 Nova Lane, Menlo Park, California.

FOR SALE: Stephens 102FR speaker, never used. T. P. Hurley, Pownal, Vt.

ELECTRO-VOICE "Slim Jim" Professional microphone, Model 635, cost $120, your price $95. Matched pair Pickering diamonds, 78 and 33, cost $60, your price $45. Garrard RC-80 3-speed changer with mahogany base, 2 months old, perfect condition, $30. Money orders only, f.o.b. New York. R. Bennis, Box CA-1, AUDIO ENGINEERING.

McPROUD corner enclosure for 15-in. woofer and 2-way system. Beautiful limed oak, cost $200, for $135. 2 months old. Must be seen to be appreciated. Call after 6 p.m. ILlinois 8-8179.

WANTED: Model T-12 or T-12H Rek-O-Kut turntable, with or without arm. Give condition and lowest price. Box CA-2, AUDIO ENGINEERING.

PROFESSIONAL DIRECTORY

Industry People...

F. H. Slaymaker, chief engineer of Stromberg-Carlson's sound-equipment division, chose occasion of I.R.E. convention to huddle with **M. T. Zegel,** district manager in Manhattan area, regarding company's new high-fidelity line to be introduced in May. . . . **Eleanor I. Ney,** public relations counsellor in the electronics field, also latched onto the I.R.E. clambake as an expedient means of reaching clients—old, new, and hoped-for. . . . **Arnold S. Bailey,** former Bell Lab antenna expert, announces association with Northeastern Engineering, Inc., Manchester, N. H. . . . **Mario Cortez,** associate conductor of the New York Philharmonic orchestra, rapidly achieving authority in the audio field to equal his standing in the field of music—has home installation which includes Magnecorder, McIntosh 50-watt amplifier, and Altec 604B speaker. . . .

Jimmy Carroll, formerly of G. Schirmer, Inc., music merchants, is new addition to sales staff of Harvey Radio Company's sound department, both in New York. . . . **Charles Urban,** pioneer in the transformer field, announces association with Faratran Electric Co., Newark, N. J. . . . **Ken Prince,** head man of Chicago's Radio Parts Show, made flying trip east to sew up details of Windy City's Audio Fair with **Harry N. Reizes, Fair** manager in both cities. . . . **Tom Marchiano,** formerly in the business of selling sound equipment to consumers, now calling on distributors as representative of Rockbar Corporation, New York—first assignment is to popularize the new Collaro record changer.

John S. Boyers, president, Magnecord, Inc., Chicago, overwhelmed at reception accorded new MagneCordette during introductory showing at I.R.E. Convention—ditto Spec Barker, sales manager, and Dick McQueen, ad manager. . . . **Jerry Minter,** chief engineer, Measurements Corporation, Boonton, N. J., and AES official, spearheading movement of engineers toward aviation as a hobby—shares honors with **Arthur Godfrey** as owner-pilot of a Navion. . . . **Sidney Dru,** responsible for a number of years for the excellent art and layout work in Lafayette Radio catalogs, has resigned to perform similar chores on a free-lance basis for all comers. . . . **Paul Hilton,** formerly assistant general manager of Crosley Distributing Corporation of New York, has been appointed treasurer of the Magna-Crest Corporation, also New York—announcement made by **Charles E. Rynd,** Magna-Crest board chairman.

James A. Sullivan is new addition to sales staff of Oxford Electric Corporation, Chicago speaker manufacturer. . . . **W. Cordes Snyder,** president, Blaw-Know Co., Pittsburgh, Pa., announces appointment of **Otto G. Schwenk** as v.p. in charge of industrial products. . . . **Louis H. Niemann** is new Eastern sales manager for Hytron Radio & Electronics Co.—takes place of **Fred Garcelon** who has been promoted to assist **John Q. Adams,** v.p. in charge of sales. . . . Expansion of Kierulff organization on West Coast finds **Cap Kierulff, Bill Cavanaugh** and **Dave Gury** occupying top sales spots.

Max Graff, senior partner of brokerage firm of Townsend, Graff & Co. is new addition to board of directors of Audio & Video Products Corp., New York. . . . **Joseph Maresca** has been named assistant to **Bernard L. Cahn,** general sales manager of the Insuline Corporation of America. . . . New officials of West Coast Electronic Manufacturers' Association are: **Leon B. Ungar,** president; **Noel E. Porter,** vice-president; **J. J. Halloran,** secretary, and **George Clark,** treasurer. . . . **George Halkides** and **John Tanner** are new executives of James B. Lansing Sound, Inc., Los Angeles, according to announcement of **William Thomas,** president. . . . **George Davis** is new Pentron representative for Southern California and Arizona. . . . **Edward J. Content** back home after serving as senior engineer in construction of Saudi Arabian Government Broadcasting System installations at Jeddah and Mecca . . . work was performed by International Standard Electric Corp., an I.T. & T. affiliate. . . . **William J. Doyle,** former general sales manager, has been upped to vp. in charge of sales by Astatic Corp., Conneaut, Ohio.

ADVERTISING INDEX

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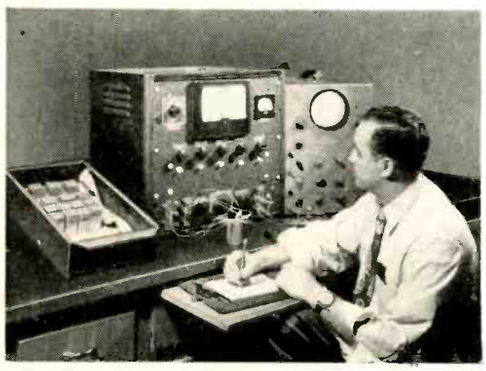

The component being checked here is a dual saturable reactor where the test and adjusting conditions necessitate uniformity of the complete *slope* of the saturation curve. The precision of this equipment permits measuring five widely separated points on the saturation curve with saturating DC controllable to .5% and inductance to .5%.

Servomechanisms and similar apparatus depend, to a considerable degree, on phase angle operation. The transformer adjusted in this operation requires an accuracy of .05 degrees phase angle calibration under the resonant condition of application. With wide change in voltage and temperature range from −40 to +85 degrees C., the phase angle deviation cannot exceed .2 degree. To effect this type of stability, specific temperature cycling and aging methods have been developed so that permanent stability is effected.

This test position involves two practical problems in a precision inductor. The unit shown is adjusted to an inductance accuracy of .3%, with precise (high) Q limits. It is then oriented in its case, using a test setup which simulates the actual final equipment so that minimum inductive coupling will result when installed in the final equipment.

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