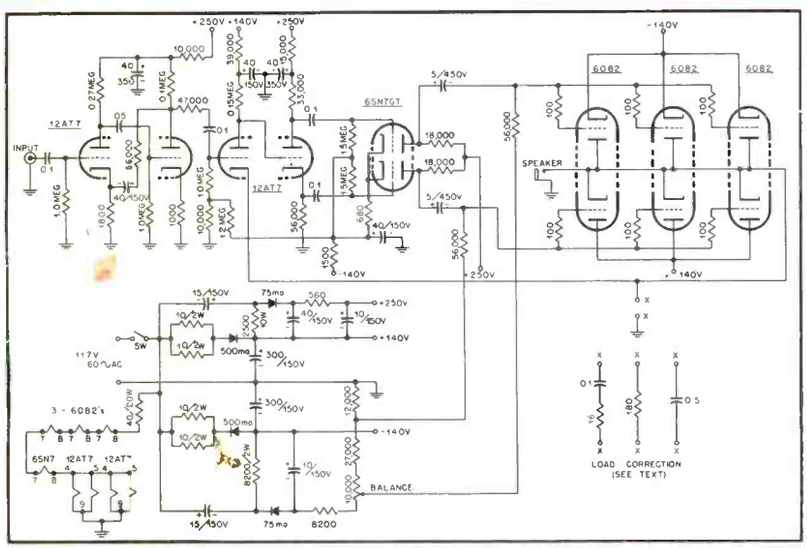
AUDIO

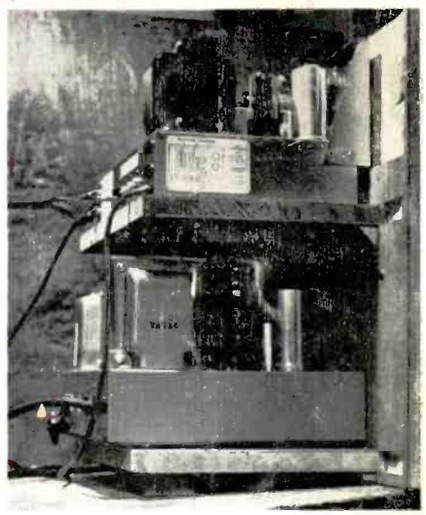
ENGINEERING MUSIC SOUND REPRODUCTION

JUNE, 1954

50c



A practical 25-watt amplifier which uses no transformers at all—either output or power—and which works with conventional loudspeakers has long been the aim of designers. One has solved the problem, and gives complete details on page 22.



One reader who wanted good music summer and winter had a budget which did not allow for 2 complete hi-fi rigs. Solution on page 24.

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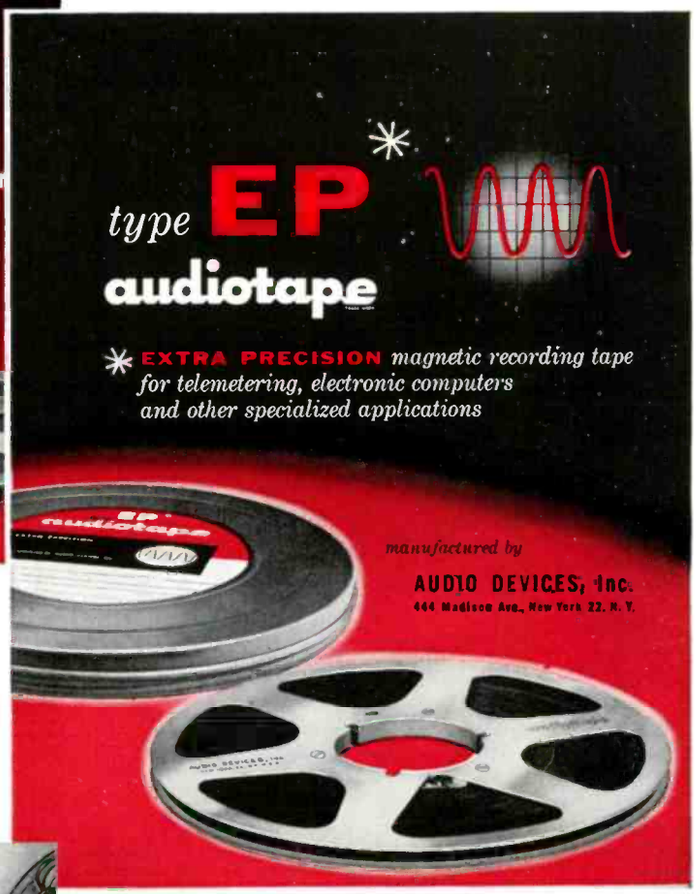

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JUNE, 1954 VOL. 38, No. 6
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

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AUDIO PATENTS

RICHARD H. DORF*

THIS WRITER has never been concerned with or had any experience with optical recording as used in motion pictures (though your Editor is a graduate of the Hollywood studios), but in common with most other engineers has a general basic knowledge of the process. It has always seemed to me rather strange that the electro-mechanical galvanometer device is still in use as a "light valve" in the recording process. After all, the thing includes parts which must move at an audio rate and therefore the question of mechanical inertia, resonance, and so on must arise just as it does in the disc record cutter, though perhaps to a lesser extent because the light valve does not have to do any work other than move itself.

But just because there is no work to be done except to control light intensity or the length of a line of light, it seems that there must be some electrical or electronic method of doing the job which would do away with movement on the part of anything but the film. Variable-density *enregistrement*[1] could obviously be accomplished by varying the intensity of a lamp, undoubtedly gas-filled; but apparently that has not proved practical. Variable-area recording is another story, however, since varying the length of a line of light while keeping the intensity constant is not that easy without moving something.

However, a recent patent has appeared with an interesting and, I would imagine, useful way of doing this. The joint patentees are John V. Atanasoff and Ronald J. Wylde of Hyattsville, Md. The patent number is 2,672,524.

The single illustration in the patent specification is reproduced in *Fig.* 1 and it shows practically the entire system. The key to its operation is a cathode-ray tube with a short-persistence phosphor. A thin line of light, perhaps further defined by a mask with a slit, is created by deflecting a sharply focused beam horizontally (normal to the direction of travel of the film) at an ultrasonic rate and varying the effective length of the line of light in both directions from the center in accordance with the instantaneous amplitude of the incoming sound signal.

The cathode-ray tube is a normal short-persistence one with either electromagnetic or electrostatic deflection and focus, though electrostatic is shown in the example. It is shown with only horizontal deflection plates since no vertical deflection is used except perhaps for d.c. positioning. Voltages for the two anodes (second anode grounded) and cathode are provided by battery B_4, which would in practice be a voltage divider across a usual power supply with positive grounded.

The deflection generator shown as a box at the left generates a suitable deflection signal, a saw-tooth or triangular wave, at a frequency several times that of the highest audio frequency to be recorded.

The deflection generator has a push-pull output—balanced to ground—and this is also impressed upon the grids of V_1 and V_2, which in combination form a push-pull cathode-follower stage. The junction point of the two grid resistors R_1 and R_2 are connected to ground through bias battery B_1 and the secondary of the audio signal-source output transformer. This connection of the signal source results in a simultaneous increase of plate current in V_1 and V_2 whenever the audio signal is positive and a decrease whenever it is negative; these increases and decreases take place, of course, at the audio rate. Therefore the cathode output of V_1 contains deflection-waveform voltage, superimposed on a "d.c." component whose value changes with the audio signal cycles. The cathode of V_2 contains deflection waveform of opposite phase but with similarly varying audio-frequency "d.c." component.

Battery B_1 simply applies negative voltage to the grids of V_1 and V_2 to maintain

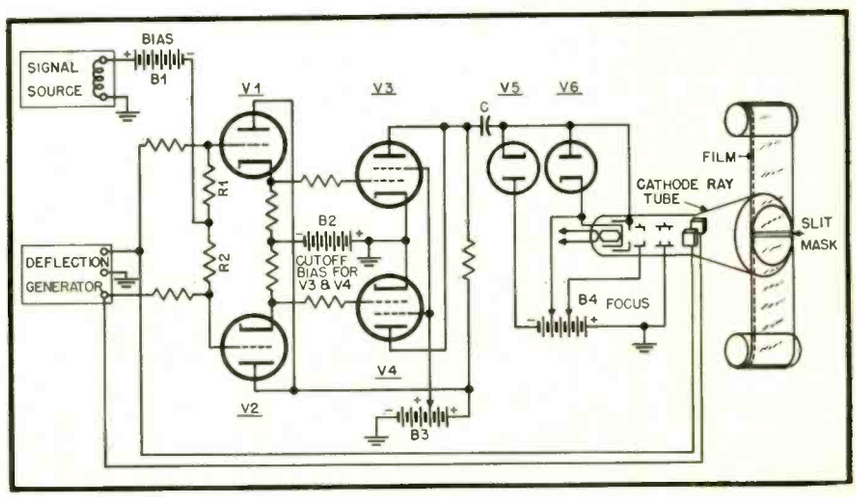

Fig. 1.

* *Audio Consultant, 255 W. 84th St., New York 24, N. Y.*

[1] New and fancy word for "recording" recently culled by the author from the French magazine *Revue de Son,* which he promised himself he would use some day.

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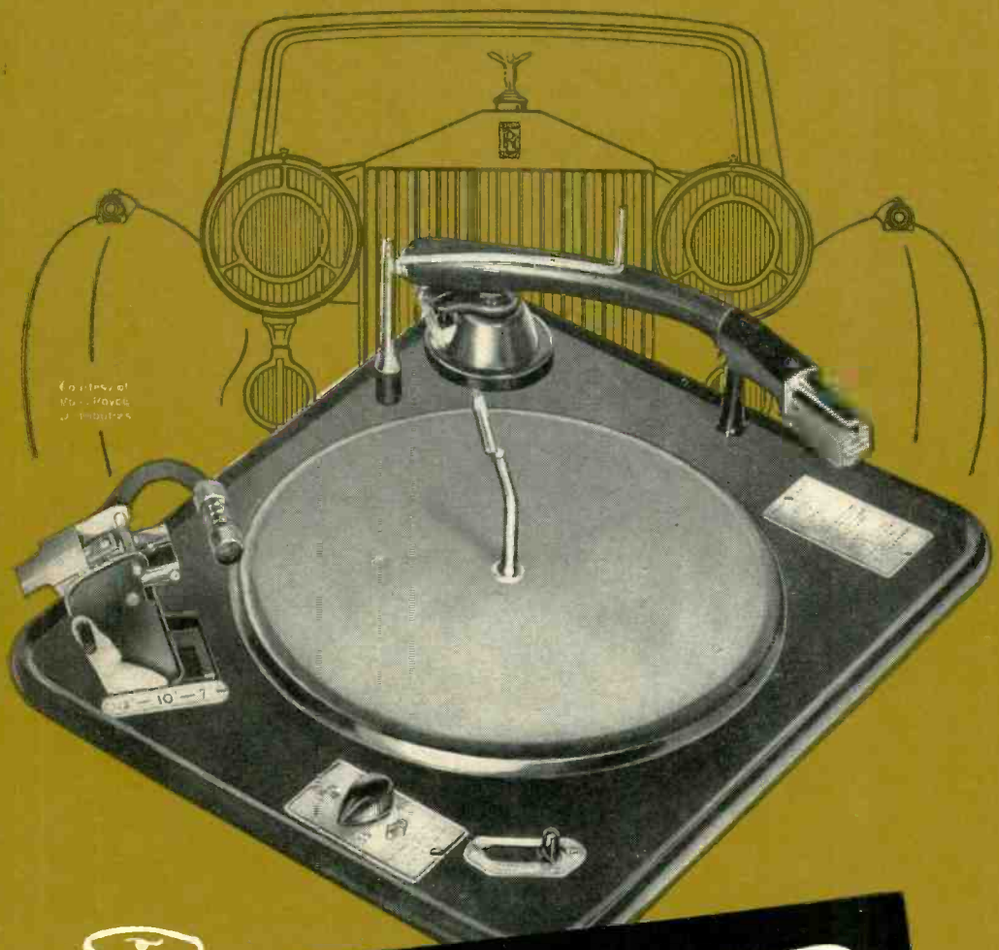

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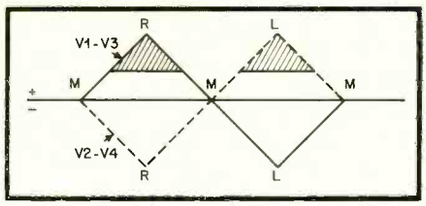

Fig. 2.

proper operating bias. The main function of battery B_2 is to apply negative voltage to the grids of V_3 and V_4, which it does because of the direct coupling between the V_1–V_2 cathodes and the V_3–V_4 grids. The voltage of B_2 is sufficient to cause cutoff of V_3 and V_4 unless a sufficiently high positive voltage is applied to the grid of either tube to make it conduct. When V_3 and V_4 do not conduct, or when they go from the conducting to the nonconducting state, the voltage drop is reduced to zero and the full B-supply voltage is applied through capacitor C to the grid of the c.r. tube. This positive-going pulse renders the c.r. tube conducting, so that whatever spot is being traversed at that instant is illuminated.

Figure 2 is a graph showing the waveform applied by the deflection generator to the horizontal deflection plates of the c.r. tube. We are assuming a triangular wave is used. The solid line is the wave applied to one plate and the dashed line that applied to the other. When the deflection voltage is zero, the beam is at the center of its path; when it is maximum the beam is at one end of its path. We have assumed that when the solid-line plate is positive the beam is at right (see letter R in figure) and that when the dashed-line plate is positive the beam is at left.

This same waveform reaches V_3 and V_4, which are normally cut off. Let us assume that connections are such that the solid-line waveform of *Fig. 2* is that passing through V_1 and V_3, the other passing through V_2 and V_4.

When the deflection voltages are zero (beam at middle—see letter M in *Fig. 2*) V_3 and V_4 remain cut off, their plate voltage is maximum positive, and the grid of the c.r. tube is positive so that the screen is illuminated. There is no audio input signal.

As the generator cycle continues, both halves of the waveform rise in amplitude. That going to V_2–V_4 has no effect since V_4 is already cut off and its grid signal only makes its grid more negative. But very shortly the V_1–V_3 signal becomes sufficiently positive at the V_3 grid to cause plate current through V_3. This causes the plate of V_3 to go negative; this negative pulse applied to the c.r. tube grid extinguishes the beam.

In the second 90 deg. of the deflection cycle the beam returns to center and the grid of V_3 becomes sufficiently negative again to cause current cutoff. At this point the positive V_3 plate voltage causes the illumination to begin again. The period of the deflection cycle which took place with the beam dark is indicated by the shading in *Fig. 2*; obviously there was light only during a period while the beam was near center.

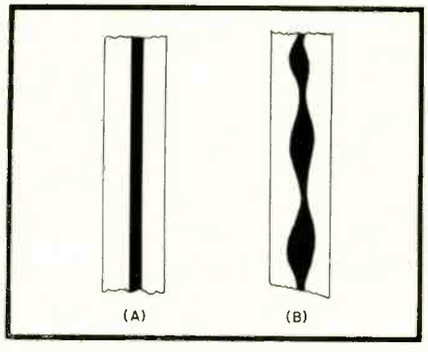

Fig. 3.

Now deflection polarity reverses and the V_2–V_4 voltage goes positive. (Since the V_1–V_3 voltage goes negative, it has no effect, V_3 already being at cutoff bias.) As the V_4 grid voltage goes positive the resulting negative plate pulse again biases the c.r. tube to cutoff and again the screen is dark except at the center. This time, of course, the beam travels to the left and back.

All this time the film has been passing the light slit and (A) of *Fig. 3* shows how it will look after development—dark at the center where the light has struck. The deflection rate is so high with respect to the film travel speed that the line appears solid. Keep in mind now that the illumination of the beam goes out only when the grid of *either* V_3 *or* V_4 goes positive by a certain amount or more.

Now suppose some audio signal comes along. Let us see what happens at one point in an audio cycle when the signal is very negative with respect to ground. The negative audio is applied equally to the grids of V_1 and V_2 and results in less conduction in both tubes. As a result the cathodes of both tubes are much less positive than before and this greater negativeness appears at the grids of V_3 and V_4. The relationship between the d.c. level and the deflection waveform is shown by *Fig. 4*, where the waveforms are intact but are well below the zero-level baseline.

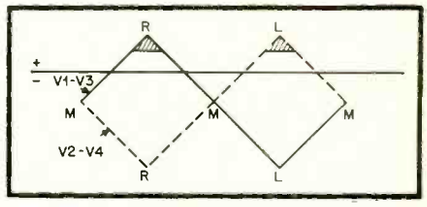

Fig. 4.

Again, with the beam at middle, both V_3 and V_4 grids are negative, so that the c.r. tube conducts and light is seen. But now the V_3 signal must go almost to the limit of its amplitude before it becomes sufficiently positive to extinguish the beam. And on the left-going trace the same is true of the V_4 signal. As a result, the beam, instead of being lighted only around the center of the trace area, is lighted almost out to its ends. The shaded parts in *Fig. 4* show that the beam is extinguished only at its extreme right and left ends. The resulting film will show a very wide area of blackness after development.

The converse is true as well. When the audio is at a maximum *positive* point in the cycle, the V_3 or V_4 grid voltage is so positive that the blackout begins almost instantly when the beam departs from middle position. It is thus obvious that the instantaneous level of the audio cycle determines the width of the black area on that section of the film passing the slit at that instant. The width of the black area is exactly proportional to the instantaneous amplitude and phase of the audio cycle and a sine-wave audio signal will appear in the developed film as in (B) of *Fig. 3*. When the positive film is printed it will be black at the edges, with the push-pull sine-waveform at the center in white (clear) and will be a standard variable-area recording.

(*Continued on page 59*)

Introducing Model TL/10, an ENTIRELY NEW Amplifier-Pre-Amplifier Combination

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Bottom view of TL/10 chassis, showing all components mounted on terminal board for easy servicing . . . as in the most expensive scientific laboratory and government equipment.

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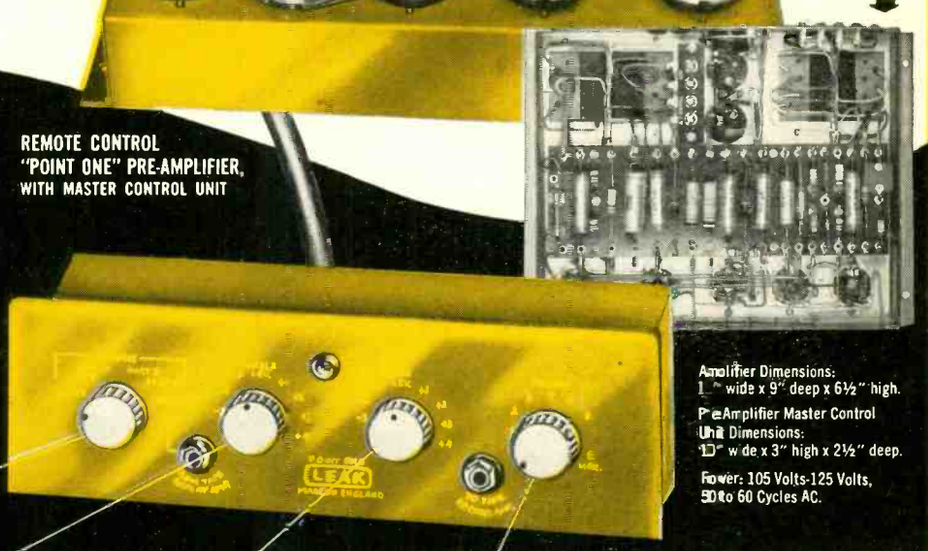

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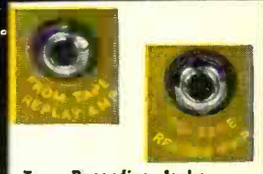

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London Letter

RICHARD ARBIB*

British Radio Components Show

ALTHOUGH THIS YEAR your Editor did not honour the British Components Show with his presence, we all have happy memories of the U.S.A. contingent which included him last year. It was undoubtedly a tribute to our American friends that led the organizers of this year's show to ask Leonard Carduner, president of British Industries Corporation, New York, to reply to the toast of the visitors at the official inaugural luncheon.

This exhibition, which took place as usual at Grosvenor House, had 130 exhibitors including many names familiar to U.S.A. readers including Garrard, Collaro, Partridge and practically all the loudspeaker manufacturers I mentioned in my letter of March. Incidentally Electro Acoustic Industries were showing an interesting range of inexpensive speakers specially constructed to withstand extreme climatic conditions. Many British set makers are now fitting these speakers to equipment destined for the tropics.

Perhaps I may be forgiven for mentioning that the new Ersin Multicore 5 core Solder made its first appearance at the Show and an exceptionally large order was booked for the U.S.A. market.

Radio Set in a Plug

An idea which seemed to be novel, introduced by Truvox, is what they call a "Radio Jack". This is a jack plug with a case somewhat larger than normal fitted with a terminal and a switch. It is intended for tape enthusiasts and is plugged into the microphone input socket. Built into the case is a special high-Q coil tuned by two preset capacitors controlled by the toggle switch. An aerial has to be connected to the terminal. A germanium rectifier built into the case rectifies the signal and the capacitors can be pre-set to two stations operating between 500 and 1500 kc. Providing the recorder is used reasonably close to suitable radio transmitters virtually distortion-free recordings should be obtained.

Direct Live-Record Demonstration

The loudspeaker manufacturer who will publicly compare his wares with the genuine article must have supreme confidence in his speakers. As our photograph shows Gilbert Briggs did just this recently when an audience of over a thousand in Bradford, Yorkshire, were able to compare the piano performances of Edgar Knight reproduced from commercial records through the Wharfedale three-speaker system and from

Seen at the British Radio Components Show are these five whose names are familiar to hi-fi enthusiasts everywhere. Left to right, Harold Leak (Leak Amplifiers), G. A. Briggs (Wharfedale Loudspeakers), Leonard Carduner (British Industries Corp., New York), Richard Arbib (Multicore Solders), and Hector Slade (Garrard Record Changers).

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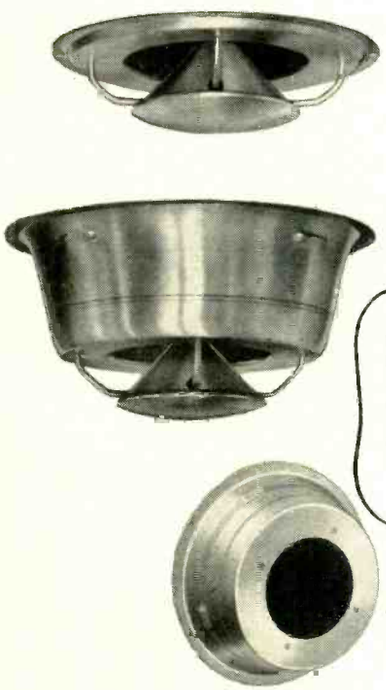
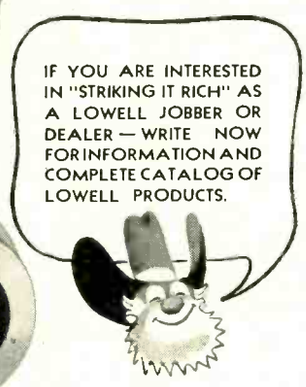


Construction in 1954, government statistics show, will be the highest in the nation's history. Much of this construction calls for commercial low level sound installations — and LOWELL is the leader and pioneer in this field. By becoming a LOWELL jobber or dealer, you can "cash in" on this phase of the huge construction program — add important profit volume to your existing business!



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a piano on the same platform. Many of us will hope that the success of this demonstration may lead Mr. Briggs to repeat it in other halls in England and possibly overseas.

Glyndebourne—An Unforgettable Experience

Imagine being in Grand Central Station, New York, at about 3 p.m. on a summer afternoon in June or July and seeing a hundred or so men in Tuxedos accompanied by almost the same number of women in long evening dresses. You would hardly be able to believe your eyes would you? Yet you could see a similar scene at Victoria Station, one of London's largest railway stations practically every afternoon during June and July.

So that the U.S.A. readers of AUDIO visiting England this summer may not miss one of the musical treats of their lives, let me tell you about Glyndebourne which besides delighting the thousands that visit this unique opera house, also provides the means for hi-fi enthusiasts to capture on tape the performances of opera probably nearest to perfection, for the British Broadcasting Company broadcast them in their entirety.

Glyndebourne is an opera house seating about 600 built in the garden of an estate which has been in the family of the present owner, John Christie, for more than 700 years. The family house, adjoining which the opera house was built in 1932, is merely 300 or so years old.

Although comparatively small in seating capacity, it is believed that the opera house and its ancillary buildings occupy more ground than any other opera house. Perfection has always been the keynote at Glyndebourne and thus the acoustics, the lighting, and the scene changing mechanism is in keeping with the superb performances that are probably unexcelled in Europe.

Obviously there must be something exceptional about Glyndebourne for after paying three times as much for a ticket as he would for London's Covent Garden Opera House, your enthusiast (if he is staying in London,) has to get into his Tuxedo soon after lunch. Incidentally, theatre and opera tickets cost less in England than U.S.A. and the best seat at Glyndebourne does not exceed $9.80.

Disregarding the stares of the puzzled London population, he makes his way to Victoria Station and catches a train which, after a 55 mile journey, arrives at Lewes, the County town of Sussex, a few minutes before 5 p.m. Whereas at London's Victoria Station even on Glyndebourne days Tuxedos to ordinary clothes are probably in a ratio of 1 to 1,000, in the early afternoon at Lewes station it would be the other way round if this sleepy Sussex town could accommodate 1,000 travellers in its station. However, your enthusiast will be dressed like the majority when he leaves the train and boards a bus (return fare 40 cents) for the three mile journey to Glyndebourne.

The performances, which this year include Mozart's "Don Giovanni", Rossini's "Arlecchino", Gluck's "Alceste", Stravinsky's "Rake's Progress" and "Ariadne Auf Naxos" by Richard Strauss, commence at 5:30 each Wednesday through Saturday and an hour earlier on Sundays. There are no performances on Mondays and Tuesdays.

Head Gardener's Name in Opera Program

For a few minutes before the performance your visitor may take a quick glance at the glorious gardens which surround the Opera House. Glyndebourne must surely be the only Opera House in the world which has the name of the head gardener in the program.

Bells which ring throughout the grounds call your friend to the auditorium which has an orchestra pit occupying about a quarter of the area of the audience seats. Incidentally, there is rarely a spare seat and it is essential to book in advance and be there in time for it is an inflexible rule that no one is admitted after the commencement of the overture until the second act.

After the first act the audience troop out for the 75 minute interval. The majority take dinner in one of the three dining rooms where one can easily find oneself sitting next to a Lord or other member of the nobility, for the tables take a minimum of six persons.

A bottle of wine with your dinner and a liqueur in the garden afterwards will prepare you for a stroll across the immaculately kept lawns and along the stream that runs through the estate. Those who do not take dinner can be seen eating *al fresco* meals sitting by the side of the stream in evening dress. About eight o'clock Act 2 commences and the performance usually ends about 9:30. A quick drink and you can catch the bus for Lewes and the London train.

It is easy for those who have never been to Glyndebourne to sneer at it. Each person I know who has been has remembered his visit as memorable for the rest of his life. A perfect performance heard under perfect acoustics in a unique setting. It may seem to be ridiculous but those who know and love Glyndebourne can appreciate why, when the B.B.C. televise a performance at the end of each season, they make their cameramen wear Tuxedos. It just seems right to do so although any U.S.A. visitor will not be turned away if he comes without one.

Your English tape enthusiast friend will have tapes of all the Glyndebourne performances and will be proud to play them to you as representing the finest in opera.

At a recent lecture given by G. A. Briggs of Wharfedale Loudspeakers in Bradford, England, a comparative demonstration was given before an audience of nearly 1500 between live piano performances of Edgar Knight and his commercial records reproduced through Wharfedale speaker systems. Mr. Briggs can be seen at the upper left corner behind the pianist and the sound equipment on the stage of St. George's Hall, Bradford.

Hi-Fi Haunts in London's West End

In the April issue I recommended that the U.S.A. visitor to London should see one of the West End's largest record stores and in the May issue I described a visit to the hi-fi department of one of the capital's oldest radio shops.

The enthusiast who wishes to inspect a showroom organized on rather American lines and specializing in high-fidelity equipment might well call on B-K Partners Ltd. who are situated in swank Regent St. near Oxford Circus which, of course, is not a circus at all but just the junction of busy Oxford and Regent Streets. Hi-fi enthusiasts A. E. Benney and J. L. Mathews, directors of the firm, will allow you to play around with the intricate control panel whereby you can compare immediately the new Leak T.L.10, Quad II, Williamson, and half a dozen other amplifiers operating with different pickups and a dozen or so different loudspeakers.

Benney and Mathews told me recently that for many U.S.A. visitors they build hi-fi equipment into genuine or reproduction antique chests or commodes. Several examples were on view and it was interesting to see how furniture a hundred or so years old had been adapted to house the latest devices of the art of audio.

(Because of Mr. Arbib's visit to the United States in May and June, there will be no London Letter in the July issue. ED.)

COMING EVENTS

June 23–26—Acoustical Society of America, 25th anniversary meeting, Hotel Statler, New York City.

July 8–12—The British Institution of Radio Engineers, 3rd post-war convention, University of Oxford, England. For further information, write The Secretary, B. I. R. E., 9 Bedford Square, London, W. C. 1.

July 19–30—Transistors and their applications, special summer program offered at Massachusetts Institute of Technology. Details and application blanks may be obtained from the Summer Session Office, Room 7-103, M. I. T., Cambridge 39, Mass.

Aug. 25–27—Western Electronic Show and Convention. Ambassador Hotel, Los Angeles, Calif.

Sept. 30, Oct. 1–2—1954 High-Fidelity Show, International Sight and Sound Exposition. Palmer House, Chicago, Ill.

Oct. 4–6—National Electronics Conference, Hotel Sherman, Chicago. Papers are solicited on all electronics subjects, and the program chairman would appreciate sugestions for titles and authors of suitable papers. Write George E. Anner, Elec. Engrg. Dept., University of Illinois, Urbana, Ill.

Oct. 13–17—1954 Annual Convention, Audio Engineering Society. Hotel New Yorker, New York City.

Oct. 14–17—The Audio Fair, Hotel New Yorker, New York City.

Nov. 18–19—Sixth Annual Electronics Conference sponsored by the Kansas City Section of the I.R.E., Hotel President, Kansas City, Mo.

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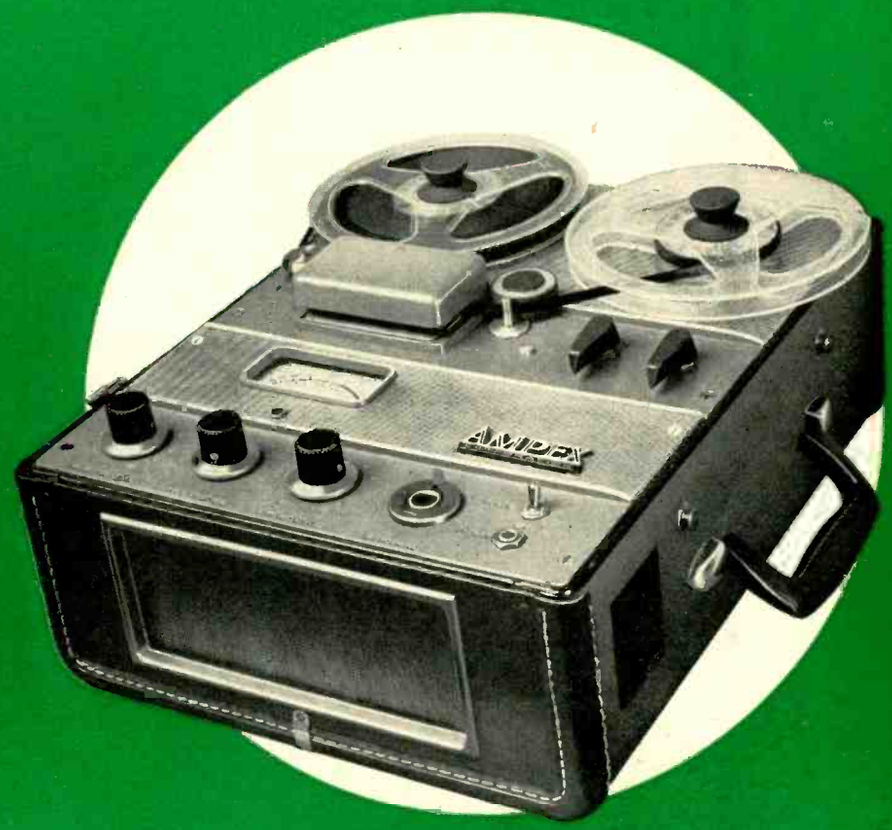

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LETTERS

Pipeless Organ

SIR:

Mr. Canby's department in February AUDIO, has, in his speculations on "Plans for a Pipeless Organ," gone on quite a lavish spree. While he has been thoroughly idealistic about his musical goals, I'm afraid he will find 1226 vacuum tubes and their associated circuit components quite a job. Were he to carry this plan to its logical conclusion, he would also require separate amplifiers and speakers for each of the generators, so as to get the equivalent sound-in-space relationships found in pipe organs!

Many years ago—1932 to be exact—I was given some special demonstrations of a similar vacuum-tube organ in the broadcasting studios of the "Post Parisienne" in Paris.

It was quite an assemblage of apparatus, perhaps even more complicated than that of the conventional organ pipes it was designed to replace. But, even this organ did not include separate speakers for each separate oscillator. Considerable difficulty was experienced in keeping the vacuum-tube oscillators in good tune—the equivalent difficulty is present in all pipe organs.

Considering that he is attempting to produce 1409 tones of various pitches and timbers, why then is this not much more simply done with pipes themselves? Outside of air valves, magnetically actuated, an air supply, and a pressure stabilizer, little else besides the key and stop controls is needed. Then he would really have a *pipe* organ, but without the great complexity required of vaccum-tube generators, amplifiers, and speakers.

Admittedly, Mr. Canby is having fun speculating and exploring the vacuum-tube organ on paper, but few, I imagine would have the temerity or the pocketbook to invade such hostile territory.

If I may be permitted a suggestion, why not, for the primary generators, use air-blown reeds? These are relatively very small in size, they are inexpensive, they will stay in tune for years, and their air-supply requirements are low. Even the palette valves may be omitted by using continuously blown reeds and keying the tones in and out of control of polarizing voltage. Buffer filters, of course, are necessary to prevent keying clicks, but these involve only small capacitors and resistors.

By use of two or three pickups for each reed, with control of both amplitude and polarity of the polarizing voltage for each, a very wide range of output timbres is obtainable. Further, if several ranks of reeds are used, ample ensemble effects are obtained with different tone qualities for each voice in the mixtures—as described briefly in my 1938 IRE paper, "Electronic Music and Instruments."

Accordian-type reeds, wherein the tongues vibrate *into* instead of *through* apertures in their blocks, yield quite harmonic-rich output tones, capable of wide control through pickup and circuit design.

It is even possible, by use of special key resistors, to get individual dynamic control of the tones, much as is done in the piano. No organ does this effectively.

So here, in a package, and with a degree of complexity which can be handled by the average audio or radio engineer, is a rough specification for a really fine mechanico-electronic organ. It is much like the Wurlitzer organs now being manufactured under

PROVEN FINEST IN PA

* Pat. D189,504 and Pat. Pend.

Gives Clearer, Cleaner, Wider-Range Reproduction, Better Dispersion, Greater Penetration and Coverage... at Very Low Unit Energy Cost!

Results are so amazing that the "CDP" is outmoding and rapidly replacing conventional PA re-entrant horns. Exclusive E-V "CDP" utilizes two coaxially mounted diffraction horns working from both sides of a single diaphragm. Each horn is designed for optimum air loading and reproduction within its own range. Also uses the new acoustic application of optical slit diffraction for perfected smooth sound dispersion virtually independent of frequency. Permits use of fewer units at far less cost. Greatly improves public address—in all types of applications—indoors and outdoors. *One test will convince you!*

Model 848 CDP. 25 watts. 16 ohms. 10½" wide, 20½" high, 20" deep over-all. List Price $69.50. **Net $41.70**

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- Peak-free response 175-10,000 cps.
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- Speech articulation index greatly improved.
- Weather-proof, blast-proof, splash-proof. Virtually indestructible.
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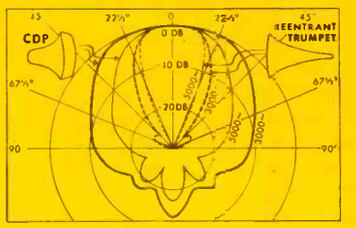
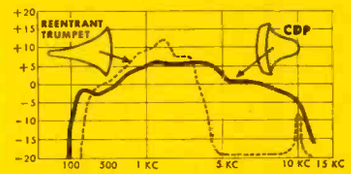
- Provides augmented bass response when stacked in adjacent positions or when mounted singly against wall, in corners or where ceiling joins wall.
- Permits various polar patterns for most effective use.
- Molded of glass fibers for extra strength and improved acoustic properties.

Send Now for Helpful Bulletin No. 197

Gives complete and helpful information about the performance and application of the "CDP."



COMPARE POLAR PATTERN
Sound distribution of the E-V "CDP" exceeds 120° at all frequencies up to 10,000 cps.



COMPARE RESPONSE AND EFFICIENCY
Note extended high-frequency range of the "CDP." Response is smooth, peak-free 175-10,000 cps.

NO FINER CHOICE THAN

Electro-Voice

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN

the writer's patents. My first model of this type was built about 20 years ago, and it was a comparatively easy job.

B. F. MIESSNER
Miessner Inventions, Inc.
Van Beuren Road, R.F.D. 2
Morristown, N. J.

Stereophony

SIR:

I have read Mr. Dorf's letter concerning the meanings of binaural and stereophonic sound reproduction. There is an article which does fill the gaps in definitions and understanding very well on this subject; it is in the Journal of the *S.M.P.T.E.*, November, 1953.

Incidentally, the article is not quite as optimistic as Mr. Dorf was concerning the effect on one of moving about an auditorium containing sterophonic sound reproducing equipment.

The article contains interesting effects on listening with various systems and frequency ranges of the systems. Some very practical results are found concerning equipment cost.

The "pan-pot" technique is described as a method of obtaining "artificial" stereophonic channels. The motion picture *Shane* was made using this techniqce. Although the results were favorably described by one of the engineers for the studio which produced it, people I have spoken to who have seen *Shane* said they heard no noticeably different sound.

The technical and historical information in this article make it very worth reading.

GEORGE C. GINGRICH
1304 Faunce St.,
Philadelphia 11, Pa.

"Golden Ear" Replies

SIR:

I was interested in Mr. Varkonyi's report on his experiments with the cross-coupled inverter. Hafler (of Acro) says he found it to be down 6 db at 70 kc as compared with the split-load inverter, but that it does preserve better balance at the high end, as well as when it is driven to the limit. High-frequency response depends on the circuit capacitances, and some additional improvement can be achieved by neutralizing the second tube of the inverter. With care in reducing wiring capacitance and by using miniature tubes, it is not difficult to get reasonably flat response to 50 kc at the output of the inverter without feedback, which seems excellent for triodes.

It is true that the feedback resistor and the voice coil are in parallel with the cathode resistor to which feedback is applied, and as the feedback resistor is reduced the net cathode resistance is decreased. This can be avoided with the cross-coupled inverter by applying the over-all feed-back to the off grid of the input pair. (See White Powrtron, Æ, Nov. 1953.)

I don't support there are any perfect audio circuits, and I still consider the cross-coupled inverter superior to any other that I have tried. Varkonyi notes that though the split-cathode inverter produces greater reduction of distortion with increased feedback, the low-frequency stability is poor. Hafler has noted, on the other hand, that the split-load inverter is less stable at the high end and more seriously unbalanced as it is driven to the limit.

In short, granting some limitations. I think this is an excellent inverter, and I caution others not to sell it short.

JOSEPH MARSHALL,
The Bleachers,
Ozone, Tenn.

are you fighting space?

connect with cannon!

Are you looking for complete electrical circuit dependability in a very, very small space?

If so, you should use Cannon carefully engineered miniature and sub-miniature multi-contact connectors. In ½ or ⅓ the usual space, they give you up to 50 contacts, the same number as a standard connector, and still retain all the factors of utility, reliability, and mechanical strength found in Cannon's standard size connectors. They are very rugged, easy mating, unusually versatile, neat and compact.

Miniatures—Maximum Dimensions Only 1″ x 2″!

High-dielectric insulation. Rack, panel, chassis types . . . receptacles and plugs, standard, pressurized, or hermetically sealed . . . box, wall, or cord mountings . . . for audio, control, and instrument use. D and U sub-miniatures have steel shells. DPA and K miniatures have die-cast shells. Five-ampere gold plated contacts are found in all miniatures and sub-miniatures, excepting U receptacles, which have steel contacts. Larger contacts having higher current ratings, and co-ax contacts, are in process of development.

Sub-Miniatures—Only 2-5/8″ x 39/64″!

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Please refer to Dept. 109

CANNON ELECTRIC COMPANY, 3209 Humboldt Street, Los Angeles 31, California.

Factories in Los Angeles, East Haven; Toronto, Canada; London, England.

Representatives and distributors in all principal cities at your service.

EDITOR'S REPORT

FM, AM, HI-FI, ETC.

MANY ARE THE COMPLAINTS originated by broadcasters about the lack of public interest in FM, and the falling off in general listening to radio as a result of the big upswing—over the last five years or so—to TV. And while these same broadcasters point with cosiderable pride to their record of "public service" programs, they interpret the lack of vociferousness from their listeners to a lack of desire for good music programs.

Broadcasting • Telecasting, in the March 22 issue, notes that WGMS, Washington, D. C., attracted over 30,000 people to its Hi-Fi Fair principally by radio promotion, although some newspaper supplements also supported the venture. *B-T* suggests a moral that any radio station "can create business by promoting specialized programming."

The history of New York's WQXR backs this up; WNYC, owned by the City of New York broadcasts "good music" over most of its day; Seattle's KISW-FM derives a large amount of its financial support from a Listener's Committee; Berkeley's KPFA lists unusual subjects, in addition to its fine music broadcasts; a station in Chicago announced it would close after a certain period—received some 14,000 letters of protest at this announcement—used the letters to convince sponsors that it had listeners, and continued to operate.

Admittedly, TV is stronger competition for leisure time. But many people engage in pursuits which do not give them complete freedom of all of their senses—some play cards, others read, knit, iron, work at some hobby such as photography or model building—(or even amplifier building)—which requires all of their senses except hearing. Many of these same people like music while they work. They enjoy it, but since they are not constantly bombarded by announcements they are not intensely conscious of the sponsor, yet they will howl if their source of music is threatened.

We doubt if Bartok could sell biscuits or if Vivaldi could sell vitamins, but we are firmly of the opinion that institutional and prestige advertising on good music stations would reap a harvest in good will for the sponsor. Not that the listeners would all run out that evening to buy a tube of toothpaste or a package of king-sizes, but we do believe that they would remember a bank, or a furniture store, or an automobile dealer who brought them the kind of entertainment they want when the time came to use any of these products. Networks cannot provide that kind of programming—they must attract the maximum number of listeners, and that means they must provide a fare which interests the majority of people. But the smaller station which works on lower overhead and which can attract a loyal audience of discriminating people should succeed—either in New York, Albuquerque, or Hobbs Corners.

We are also pleased at *B-T*'s belief that the public "is starting to get fussy about the quality of reproduced musical sounds . . ."—a credo which we have believed in for years. *B-T* closes with an interesting paragraph:

"Obviously high fidelity has long since passed out of the basement tinkerer's hands into many living rooms. A growing audience is there for those who care to solicit it." As to the first part, we have said so for a long time; as to the second, it follows naturally.

UNRECORDED BORROWER

We are advised by F. V. Hunt, Gordon McKay Professor of Applied Physics at Harvard University, that the librarian in charge of the Music Division of the New York Public Library reports that the book which was the source for "Audio in the Year 1693" (*Æ*, March, 1953) has been liberated from the library shelves without benefit of the usual records. We wonder if some casual reader of the article (obviously not a regular reader) has been constrained to read the original book in Latin. We trust that if such is the case the book may soon find its way back to its rightful resting place when the borrower is through with it.

ERRATUM

Ross F. Firestone, eagle-eyed Chicago reader, calls us to task (1) for crediting Sir Isaac Newton instead of Lord Kelvin, and (2) for misquoting in the May issue. It *was* Lord Kelvin, and the correct statement is:

"I often say that unless you can measure what you are speaking about, and express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of Science, whatever the matter may be."

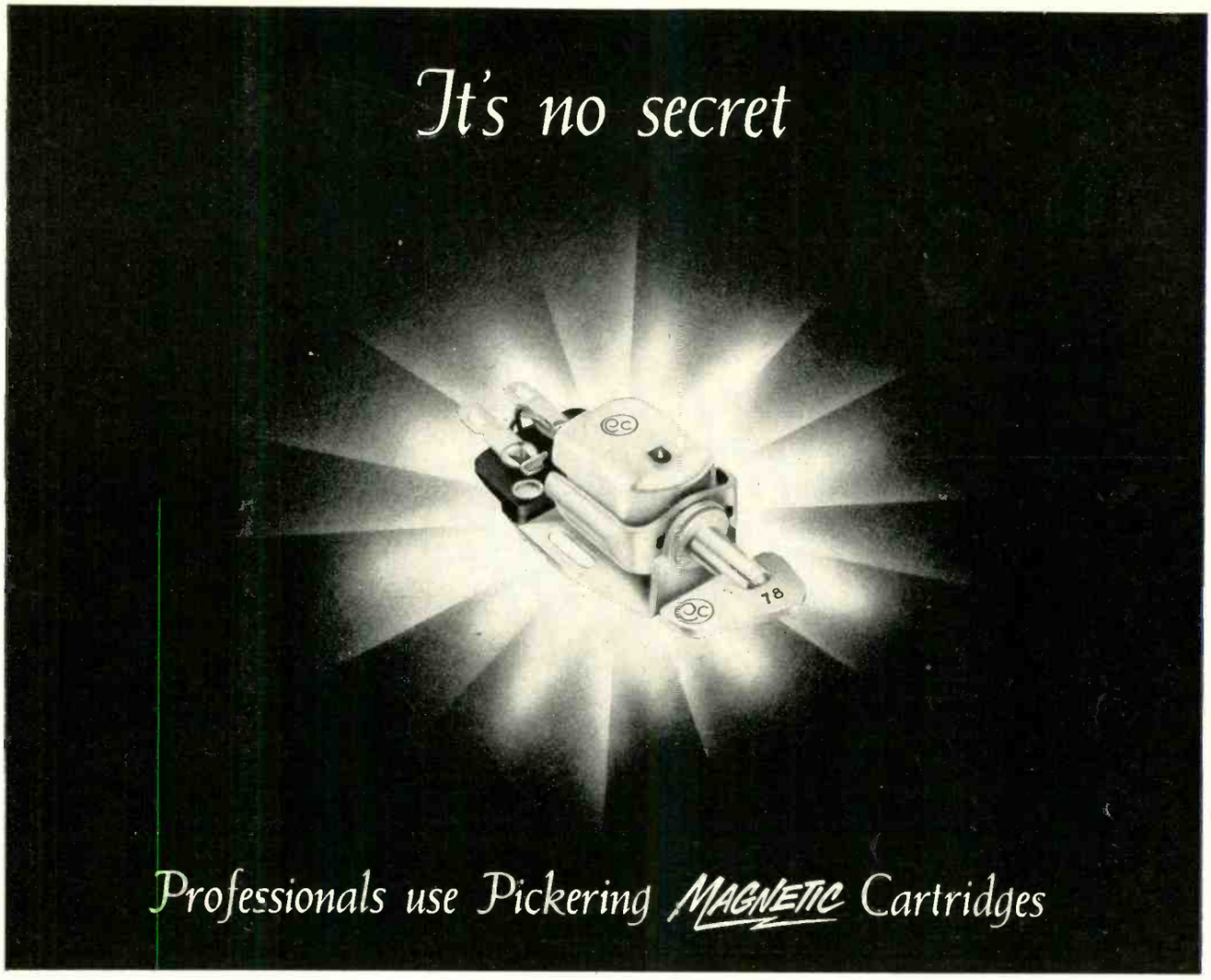
Our knowledge is now less meagre than it was a month ago.

AUDIOPHILE OR ?

Only a few readers offered suggestions as to a new word to replace "audiophile"—which combines, according to Capt. A. G. Pelling from the Pentagon, audio with "phile" which has the innocent meaning of "one who loves or has a fondness or affinity for" but which has the unfortunate phonetic association with words such as "bile," "guile," and "phobia." He suggests, as his entry, the word "Audiofan"—related to a sport such as baseball and defined as "an enthusiastic devotee of a particular diversion, as baseball; hence, an ardent admirer and champion of some writer or art." The Captain will be suitably compensated in accordance with the EDITOR'S REPORT of the April issue.

Another compensatee, Norman T. Ball—also of Washington D. C.—suggested, among others, Audiotor, Audiotee, Audiosseur, and Euphonian. E. M. Peres of New Orleans says "ugh!" to audiophile, and substitutes High Fidolater—a pagan worshipper of High Fidolatry.

On the comical side comes announcer George E. Steinhardt of New York with the explanation that these people insist upon "flat" reproduction, and that they consider their pickup "head" of greatest importance. His suggestion—Flathead.



You're in the best of company if you use a Pickering MAGNETIC Cartridge. You have this in common with:

1. *Leading record companies who use Pickering Cartridges for quality control.*
2. *Leading FM/AM good music stations and network studios.*
3. *Leading manufacturers of professional equipment for radio stations, recording studios, wired music systems and automatic phonographs, who install Pickering Cartridges for the maximum performance of their equipment.*

Why Pickering MAGNETIC Pickups are the Choice of Recording and Broadcast Engineers!

"All modern disc recordings are made with MAGNETIC cutters. Within the geometrical and mechanical limitations of recording and reproducing equipment, a Pickering Pickup will re-generate an exact replica of MAGNETIC cutter response to the original program of music, speech or sound. This is a fundamentally inherent characteristic of the Pickering Pickup, supported by basic electromagnetic theory and countless precise laboratory measurements. This is why Pickering MAGNETIC Pickups provide the most nearly perfect coupling possible, between reproducing equipment and original program. This is why they sound cleaner . . . less distorted.

"Through the medium of the disc material, the reproducing system is effectively driven by the cutter electrical response itself."

PICKERING *and company incorporated • Oceanside, L. I., New York*

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature; write Dept. A-5

SPLITTING HAIRS

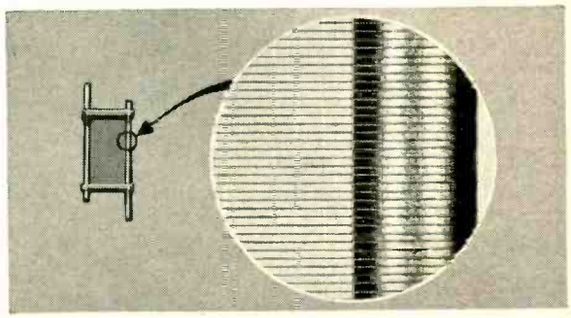
TO SPEED CALLS

This coaxial system electron tube amplifies more voices at the same time because of wider frequency band—made possible by bringing grid and cathode closer together.

To triple the voice-carrying capacity of coaxial cable, Bell Laboratories engineers had to create new amplifying tubes with the grid placed only two-thirds of a hair's breadth from the cathode. Furthermore, the grid wires had to be held rigidly in position; one-quarter of a hair's shifting would cut amplification in half.

Working with their Bell System manufacturing partners at Western Electric, the engineers developed precise optical means for measuring critical spacing insulators. On a rigid molybdenum grid frame they wound tungsten wire three ten-thousandths of an inch thick. To prevent the slightest movement they stretched the wire under more tension for its size than suspension bridge cables, then bonded it to the frame by a new process.

The resulting tube increases coaxial's capacity from 600 to 1800 simultaneous voices—another example of how Bell Telephone Laboratories research helps keep your telephone system growing at the lowest possible cost.



Grid is shown above left, actual size. Picture at right, enlarged 15 times, shows how wires are anchored by glass bond. They will not sag despite nearness of red-hot cathode.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS
FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

A Broadcast Consolette For The Announcer

L. GOELLER*

A suggested design for a broadcast consolette especially suited to the small station where the announcer is also the engineer, recordist, record cuer-upper, and telephone answerer.

AUTHORS OF BOOKS on radio and manufacturers of broadcasting equipment seem to believe that the great majority of radio stations have engineers who operate the control room. As a result, broadcast equipment has apparently been designed to be used by skilled technicians who have nothing else to do.

In a few large stations in some metropolitan districts, this assumption may be justified. However, 80 per cent of the 2,300 AM radio stations in the country have a maximum transmitter power of 1,000 watts or less; these low-powered stations, mostly in small communities, make up the backbone of American broadcasting. They must cut operating costs to the bone wherever possible. In a great number of them no engineers are on duty at the studios; instead, in addition to his regular reading and talking duties, the *announcer* operates the consolette, turntables, tape recorders, and other program-producing equipment.

To get actual figures, questionnaires were sent to 70 radio stations in Virginia and Washington, D.C., and were returned by 46 of them. Eighty-seven per cent of the stations answering indicate that they *use announcers in the control room exclusively*, and 33 per cent require their announcers to hold radio operator's licenses and be responsible for the transmitter as well.[1]

Current FCC regulations, put into effect shortly after this survey was taken, permit *any* employee to operate the transmitter in small stations without any sort of technical examination. Thus, trained technicians are becoming fewer and farther between, and the aptitudes, needs, and limitations of the announcer are more important than ever in the design of broadcast equipment.

An announcer is hired for his personality and voice, but a consolette designed for his use should consider all his duties. The announcer must read commercials, news, and other copy; he must "cue up" records and transcriptions (run the needle in to the point on the disk just before the program material starts), play them, and return them to the files from which he obtained them; he must thread, cue, play, and rewind tape recordings as well as make these recordings; finally, he must maintain a uniform program-level at all times. Other odds and ends come up: he must keep an eye on the news machine, answer the telephone (particularly after office hours), keep the logs, and so on. *Figure* 1 shows the operating position of a typical small station, with some of the paraphernalia used by the operator-announcer in performing his many duties.

From all this it follows that a suitable consolette will, first of all, provide the announcer with a place to put his copy while reading it, as well as a suitably located microphone to pick up his voice. Switches and volume control knobs should be easily differentiated even when the announcer is unable to look at them, and the volume indicator should show insufficient or excessive program level in such a way that the announcer, even when reading, will become aware of the needed adjustment. These features, obvious as they may seem, *are not incorporated into any commercial consolette on the market today*. Further, although present consolette design devotes a great deal of attention to studio programs (which are almost nonexistent in small stations), turntable inputs are given only casual attention and tape recorder connections are omitted altogether.

Even when the announcer is a competent technician, his announcing duties require most of his attention. For fast, error-free operation, the consolette should be designed in such a way that the announcer, after only a short training period, can run it in the same subconscious way that a secretary operates a typewriter.

The consolette drawn in *Fig.* 2 is the author's proposed design based on years of experience as an announcer and engineer, data acquired from the questionnaires mentioned above, and many discussions with announcers in a number of different localities. All data have been interpreted in terms of "human engineering" experience with other design problems as reported by Chapanis, Garner, and Morgan[2] and Paul M. Fitts.[3] Actual construction should, of course, be based on specific time and motion studies, on observation of conditions in the field, and on human experiments on full-scale mockups (using as subjects persons who have never been trained in radio work to prevent interference by habit patterns learned on other consolettes). This tentative design is offered freely to any individual or group interested in the construction of broadcast equipment. The author's hope is that someone someday will build a consolette to meet the needs of the announcer in the small station.

The distinctive features of the consolette in *Fig.* 2 are discussed below with reference to the key numbers in the drawing.

In small stations, most local programs consist of transcribed or recorded music,

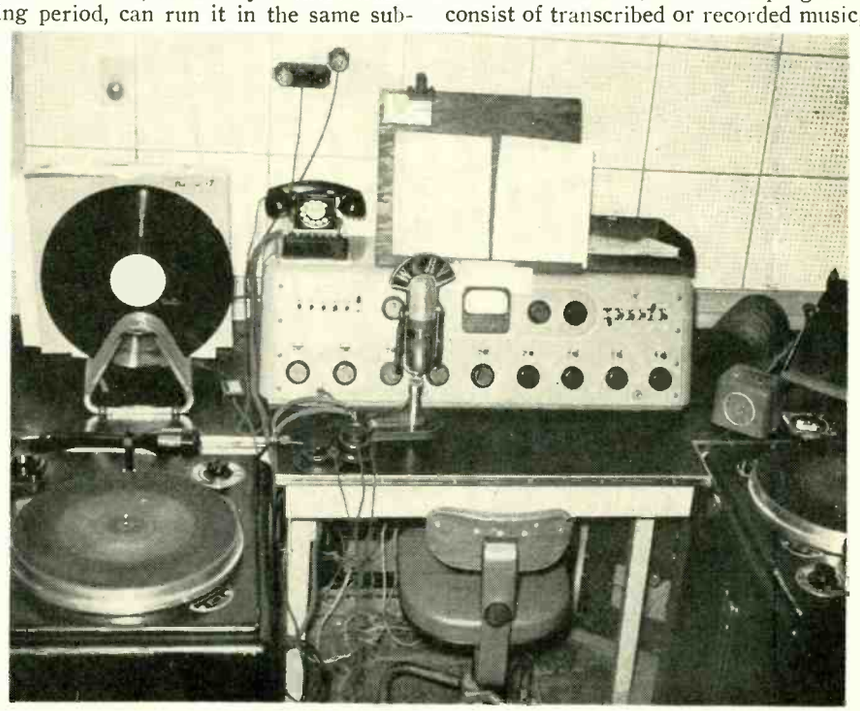


Fig. 1. A control room operated by announcers. Notice the wooden copy rack which has been added to the consolette, the records to be played, and the telephone which the announcer answers after business hours. In such installations microphone placement is always a problem.

* *141 Rogers Hall, Charlottsville, Va.*

[1] These stations, in areas ranging from rural to metropolitan, are representative of the country as a whole except in sections where contracts with labor organizations limit the duties of personnel.

transcribed or taped commercials, and live commercials and other speech matter. The announcer needs a microphone for himself, two turntables (three are desirable when short transcribed announcements are scheduled), and two tape recorders. Controls for such equipment will be the most used of all, and should be placed where they can easily be reached by the announcer: in the area immediately in front of him.

The consolette is planned around these controls and a rack to hold the announcer's copy. The rack (1) is located directly in front of the announcer and is properly illuminated by built-in lighting fixtures. The microphone (2) can be any one of the modern small units which do not obstruct the announcer's view of his copy. The boom should be a gooseneck for easy adjustment. The microphone switch and volume control (10) are immediately below the reading rack.

The turntable volume controls are located in a group (8), just to the right of the microphone switch; the tape recorder controls (11) are just to the left. To permit fast cueing of both tape and disc-recorded material, these volume controls automatically connect the turntable or tape recorder associated with them to the cue amplifier when the volume control is in the extreme off position. Instead of the usual rotary ones, "vertical" gains are used here because they can be placed closer together without accidental operation when adjacent controls are used; this permits more controls to be placed in the area most easily used by the announcer. In addition, a mere glance or even a touch will tell the announcer approximately how loud the given program source is. This is important, for instance, when the announcer is reading and holding a musical background under his voice.

The microphone button divides the tape and turntable controls into two separate groups, each far enough from the other (about 6 to 8 inches) to permit the announcer to tell by the position which group he is using. Within each group, knobs are differentiated by distinctly contrasting *shapes*. Color coding, while attractive and perhaps useful for training purposes, has little other value because the announcer, while giving full attention to his reading, cannot feel the difference between a red knob and a blue one.

In addition to keeping a program on the air, the announcer must often audition records and other material and make tape recordings. Thus the consolette must have one output to feed the transmitter, and another to feed the recorder-audition bus. Further, each program source—such as those in (8) (10) (11) and others to be considered below—must be capable of being switched to either output channel or to an off position. When they are down the keys (5) at the right of the reading rack connect the program sources of (8) (10) (11) to channel A, and when up, to channel B. Off is in the middle position. For most local programming, the announcer will throw all six switches to the down position when he comes on duty; thereafter he need only slide five volume controls and push the mike button. To audition or record material from a tape machine, a turntable, or the microphone, all he needs to do is throw the proper switch up.

Note that vertical motion of switches in a horizontal row, as proposed here, makes a thrown switch stand out clearly; the usual horizontal motion in a horizontal row, on the other hand, harmonizes and so is hard to detect without careful observation.

Each of the two output channels has a separate line amplifier and master volume control (4). The switch between the master volume controls connects the channel-B amplifier in place of the channel-A amplifier and and *vice versa* in the event of tube failure.

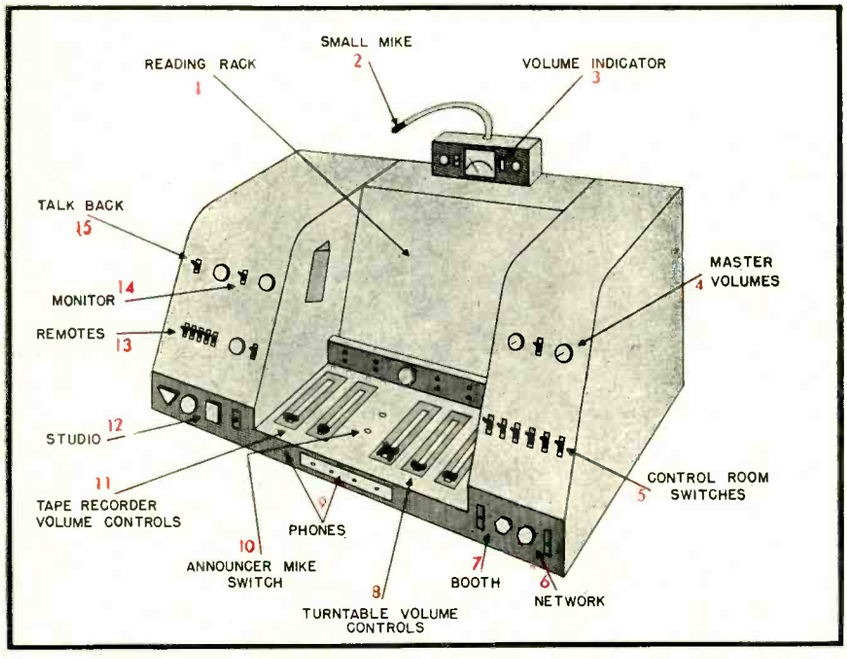


Fig. 2. A tentative consolette design planned around a copy rack and microphone for the announcer. Controls are grouped functionally and shape-coded for easy identification while the announcer is reading. Details are discussed in the text.

Additional Microphone Inputs

Although a studio goes unused a large part of the time, one is almost certain to be provided. Often an announce booth or an additional microphone in the control room is convenient for news programs or interviews. The consolette must have volume controls and channel keys for these mcirophones (7) and (12). The volume controls are all rotary because they need relatively little adjustment, and are located 2½ inches above the table top so that the announcer can operate them while resting his arms on the table. This reduces fatigue and aids in locating the controls.[4] Again all knobs are *shape-coded* for positive identification. Note that the studio has only one key for its three microphones. This greatly simplifies program production and eliminates errors.

Program Sources Outside The Station

Network programs and "remotes" (programs from various locations in the general area served by the radio station) usually reach the control room over telephone wires. Because network programs make up more than 25 per cent of the total air time of more than 60 per cent of the stations surveyed, a separate key and volume control (6) for the network are desirable. Network controls are seldom used in complicated sequences with others; for this reason they can be located in an area reached by one hand only. The network key is separated from the booth key by the two shape-coded volume controls, making almost impossible a mistake of one key for the other.

Controls for remotes (13) make possible the selection of any one of five telephone lines. At the left of (13) are the five selector keys which choose the proper line. To put the program from a given line on the air, the selector key is thrown to the down position. This connects the line through the rotary volume control to the key at the right in (13), which in turn connects the chosen remote line to channel A or channel B as desired. To feed a cue to the remote crew over the telephone line so that they will know when to begin their program, the proper selector switch is thrown up; this puts the line across the output of the monitor amplifier.

The monitor amplifier also drives speakers in the studio and booth; by depressing the talk-back switch (15), the announcer connects his microphone to the input of the monitor amplifier, enabling him to give instructions to persons in the studio or on remotes without tieing up either program channel. The talk-back switch, spring-loaded to return to the off position when released, is operated by the left hand, leaving the right hand free for taking notes or operating the main controls (8) (10) (11).

(Continued on page 55)

De-emphasis Networks in FM Tuners

HERMAN BURSTEIN*

Incorrect de-emphasis networks in FM tuners can wreak havoc with broadcast frequency response. Checking to see that the components are right is extremely simple, and replacing wrong ones with right ones is both easy and profitable for the listener.

WHILE MUCH HAS BEEN WRITTEN about proper playback equalization of disc recordings, comparatively little has been said of the no less important equalization required in another component of high fidelity systems—the FM tuner.

The F.C.C. requires commercial FM broadcast stations to use 75-microsecond pre-emphasis. This produces 13.7 db emphasis at 10,000 cps and a 3-db boost point at approximately 2,100 cps. In the FM tuner a 75-microsecond R-C network is required following the detector for proper de-emphasis and flat response. For example, as shown in *Fig.* 1, the network may consist of a 75,000-ohm resistor and .001 μfd. capacitor; or, as shown in *Fig.* 2 it may consist of a 150,000-ohm resistor and .0005 μfd. capacitor. The time constant of the network is equal to the capacitance in microfarads multiplied by the resistance in megohms.

Although the net output of the FM tuner should be flat over the audio range, a number of tuners employ de-emphasis networks with values substantially lower than 75 microseconds. This produces insufficient de-emphasis and, as the net result, treble boost. The writer has seen, for example, a network with a value of only 22 microseconds in an otherwise first-class tuner. At 10,000 cycles this tuner has the considerable boost of 9 db. The unwitting user of such a tuner will experience shrill reproduction instead of the flat response expected, when the amplifier tone controls are set at flat position.

The remedy, of course, is simple and consists of replacing the network resistor or capacitor with one that yields an R-C product of .000075. (Or, multiplying C in microfarads by R in *ohms*, the product should be 75.)

An alternative course is to use the amplifier treble control for the additional de-emphasis required. However, this is usually undesirable because, for one thing, it may leave the user insufficient range of treble attenuation for other purposes. For example, assume that the amplifier's maximum treble attenuation at 10,000 cps is 15 db and that the tuner de-emphasis network requires 9 db attenuation by the amplifier at 10,000 cps in order to achieve flat response. Hence there is left a range of only 6 db and on occasion appreciably more than this may be required to satisfactorily reduce objectionable characteristics of some program material—hiss, noise, insufficient treble compensation of records by the FM station, and so on.

Another argument against use of the treble control is psychological. The user should have the mental satisfaction of knowing that he is getting reasonably flat reproduction of FM broadcast material by his amplifier when its tone controls are set at flat. In the case of disc recordings, considerable efforts have gone into development of preamplifier units with controls that compensate for all known recording characteristics and feed faithful reproduction of program material into the main amplifier. Comparably, the FM tuner should yield reasonably flat output, and the tone controls should be used principally to adjust for speaker characteristics, room acoustics, balance, and personal preferences.

A third and perhaps the best reason for not using tone controls to correct for an incorrect de-emphasis network is simply that they may not do the job right. What matters is not only that the attenuation be correct at 10,000 cps, but that the attenuation be as nearly as possible complementary to the transmitter's emphasis at *every* frequency. A general tone control is usually designed to start attenuation at a given frequency, which may or may not be the turnover of about 2,100 which a 75-microsecond network will give. If it is not at that frequency, the result cannot help but be anything from very approximate to far wide of the mark, and the net result may be very pronounced and irritating peaks or valleys in the net response between studio microphone and living-room loudspeaker.

Why, then, do some manufacturers of FM tuners use de-emphasis networks resulting in treble boost? According to an engineer employed by one such manufacturer, the answer is, to compensate for speaker and amplifier treble deficiencies. In another quarter a point was made of compensating for high-frequency losses resulting from a long cable connection to the amplifier. The writer suspects that another, but unstated, reason is to take advantage of the still prevalent identification of high-fidelity with exaggerated treble.

The reasons listed above seem invalid. It is most likely that the purchaser of an expensive tuner will buy associated equipment of equally high quality which possesses good to excellent treble properties. With respect to cable length, up to 6 feet may easily be tolerated, and either special low-loss cable or tuners with cathode-follower output are available for the minority of installations where the distance between tuner and amplifier exceeds 6 feet.

In low-priced equipment where tuner, amplifier, and speaker are assembled as an integral system and where only a treble-attenuation control is available, it may be advisable to use a de-emphasis network that produces treble boost for two reasons, (1) to match *known* treble deficiencies of the particular amplifier-speaker combination, or (2) to enable the simple tone control to cover the range from treble boost to treble attenuation.

But FM tuners sold as separate high-fidelity units should be exactly that, and not high-treble units. Exaggerated treble should be erased as the hallmark of a high-fidelity system.

The audio enthusiast who proposes to purchase an FM tuner on the basis of listening tests had best make certain that his choice is not governed by different de-emphasis networks in the various tuners he is considering. The present owner of an FM tuner may well have his schematic checked and have the necessary change made if the de-emphasis network differs too much from 75 microseconds.

The de-emphasis table shows the amount of de-emphasis and the resulting

(*Continued on page 60*)

* *280 Twin Lane E., Wantagh, N. Y.*

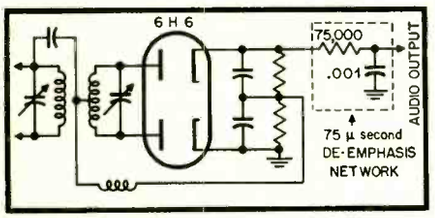


Fig. 1. This is the standard discriminator circuit. The de-emphasis network comprises only two small components, easily identified, checked, and corrected.

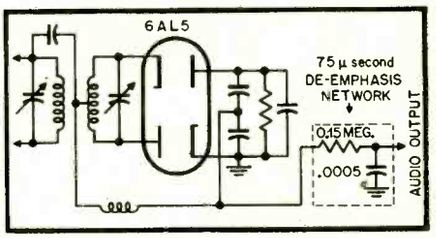


Fig. 2. The ratio detector requires the same type of de-emphasis network; the text tells how to judge the values. Any owner or buyer can check a tuner's de-emphasis by a simple multiplication.

A Transformerless 25-Watt Amplifier for Conventional Loudspeakers

D. P. DICKIE, JR.* AND A. MACOVSKI**

A Low-Cost, High-Quality Amplifier Using No Iron-Cored Components

DURING THE PAST SEVERAL YEARS audio amplifier design has progressed at a rate second only to that of the transducers associated with it in typical sound reproduction systems. A decade ago one could justifiably point to phonograph pickups and loudspeakers as the quality-determining links in the average home audio system. This disparity has been steadily narrowed and at the present time no one can generalize as to weak links. Suffice it to say that innovations in amplifiers have been less startling, since they had an initial jump on the rest of the elements involved in the sound reproduction process. Such advances as have been made center primarily about the output transformer. With minor exceptions, no basic circuit changes have found their way into commercially available amplifiers.

This attack on the problem was a logical one since only the transformers and the vacuum tubes in an amplifier can operate in a nonlinear fashion and thereby produce harmonic and intermodulation distortion. Furthermore, the fundamental limitations on bandwidth or frequency response have generally been due to the output transformer. One of the most practical ways to minimize harmonic distortion is to employ inverse feedback around those circuit elements that are responsible for the generation of distortion products. Again, the stumbling block has been the output transformer, for its high-frequency attenuation and phase shift characteristics have thus far limited the amount of inverse feedback which could be stably employed. This vicious circle has stimulated many inherent improvements in transformer design, but the fundamental problems still exist, although mitigated in magnitude. It is unfortunate but true that the region of most serious distortion in a transformer is in the low- and very-low-frequency range. At these frequencies the magnetizing current may become sufficiently high to produce saturation flux densities in the core. Although inverse feedback can substantially reduce the distortion in the near-saturation region, its application is dependent upon the high- as well as the low-frequency characteristics of the transformer. There is no simple solution to the problem and careful attention must be paid to the sometimes conflicting demands of good high- and low-frequency performance. It should be pointed out here that the problem is not merely confined to frequency response of the transformer. Most good output transformers exhibit a frequency response far wider than that needed for sound reproduction. The problem of being able to transfer large amounts of power without distortion, particularly at the low-frequency end of the range, is another issue altogether.

Still another limitation imposed by most output transformers in high-quality systems is inability to operate well in class-B and AB power-amplifier stages. Unless there is a very high co-efficient of coupling between the two halves of the primary, transient signals are generated by the nonsinusoidal currents which flow in the half-primaries. Class-B and AB operation can contribute greatly to the power handling capabilities of an amplifier stage, but unfortunately these classes of operation have become associated with higher distortion. While this is fundamentally true, the amount of distortion is not serious and if sufficient inverse feedback is employed the output signal will be a good replica of the input. Full realization of these more efficient operating conditions must await the practical application of large amounts of inverse feedback.

The Transformerless Amplifier

With these problems of output transformers in mind many have envisaged transformerless amplifiers. While many of the problems associated with transformerless design seem overwhelming, at least one manufacturer has licked the biggest problem by winding a 500-ohm voice coil for his loudspeakers. Performance is almost unbelievable in those regions where transformer-type amplifiers fall down. It was felt by the writers that if outstanding performance could be obtained in a transformerless amplifier which could drive loudspeakers of conventional impedances, a very practical unit might be the result.

At the outset of study of the problem it was determined that any design should be a practical one. The use of transmitting-type tubes or inordinate quantities of receiving-type tubes was not justifiable. Plate efficiencies comparable to existing high-quality amplifiers should be achieved. Size, cost and weight should not exceed those of comparable amplifiers. Furthermore, it was felt that for a real contribution to be made, very exceptional operation should be the rule not only in the usual respects but particularly in those respects where transformer-type operation has its weaknesses. Since most high-quality loudspeakers are available in 16-ohm impedances, this amplifier was designed for that impedance. Following standard practice, the entire unit was designed for use with preamplifiers suitably equalized for the particular program source and capable of delivering 1 volt of signal.

Preliminary study yielded some startling results. It seemed that the unconventionality of the goal—that of driving a low-impedance speaker directly—actually set off a chain reaction of further innovations. While most of the features ultimately used are tried and true procedures in the electronic industry, this particular combination of them is new to audio. The infusion of new blood seems to produce a healthy new approach to an old problem.

Theory Of Operation

The output stage of the amplifier is the single-ended, push-pull type as shown in *Fig.* 1.[1] The quiescent current is equal in both sets of triodes, with no d.c. flowing through the load. The tubes are driven out of phase with the difference in current between the tubes flowing through the speaker load.

The most efficient method of utilizing this system is to bias the output tubes close to cutoff with the operation approaching that of class B. The usual objections to this mode of operation, such as switching transients and distortion, do not apply if no output transformer is used. Class-B operation provides maximum power output with minimum plate dissipation so that the peak current capabilites of tubes can effectvely be used. A low-impedance power supply is necessary with this arrangement so that the supply voltage will not drop excessively when the maximum current is drawn and thereby reduce the maximum power output.

The power supplies used are half-wave selenium rectifier circuits developing + 140 v. and − 140 v. with respect to ground. These use large capacitors, with no additional filtering which would raise the power-supply impedance. To get higher voltages for low-level stages, additional selenium rectifiers are used in voltage adding arrangements to obtain 250 volts as shown in *Fig.* 1.

The absence of an output transformer allows 40 db of feedback to be applied by connecting the voice coil directly to the cathode of the phase splitter driver. Besides its distortion reduction characteristic, the application of feedback serves to reduce drastically the hum voltage

* *Pacific Mercury Television Mfg. Corp., 5955 Van Nuys Blvd., Van Nuys, Calif.*
** *RCA Laboratories, 711 Fifth Ave., New York 22, N. Y.*

[1] Chai Yeh, "Analysis of a single-ended push-pull audio amplifier," *Proc. IRE*, June 1953.

which would otherwise be present. Since the gain within the feedback loop is essentially unity, an additional voltage amplifier is used, with separate feedback, to build up the input voltage to the voice-coil level.

Circuit Details

Figure 1 shows the final circuit of the amplifier. Three 6082 double triodes are used. They are 26.5-volt versions of the popular 6AS7G. These tubes are capable of 700 ma of peak current per triode section at the plate voltages used. The 6082's allow the use of a series heater string, eliminating a filament transformer. The tubes cut off at about 70 volts, and a 60-volt fixed bias is used on each. The bias on one side is made adjustable so as to equalize the d.c. in the two sets of triodes and insure that no d.c. flows in the voice coil. To protect the tubes, a low d.c. impedance of 56,000 ohms is used in the grid circuit.

It should be noted that the 6082 is not intended for use with fixed bias unless a limiting resistor is added in either the plate or the cathode circuit of the tube. Although this circuit does not use such resistors, their omission is feasible because the tubes are used under quiescent conditions well below maximum ratings.

The voltage-amplifier stages are all operated class A with conventional circuitry. A separate driver is needed for each side of the output tubes, since insufficient output is obtained from the phase splitter to drive the output tubes directly. One side of the phase splitter has a larger load than the other, since the input to the lower group of output tubes has the speaker impedance in the cathode. This causes degeneration and necessitates higher input than the upper group. In the first voltage amplifier, bias is obtained using unbypassed cathode resistors since the loss in gain can easily be tolerated. The phase-splitter driver, however, has fixed bias applied to its grid by dividing down from the – 140-volt bus, since maximum gain is desired within the main feedback loop.

The high-current power supplies use 300-μf capacitors and 5-ohm protective resistors (each made up of paralleled 10-ohm units). A voltage adder circuit is used for the – 250-volt supply, which supplies only bias. Another voltage adder circuit is used to supply + 250 volts for the driver stages. Additional R-C decoupling is used to minimize hum in the low-level stages.

Operational Details

As with all power-transformerless equipment, care must be used when connecting to other pieces of equipment to see that the cold side of the line is connected to the chassis. Although this is readily achieved, the use of a small power line isolation transformer would eliminate the need for caution.

As would be expected, 40 db of feedback can be applied only within a loop having a minimum of phase shifts to avoid instability. It is therefore necessary to modify the arrangement when using speakers which present other than a resistive load to the amplifier. This situation is not generally encountered in transformer-type amplifiers since the output transformer itself becomes the main impedance at high frequencies. That is, the speaker high-frequency impedance is not reflected through the transformer. *Figure* 1 shows three alternative ways to deal with instability due to an inductive speaker load, which not only causes additional phase shift, but causes higher amounts of feedback due to the increased load impedance. The 180-ohm resistor merely limits the maximum impedance of the speaker and thus prevents excessive feedback. The 0.5-μf capacitor is a low impedance at high frequencies, shorting the inductive load. The series 16-ohm resistor and .01-μf capacitor places a 16-ohm resistor across the speaker at high frequencies and an open circuit at low frequencies. This serves to provide constant impedance and feedback over the frequency range. If any instability is noted with a given speaker, try one or the other for best operation.

The balance adjustment for zero d.c. in the voice coil can be made with a milliammeter in series with the voice coil (a closed-circuit jack might be added for the purpose). It should be repeated when tubes are changed or after many months of operation.

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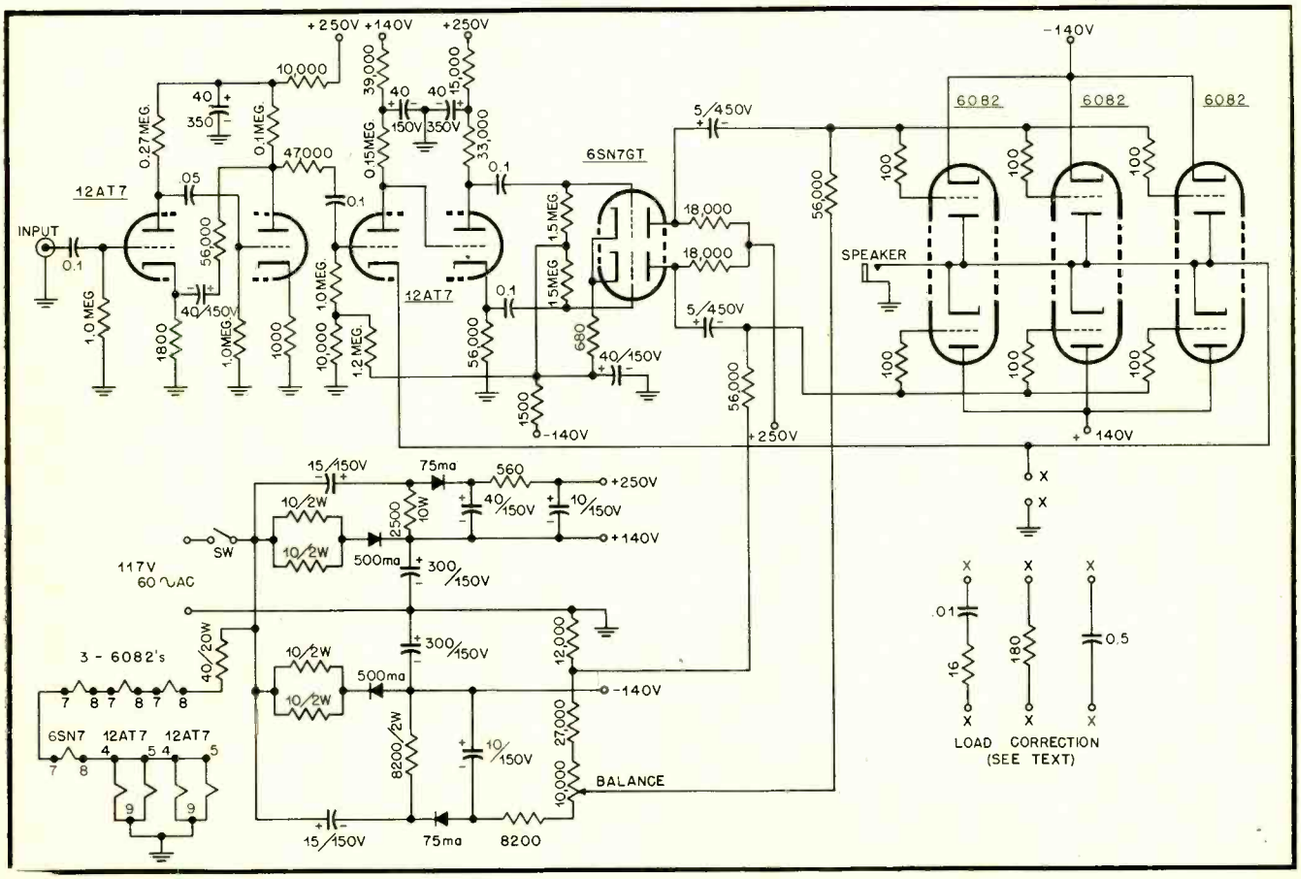

Fig. 1. This is the complete schematic diagram of the transformerless amplifier. Its total cost is comparable to that of a single high-quality output transformer. For safety, use of a 1-to-1 isolation transformer is recommended between the a.c. line and the power input terminals.

at home with AUDIO

LEWIS C. STONE

Hi-Fi in Town and Country

SPEAKING OF TWO ITEMS on this department's agenda (see *at home with* AUDIO, April, 1954), one touching upon inspired solutions to problems in hi-fi installations and the other on variations on the theme of hi-fi housing—points that we had expected would more likely be taken up separately from time to time—we have this month a communication that presents fairly interestingly both sides of the coin.

Although the hi-fi equipment recently acquired by reader Farber (New York) is permanently housed, the fine custom-built cabinetry has been so designed that tuner and amplifier are easily removed on a single mounting, and are fully portable. (Fig. 1) The containing cabinet—a chairside model—is left in town while the playing units "go to the country" for the summer.

We find it difficult to resist being impressed by the ingenuity of this particular solution to the double-barrelled problem of hi-fi installation and housing, as it was divulged to us recently. It could be anybody's problem; it might even be yours. So we are inclined, therefore, to report this undertaking in the second person, addressing ourselves more directly to the "you's" who may, in an idle moment, read through this department.

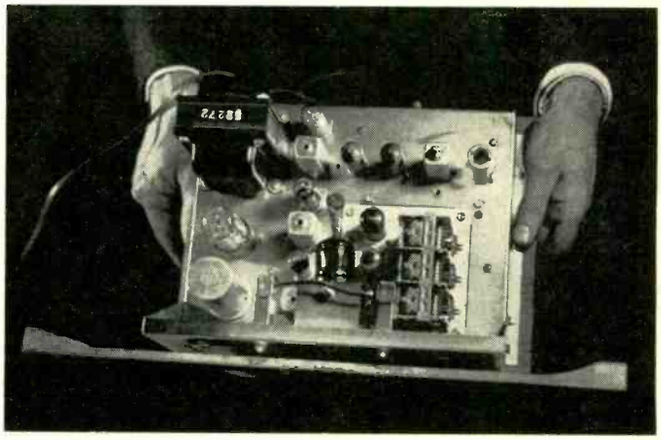

Fig. 1. Design of cabinet makes it possible to lift out tuner and amplifier as a unit by means of the panel which carries the shelves mounting the equipment. The unit becomes completely portable.

It May Be Your Problem

To proceed, second-personally—so you've shot the works and got yourself some real hi-fi equipment. Going by the book and by your own good ear, your outfit has been shaped up with an FM tuner, amplifier with preamplifier, speaker and cabinet, 3-speed changer and magnetic pickups fitted with diamond and sapphire styli for LP's and 78's respectively.

In all, you have laid out some seven, eight hundred dollars including the TV set. We hear that you have still to fill in with a good quality tape recorder; but that's for next year. In other words, you have taken a step, after weeks and maybe months of haunting audio salons and show rooms, and perusing hi-fi esoterica in the available public prints. The advice and information gleaned from these sources you have assimilated in so far as you have been able to select the quality of units for a hi-fi system that gives you, personally, the best listening pleasure. When, however, it came to housing all this you and the books, catalogs and periodicals parted company.

You found that, for the most part, the hi-fi housing options offered are either loose aggregations for placement on bookshelf, table top and such; or concealment in chests of drawers, fixed-over wardrobes, china closets, old record or music roll cabinets, cedar chests, grandma's dry sinks, chamber pot commodes, and what else.

You had looked at and passed over, with real regret, you said, some very excellently executed ideas in modern stock cabinets made especially to house all possible hi-fi equipment. And seeing some of the suggested room arrangements pictured in AUDIO and elsewhere served but to sharpen your

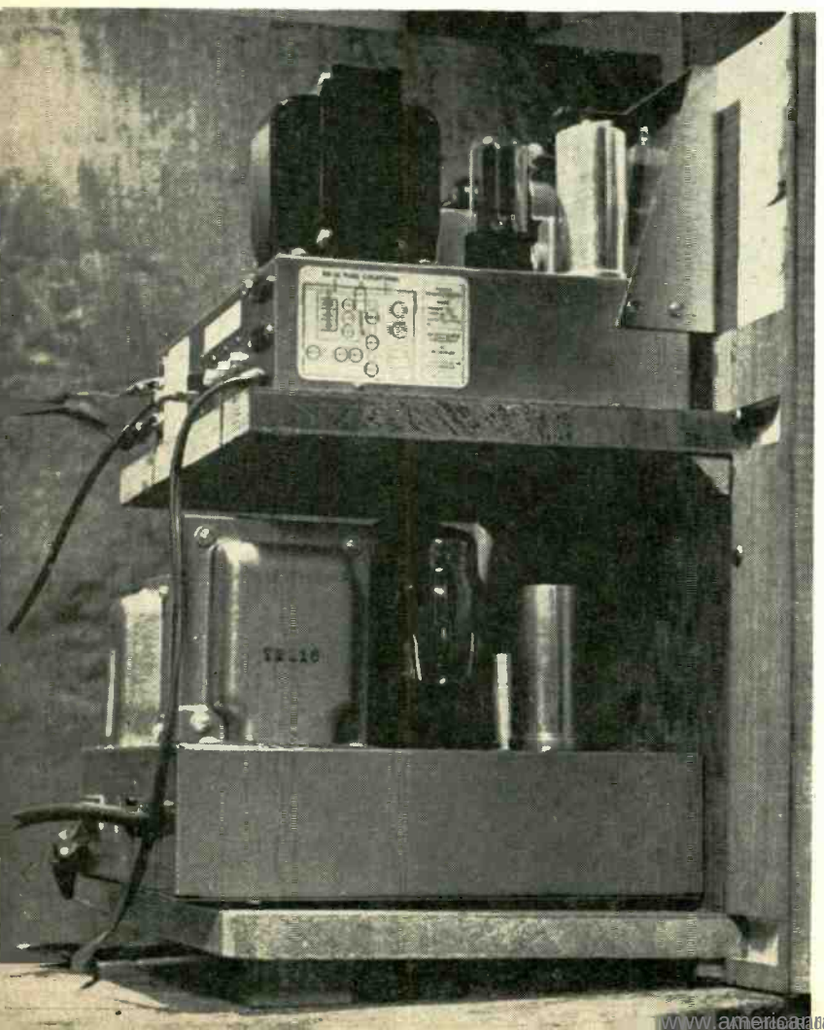

Fig. 2. Shelves secured permanently to the inner face of the "front end" panel support the FM tuner (top) and the power amplifier with preamp mounted integrally (bottom).

Fig. 3. Face of panel shows ventilating holes in a symmetrical pattern, balancing with the tuner control knobs above and the amplifier control knobs below. Hand grips at each side are heavy brass, serve to lift out the panel and the equipment secured on its inner face.

appetite for the finer built-ins, and you intensified your efforts to find a right solution to your particular hi-fi housing problem.

And in your communications to this department, your problem has been described essentially as one of "having your built-ins and moving them, too." Moving them, in fact, from city to country, from chairside in the one to fireside in the other; and back again.

You justified your requirement very simply. Having at long last learned enough to know what you wanted that you could afford in hi-fi, then finally buying it. Having, moreover, listened to the performance of your assembled system on test (turned down to a whisper for strings without loss of tonal values, or whipped up to thundering proclamations of lustier passages for organ or orchestra, then—what's more—turning *them* down to a whisper without loss of tonal values either) in your delight over the expanded universe of music it brought to you, you became unwilling to put up with anything less, ever, and under any controllable circumstances. In fact, so impressed were you with the speaker's reporting beautifully all that the other components gave it, you were moved to hint that the laconic, quantitative symbol "db" of the audio technician had become for you the qualitative "ringing decibels" of exquisite musical enjoyment.

The Problem Gets a Hearing

You had, in short, achieved a near-miracle with your personally selected system; and you were seeking another near-miracle. You wanted to enjoy your new hi-fi equipment when you went on vacation—every year's summer, for ten weeks. Too long a time, you felt, to do without good music. A way had to be found to avoid going without, without having to spend money for duplicate equipment. A way of housing that would make it possible to take the major units along, but without the handsome cabinets and without going to the trouble and expense of a major moving operation, or ripping out shelves and wiring and restoring them later each time, when vacation's end brought you back to your city apartment.

As we understand it, you brought your problem to a custom furniture designer and builder. And it was there that your problem virtually solved itself by the mere telling of it. A design was soon developed for a compact chairside cabinet (cost, the control) wherein the equipment-supporting shelves were made mobile, the wiring easily detachable. The shelves were in fact mounted on the back of a control panel, *Fig. 2*, which in turn has been closely fitted, but not fastened, so that it can be taken easily from the body of the cabinet.

When used in town, the tuner and power amplifier with preamp are fitted into the fully ventilated well of the chairside cabinet, hanging down from the horizontally positioned front panel. This panel is supported on sturdy wood strips so secured to the sides of the well that it sets the panel far enough down to clear the control and tuning knobs when the invisibly hinged lid is down.

A series of twelve holes in the panel face are rather effective ornamentally, balancing the control knobs above and below, as seen in *Fig.* 3. The approximately 120 watts of heat generated by the power amplifier is exhausted through these holes in a chimney effect, the bottom of the containing well having sixteen ventilating holes bored through. The uniform chimney effect is enhanced by having the cabinet stand on wooden legs five inches above the floor, allowing free air movement in and around the enclosed equipment.

This is a vital part of the housing cabinet design, for there are no speaker grills or other sizable openings usually associated with stock models of chairside cabinets. When closed, the cabinet looks like a rather trim bench or coffee table. Yet it houses compactly, and free from any hum or other freak disturbances, not only the FM tuner, preamp and power amplifier, but the 3-speed record changer. The latter is completely invisible, as seen in *Fig* 4, and comes to view only when one of the seemingly jointless cabinet ends is pulled out on smoothly sliding suspension tracks. The necessary wiring connections between units are run through holes bored for ventilation into a divider panel separating the cabinet into two inner compartments or wells. Cable connection to

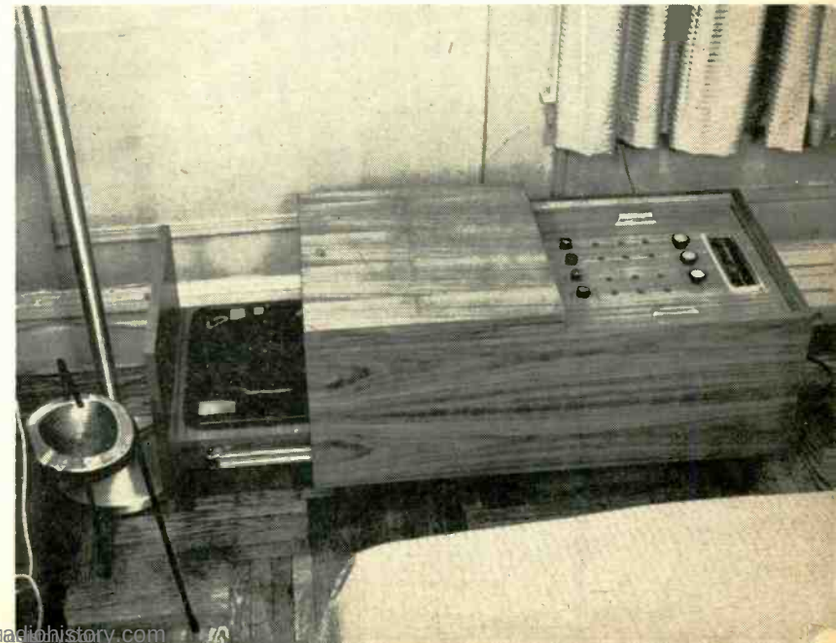

Fig. 4. Cabinet is chairside model, custom designed and built with the precision of metal-to-metal machining. Walnut veneers are matched. Lid covering panel is swung back on invisible hinges, resting over record changer compartment. Record changer slides out on file drawer suspension rollers.

Fig. 5. The bass-reflex cabinet is placed independently and permanently in the city apartment. Contains a 15-inch coaxial speaker with crossover network at 2000 cps. HF balance control (rolloff) unit is mounted on the back panel.

wall power outlet is run through one of the ventilating holes bored into the bottom panel of the well; and so are the FM antenna lead and the connection to the speaker cabinet, as in *Fig* 5.

The Solution Works Out

Within a few weeks after the appearance of this text, the Farbers expect to disconnect the tuner and amplifier from the wall outlet, from the record changer, and from the speaker. Then the entire panel front will be lifted out by taking hold of the two polished brass handgrips. With it will come tuner and amplifier, each mounted on a shelf, all intact with control knobs, control indication decals and tuning calibrations. The full-sized hi-fi system then becomes as mobile, practically, as a small portable combination set.

And this is by no means all. The record changer is slid from its permanent mounting, to be placed beside the panel and the units that are attached to its shelves, onto a carefully padded spot in the family station wagon, and so off to the country. Arrived at the cottage, these parts will be disposed in casual country fashion. The panel unit fits upright and flush into the fore-edge of a 15-inch deep built-in bookshelf arranged to accommodate it, as seen in *Fig.* 6, even to the point of having the shelf immediately above the top of the panel board bored with enough holes to vent the amplifier's heat into a clear space reaching to the shelf next above. A 12-inch speaker is corner-mounted permanently elsewhere in the same room.

And this is how one family has solved its town and country hi-fi housing and listening requirements, with a minimum of expense and with a near maximum of good looks. Undoubtedly, the virtue of mobility has been rather effectively dressed up in finely executed cabinetry, of which the parts-concealing walnut-veneered front panel is a key member.

How It Was Done

For those with an itch for details, here is what custom cabinet builder Ross suggests:

First of all, be sure to use lumber of adequate thickness and heft, certainly no less than ¾-inch stock. (Actually this is 13/16-inch in the trade). Use fir plywood for the equipment shelves, walnut veneer (if you like) of the same thickness for the front "control" panel.

You will note that a groove has been cut into the inner face of the panel, for each shelf. Make this groove ½ inch deep by a tight ¾ inch wide, to accommodate the shelving stock firmly. Secure each shelf with resin type glue (such as made by Federal Adhesives), applied to the inside of the groove and to the insert-edge of the shelf. This glue should set solid within 12 to 20 minutes. Now make four angle cleats from ¾ inch stock, about 2 inches long. You can see these mounted in *Fig.* 2. Glue one of these tight to the underside of each end of the shelves; then toe-nail each cleat with three finishing nails. Handled this way, there is no need to bolt the shelves through to the face of the panel and spoiling its sleek look.

You will note that we have rabetted that part of the panel which backs onto the face of the tuning dial. This was done to bring the tuner close enough to the panel so that the tuning control shafts could be kept to original factory lengths, saving considerable time which would otherwise be taken to juggle with extension rods to make things fit together. Let me say, too, that the thinned down section at the tuning dial in no way affects the durability or load bearing capacity of the panel board.

Reader's Choice

Some readers will probably settle for a similar smart looking "front end" fitted into their bookshelves, but made removable for convenient servicing and parts replacement—no more. Fit the "one-unit" panel into the shelves (which should be at least 14 inches deep) tilted slightly towards the back. This will eliminate using bolts or other hardware to hold the panel and its complement of shelves with equipment, in place. Resting at the very slight angle formed by a pitch of approximately one inch from front to back, the weight and inertia of the equipment will hold it securely in place, though readily removable with the aid of the two handgrips.

Be sure to reinforce the bookshelf on which the entire panel assembly will rest. Try placing two pairs of 2 in. square wood supports, one pair along the back, the other along the front, of the bearing shelf.

For those who may have in mind attempting a full duplication of this hi-fi "town and country" idea, little more need be added beyond mention of the dimensions of the chairside cabinet used here. As a whole, the cabinet measures 36 in. long by 18 in. wide by 13½ in. deep, closed. Space for the record player compartment measures approximately 18 in. by 16 in., and this is separated by a ¾-in. plywood divider from the 18-in. square compartment for the tuner and amplifier units. Clearance between this equipment (as it "hangs" from the panel) and the bottom ventilating panel should be at least 2 inches.

The two shelves which support the tuner and the amplifier with preamp, are each 9½ in. wide by 12 in. long. The brass lift handles on the face of the panel are secured with two 1¼-in. machine screws passed through the wood into threaded holes tapped into each of the handles.

The Works

The hi-fi unit specifications are as follows:

The tuner is Browning FM, Model RV-31, with controls for tuning, off-volume and selector switch for phono, TV and recorder.

The record changer is Garrard Model RC-80, three speeds. It moves on Grant file drawer slides.

The "town" speaker is Jensen 15-inch coaxial Model H-530, with crossover network at 2000 cps. It is mounted in Jensen Type C-151 bass reflex cabinet, with HF balance control (roll-off) mounted on the back panel.

The "country" speaker is Permoflux, 12-inch, Model 12X81.

The pickups are two GE magnetic cartridges fitted with diamond and sapphire styli.

The amplifier is Newcomb, Model A15, 15 watts, with four control knobs for on-off, treble, volume, and selector for radio or phono, with three positions for record equalization, marked DOM, FOR, AES. A preamplifier is mounted on the same chassis.

There are some who may carp at the indication DOM (for domestic) and FOR (for foreign) as being too elementary and over-simplified for really effective record compensations. And there are those who will hold, on the contrary, that for most of us, the ear will control the final vote, given any fair means of knob adjustment for record playback. In this case you will note there is an AES (Audio Engineering Society) setting, which has come to be a fairly widely accepted playback curve by an increasing number of record manufacturers. In fact, the Farbers play most of their records with the knob turned to the AES setting practically permanently with, in their opinion, very satisfactory musical results.

Credits

The system installation was aided by Vector Laboratories, New York, through whose kind cooperation this undertaking is reported here.

The cabinetry was planned, designed and built by Modern Furniture Craftsmen, New York.

Home photographs were taken with the permission of Miss Farber.

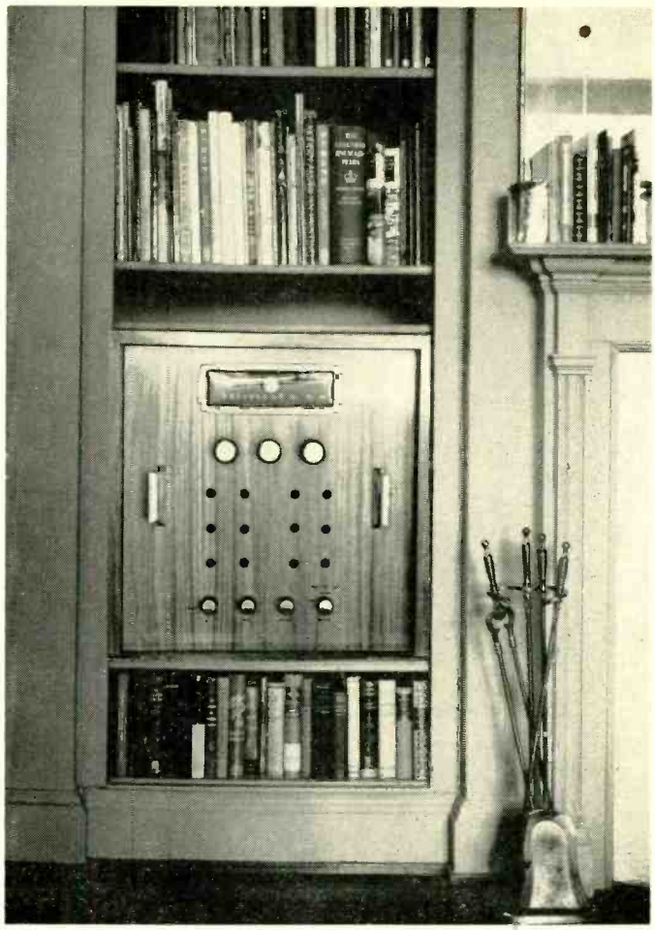

Fig. 6. Taken from its horizontal positioning in the chairside cabinet in town, the panel and its burden of hi-fi equipment is shown here as it appears when placed in bookshelves in the country cottage. Note space between shelves immediately above panel, which permits exhausting of the amplifier-generated heat through holes bored into shelf, in combination with the vent holes on the face of the walnut-veneered panel.

The Sound That Goes Nowhere

UNDER CERTAIN CONDITIONS it is possible for sound to lose all its transmission characteristics. It will cease to be propagated. It will stand still, never leaving the point of origin. Turn up your amplifier to full power, feel with your fingers the powerful vibrations of the loudspeaker cone, but there will be no sound. Set off a dynamite explosion and there will be no acoustic report. We will have lightning but no thunder; wind without its rushing noise; earthquakes without rumble; we will have no speech, no music, no aural arts. Here at last you may shout at your mother-in-law at the top of your voice, but she will not hear a word no matter how keen her hearing. All without living in a vacuum.

The concept of sound standing still has a secure mathematical and theoretical basis. The velocity of sound transmission increases with temperature. The warmer the air the faster the speed. Conversely, cold reduces the speed of sound. If it were possible to obtain low enough temperature, the transmission would become so slow that we could run or walk along with our words, or even ahead of them. If we could encounter *absolute zero* temperature, the sound would stand still and cease to be propagated.

At a low enough temperature the speed of sound would be slowed down to a small fraction of its normal rate and many unusual results would appear. Our voices would be pitched lower and it would take more effort to speak. A familiar musical composition would take on a new tonal balance since the frequency range of most instruments would be shifted downward in frequency. Absorption losses due to atmosphere—particularly the high frequencies—would be reduced and we could hear sibilant sounds, once produced, at great distances. Loudspeakers would become marvels of low-frequency reproduction, and a 2-in. cone would put out "15-in." quality. Cutoff frequency for horns would drop by many octaves, all because of the lower velocity of sound travel. Wavelengths would be shorter, so the physical size of diaphragms, horns, and enclosures would be smaller for a given radiation resistance.

Temperature plays such an important part in the speed of sound that, given the wavelength and frequency, we can deduce the temperature. The speed is proportional to the square root of the absolute temperature. At absolue zero the speed must also become zero. The relationship between temperature and sound velocity is so well fixed that scientists have endeavored to obtain the temperature of the upper stratosphere by measuring the time it takes for an intense sound directed toward the sky to be reflected back to earth.

At absolute zero, sound velocity is theoretically zero and cannot move beyond the source. Air molecules lose their zip and air becomes a limp mass incapable of supporting wave motion. It cannot transmit energy. All molecular motion is stopped. Here at last is final and complete silence. At all other times silence is only a relative term. The silence in a ballon 100 miles above earth, the so-called silence of the tomb, even that represented by 0 decibels—far too low to be measured on present instruments—all are thunderous noises compared to that at absolute zero. Until that is reached there yet remains the sound of air molecules in occasional collision, and not until these molecules are stopped dead in their tracks do we have complete and absolute silence.

But the effect on sound would be the least of the new strange wonders. Metals become super-conductors having no electrical resistance. Steel becomes brittle and fragile as glass. Some materials take on a new form which is neither solid, liquid, or gas, but some weird "fourth state of matter."

But nobody will be around to witness this strange state of affairs. We would all be frozen stiff—rigid and brittle.

So take your audio pleasures while you may; turn up your amplifier real loud as a gesture of contempt for such horrible silence, and get the warm blood coursing through your veins again.

Building Your Own Hi-Fi Furniture*

IRVING GREENE** and JAMES R. RADCLIFFE***

In Three Parts—Part 2

Working with wood may seem like nothing special to the average home-craftsman, but the construction of cabinetwork for hi-fi equipment requires some techniques with which the most capable of home handyman may not be familiar.

THE FIRST STEP in laying out a cabinet project, and it cannot be stressed too highly, is to draw up an accurate wood cutting schedule. It is not enough to know that you can make the cabinet out of one 4 × 8 ft. plywood panel if the direction of the grain is not taken into consideration. Since the grain on a plywood panel always runs the long way, a few minutes with a pencil and a sheet of paper will save you a lot of grief. Draw a scaled rectangle where 1 inch equals 1 foot, laying out the sections of the cabinet. This will avoid having a piece with the grain going in the wrong direction after the panel has been cut into the various sections. The next step is to mark off the wood prior to the actual cutting. The use of a carpenter's square is a necessity. For small cuttings parallel to the edges of the panel, a marking gauge is most satisfactory. When a mark is to be made in the center of the panel, it is best to check the dimension in several places working in from the edge of the panel, then lay a straight edge through all the points marked. This method is called *taking offsets* in measuring. It is the only sure way to achieve parallelness of the line to be cut with existing panel edge.

A power saw is the best means of cutting plywood. It can either be a portable or small table power saw. Oddly enough, the procedure for cutting the plywood panel differs between the two. When using the circular table saw, the good face of the plywood should be up. With the portable circular saw, the panel should be cut good face down. This can be seen in Fig. 1. Many times, despite the presence of a good table circular power saw the old-fashioned hand saw will be necessary. For instance, a 4 by 8 panel may have to be cut down the middle to make two 2 by 8 pieces. You may find that the cutting table bed is capable of producing a cut only 15 in. wide with the rip fence fully extended. In this case, there are two alternatives. First, you can try a freehand cut on the table saw, eliminating the fence and attempting to guide the panel along a line through the saw blade. This task is fairly difficult with any panel thicker than ¼ in. The second method is to muster up some elbow grease and muscle power for an excursion across the middle of the plywood panel with the trusty old hand saw. A fine-toothed cross-cut saw is best for this type of work since it will not be apt to cause tearing or splintering of the face veneer. A saw with at least 8 to 10 teeth to the inch is preferred. When using the hand saw, the *good* face of the panel should be up.

For power saw blades, the combination type (or planer) blade is generally recommended, although a sharp cross-cut blade is also satisfactory. In good woodworking practice, it is recommended that only ¼ to ½ in. of the blade be allowed to project above the work to be cut. When ripping an 8-ft. panel the long way, 16 feet of clearance will be required. This rule of thumb does not apply to the use of a hand or portable power saw.

* Excerpted from the book "The High Fidelity Handbook," by Irving Greene and James R. Radcliffe, to be published in the fall of 1954 by Crown Publishers, Inc., New York. Copyright 1954 by the authors.

** 17-49 166th St., Whitestone 67, N.Y.
*** 170 Twin Lane North, Wantagh, N.Y.

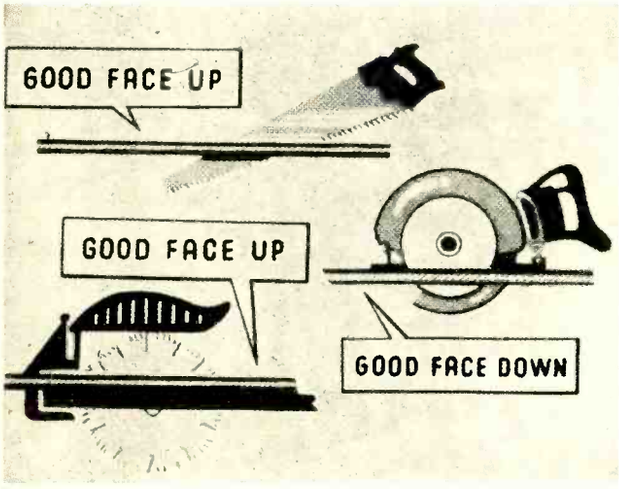

Fig. 1. Correct method of sawing veneer-faced plywood. With the hand saw and the table power saw, work is cut with the good veneer *face up*. With a hand power saw the good veneer *face down*. (Courtesy U.S. Plywood Corp., N.Y.)

Circles and Holes

In the course of constructing the cabinet, the home craftsman will have many occasions where large holes will have to be drilled and circles or rectangular openings cut. The holes will be needed for control shafts, ventilation, wire and cable runs (from shelf to shelf), speaker control escutcheons, and chassis-securing bolts. The circular or rectangular cuts will be required for tuner dial face escutcheons, amplifier panel openings, record player cutouts, speaker port openings, and large circular cavities for loudspeaker mounting.

There are many techniques in making the holes required for the various panels. The use of high speed metal-cutting drills will only tend to splinter the wood, especially the delicate veneer of expensive ¼-in. panels. The correct type of wood bit to use is shown in *Fig. 2*. They can readily be used in high speed electric drills, and will make a clean neat hole for control shafts and ventilating purposes. These flat wood boring bits are available in sizse of: ¼, ⅜, ½, ⅝, ¾, ⅞ and 1 in. They will fit into the chuck of any ¼-in electric drill. Many hobbyists may favor the use of a brace and auger bit, which is highly recommended if the worker wishes to make these holes by hand. For use with a hand brace, the expansion auger bit is the proper tool for making holes or circular openings from 1 to 2½ in. This bit can be adjusted to make a hole anywhere in that range. A word of caution—check the *minimum* as well as the *maximum*

diameter of the hole which could be bored with the bit. While a bit may bore a 2½-in. hole, the smallest hole possible may be 1¼ in. Two of these bits may be required to bore all of the holes you need. This is due to the physical size of the arm of the expansion auger bit. Some makes of expansion auger bits are supplied with two adjustable blades which will include all of the sizes needed. If the constructor wishes to use his high speed electric drill he can get a circular hack-saw tool or a high-speed expansion type circle cutter. The hack-saw tool has the disadvantage that it is available only in fixed sizes. Hence if more than one diameter were required, a tool for each diameter would have to be purchased. The expansion-type circle cutter offers the same features and advantages as the expansion auger bit. All three types are capable of making beautiful clean circular cuts.

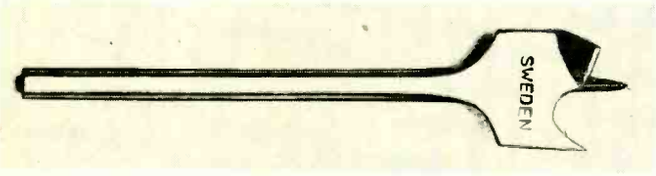

Fig. 2. A high speed flat wood boring bit for use in ¼" chucks of electric drills. (Courtesy Kambro Hardware, N.Y.C.)

Making circular and rectangular cutouts for speaker and port openings in loudspeaker enclosures presents a different problem. A jig saw is the logical tool to use, and a new type electric saw which uses the reciprocating blade is now available. The blade, slightly thicker than a jig saw blade, protrudes from the bottom and moves up and down at a tremendous rate of speed. Although this tool is hand-held, see *Fig.* 3, it has the effect of a jig saw, and a very tight radius can be followed. If the wood worker does not have either, he can still make his large openings easily. For this, the flat wood boring bit or an auger bit at least ⅜ in. must be used. Holes are then bored around the circular mark (or the outline scored or marked for the other types of cutouts) as close together as possible. The edge of each hole must just touch on the inside of the scored or marked outline. The job is finished by using a key-saw or coping saw, cutting inside the mark from hole to hole. After the cutout has been made the job is cleaned up with a cabinet rasp and various grades of sandpaper. Countless cutouts have been made in this manner with results comparable to a power jig saw. Of course, the effort and muscle power are somewhat greater. The easiest method of marking or scoring a circular opening to drive a nail in the center of the area where the opening is to be made. Then a string one half the diameter in length is extended outward with a pencil or scribing tool on the other end. Holding the string taut, scribe or mark in a circular motion until a full circle is made.

Wood Joining

This is one phase of the art of woodworking in which there are many different practices, some dictated by appearance and others due to custom or habit. We will discuss most of the common woodwork joints used today and offer comments as to their suitability.

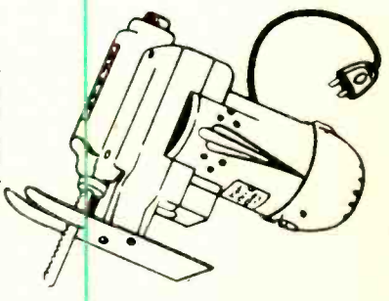

Fig. 3. A reciprocating type power saw for making circular and odd shaped cutouts in panels. It is hand held and light in weight and can be guided readily along a scribed or marked outline. With care, sharp bends and turns can be cut easily. (Courtesy U.S. Plywood Corp., N.Y.)

By all odds the simplest method of joining two pieces of plywood at the corners is the butt joint as shown at A in *Fig.* 4. Here, one piece was merely screwed and glued to the other with the screws put in from the outside. It has the basic disadvantage in that the plywood and grain is exposed. A glue block has been added on the inside to provide additional stiffness and strength. Where a speaker box was being constructed for a behind-the-wall installation, for instance, this might be an entirely suitable joint since it would never be visible anyway.

Another joint which is substantially the same is shown at B. The plywood chosen is ¾ in. lumber core, which is not nearly as objectionable insofar as end grain is concerned. In fact, there are many commercial TV cabinets on the market with just this construction. If, for instance, the top and sides are made of blonde oak plywood, then the exposed end grain is given a coat of paint to match as closely as possible the color of the wood. Also, it will be noted that the holding screws on this joint were put through the glue block from inside the cabinet.

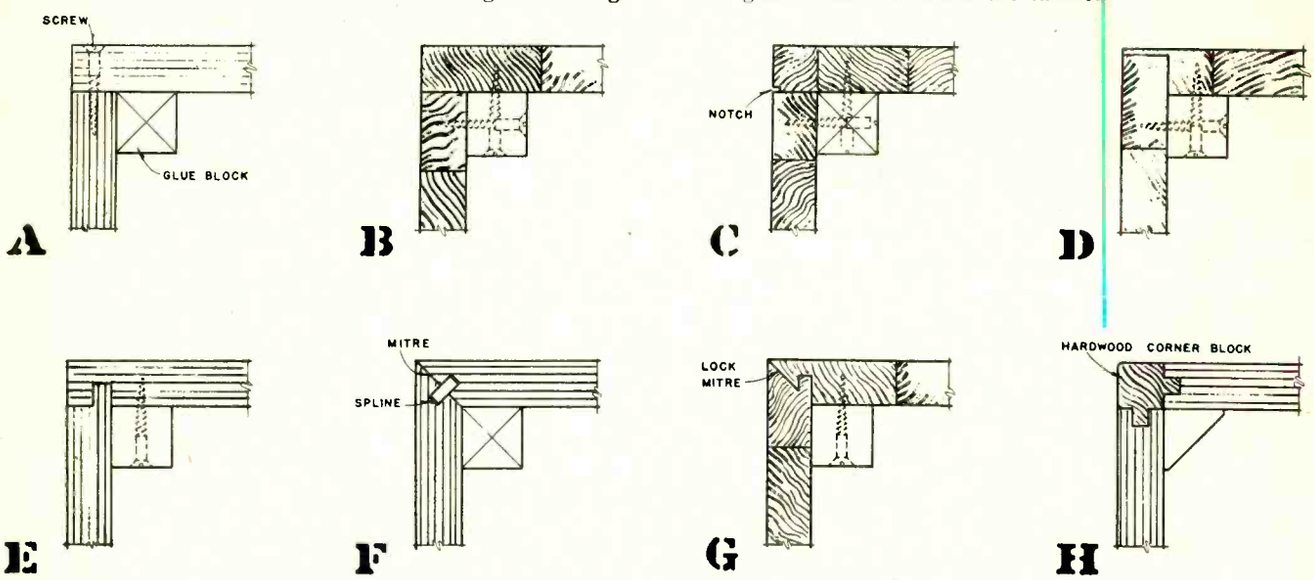

Fig. 4. Common woodworking joints used in cabinet work. Text explains details of joints shown in parts A to H. (Drawings by J. R. Radcliffe.)

The joint shown at C is another adaptation. A notch has been provided where the top and side pieces come together. This serves two purposes—it adds decorative interest to the piece, and it removes attention from the difference in the end grain panel with respect to the adjacent side panel. Incidentally, it also serves to eliminate the problem of a hairline crack being visible at the mating of these two pieces. This type of notch treatment is also very much in evidence in commercial TV cabinets.

By means of a rabbet or half dado the joint at D minimizes the visible end grain. But the glue block in this case works overtime since the panel will have been weakened somewhat in routing out the rabbet.

Another version of a rabbet is shown at E. The improvement here over previous joints is questionable, but there is the advantage of a positive locking between both pieces of wood.

At F we have perhaps the most popular and most professional method used for joining two pieces of plywood. Needless to say, this joint would only be of interest to the craftsman with power tool equipment. No end grain is visible since the two pieces come together in a 45 degree mitre. Both pieces are routed to accept a spline which runs the full length. This spline is usually made from strips of ¼" plywood, since plywood is more dimensionally stable and presents less chance for warping or twisting to occur. The spline is then glued in place with clamping pressure applied from the outside of the cabinet. The spline itself, of course, should be a very tight fit within the routed slot. Either veneer core or lumber core plywood can be used successfully in this method.

The locked mitre joint shown at G is one used sometimes by professional cabinet makers in lieu of F. It has the same basic advantages outlined for the spline mitre, with the added feature that it only requires outside clamping pressure from one side. A shaper table is necessary in making this joint.

Many pieces of furniture exist with a construction as shown in *Fig.* 4H. Corner blocks are exposed and of matching lumber. There is quite a little work in achieving a joint like this, since the lumber must be sanded flush with the plywood in so many places.

All of the above joint treatments have been shown with glue blocks in the corners. In many cases these are not absolutely necessary and may seem excessive. However, in the case of speaker cabinets, there never was a speaker cabinet that was too rigid. Screwing these blocks in place is not mandatory in all cases, but very often it is easier to get clamping action by means of a screw than to use clamps in awkward positions.

Glue—The Wood Adhesive

The constructor must use *both* screws and glue to make a nonresonant, solid joint in hi-fi furniture. If used by themselves, screws tend to become loose after a period of time, and the use of glue alone is just as undesirable. The combination of the two in jointing ensures tight, non-vibrant structures. Of the numerous types of glue available, the home craftsmen need only be interested in two general types—ready mixed and powdered resin.

The new ready-mixed glues are available in jars or tubes. They are white non-messy adhesives which dry in a matter of only 30 to 40 minutes. Called *polyvinyl,* they are liquid mixtures with a consistency that is very easy to apply.

Free-flowing, these glues are applied with a brush right from the jar or tube without previous preparation. In use, only *one* of the two pieces to be joined is coated with the adhesive and then it is weighted or given pressure until it sets. During the time clamping pressure is applied, all excess glue that may seep out of the joints dries to an almost transparent color and can be shaved clean with a sharp edge, such as the blade of a wood chisel. The holding power of polyvinyl glue is considered very adequate.

Powdered-resin adhesives are generally of the *urea-resin* type which is water-soluble. The right consistency is obtained by adding water as the mixture is stirred with a stick until the desired viscosity appears. This is indicated when solid droplets can be let to fall from the end of the stick. It is a good idea to use warm, or even hot water when mixing since this will tend to prevent lumps from forming. Unlike polyvinyl, the urea-resin glue requires four hours to set for drying. If time is not an important factor, it is best to have it set overnight. Like the ready-mixed glue, powdered glue (when mixed), is applied with a stick or brush. Despite the added fuss and bother of mixing, powdered glue is considered superior to the polyvinyl because of its greater holding power. This does not imply that the ready-mixed glue is unsatisfactory, for its holding power is sufficient; however, powdered glue is best for all heavy work.

No matter which glue is used, be sure to clean the brush thoroughly and *immediately* after use. Otherwise, it may harden so that it can not be used again.

Clamps

To be effective, a glued joint must be clamped while it is setting to dry. If a set of clamps is not available, the use of lots of screws and added glue blocks will do an excellent job. This is done by cutting square lengths of 2×2 or 3×3 lumber diagonally down the length of the piece. The resultant triangular shaped lengths are cut down to glue blocks measuring from 6 to 10 inches (depending upon the size of the pieces being joined). Pre-drill the blocks and glue into the inside corner of the joint, inserting and screwing tight a sufficient amount of screws to draw the two pieces of wood together tightly. Under normal circumstances, glue blocks are set in with brads.

Clamps come in all shapes and sizes. For small work "C" clamps with openings of 3 or 4 inches are popular and inexpensive. For clamping corners or large expanses, the bar clamp or "pony" clamp is best to use. The clamp ends are free to slide along the length of a bar or pipe. With the latter, the capacity is limited only by the length of pipe available from the local plumber's supply house. The pony clamp is made from a length of 1-in. galvanized pipe and a pair of clamp ends available in most hardware stores for about $3. The pipe is required to have one end threaded since one of the clamps is firmly fixed while the other rides free along the length of the pipe to adjust the clamp to the size of the work being joined. With this type of clamp, cabinets as much as 5 and 6 ft. wide can be worked on effectively.

Part 3 of this article will deal with the accepted types of hardware for high-quality cabinet construction such as hinges, door catches, and handles. The methods used to camouflage plywood as well as some of the constructional elements of the cabinetwork will also be discussed.

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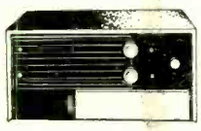

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Simultaneous AM and FM reception with separate volume and tuning controls for individual or binaural listening. Exclusive new Mutamatic Tuning eliminates all hiss and noise between FM stations — stations come in out of velvety silence, stay locked in. **$169.95** ***(less preamp.)***

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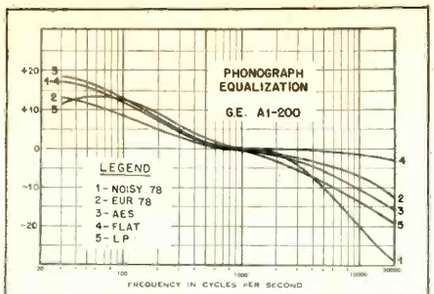
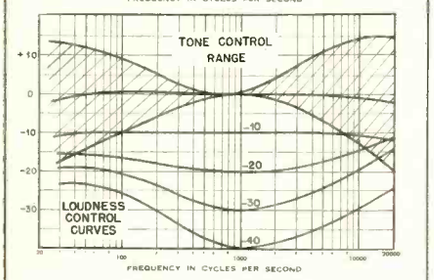
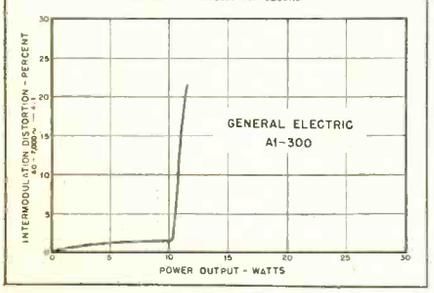
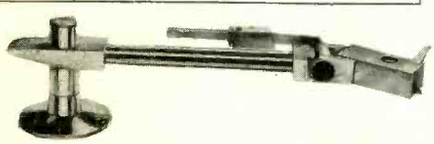








Equipment Report

The General Electric line—Garrard RC-90 Record Changer —UTC Linear Standard Power Amplifier, Model MLF

THE General Electric line of hi-fi equipment consists of everything necessary for a high-quality music installation except a radio tuner—which many users consider unnecessary anyhow, since they restrict their listening to phonograph records. With the available selection of good tuners, the lack in the GE line could easily go unnoticed, for the music lover can choose one of many to fill in between record-listening sessions.

Most familiar to all hi-fi fans is the series of magnetic pickups, which are listed just for the record (no pun intended):

"Golden Treasure" Cartridges
(with one or two diamonds)

RPX-052	Dual, .001 diamond and .003 sapphire
RPX-053	Dual, .001 and .003 diamonds
RPX-061	Single, .001 diamond
RPX-063	Single, .003 diamond

Standard Cartridges

RPX-050	Dual, .001 and .003 sapphires
RPX-040	Single, .003 sapphire
RPX-041	Single, .001 sapphire

All of the above are designed for home use, and work into relatively high impedance circuits. Broadcast models intended to work into 250-ohm circuits are also available.

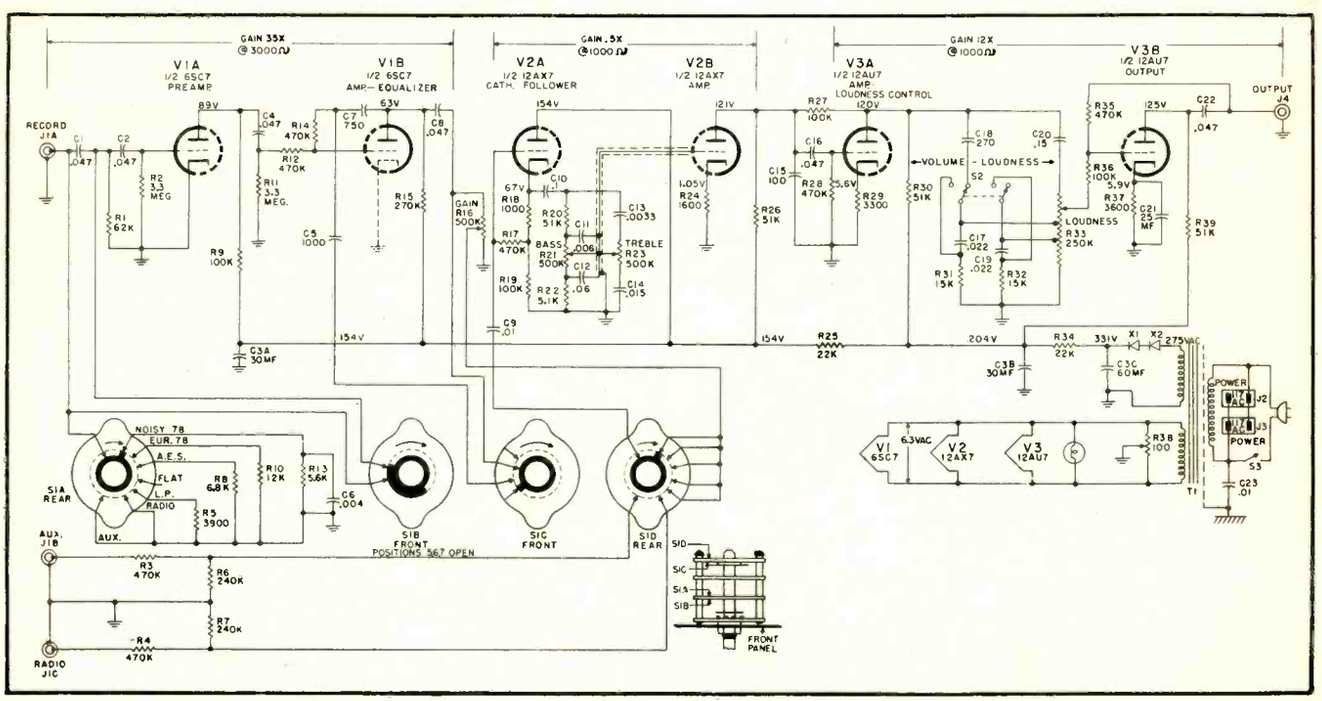
The pickups have been available for several years, as have a number of inexpensive arms, preamps (both self powered and not), and the Compensator. But only in the last few months has a complete line of hi-fi equipment been available. Starting from the pickups, there is a new arm, model A1-500 (A1-501 for 16-in. records); a preamplifier-control unit, model A1-200; a 10-watt power amplifier, model A1-300; a 12-in. Dual Coaxial loudspeaker, A1-400; and a 6-cu. ft. enclosure, model A1-406. Together they provide a system which is flexible in installation yet relatively inexpensive.

The new pickup arm, *Fig. 2*, has a number of interesting features—one of the most unique being the method of leveling. The bottom of the base is slightly curved, and is attached to a pressure plate under the motor board by three screws. After the turntable is leveled, the arm is adjusted to swing freely over the turntable by loosening or tightening the three mounting screws as required. This gives perfect horizontal balance, and avoids any mechanical bias on the stylus. The height of the arm is easily adjusted by loosening a setscrew, so as to accommodate turntables of differing heights. The cartridge is carried on an interchangeable slide which slips into the cartridge head to allow the user to change cartridges with a minimum of effort. The head tilts upward to an angle of 90 deg. with the turntable to make it easy for the user to keep the stylus assembly clean, and when in the playing position it rests on the counterweighting arm. This arm is fitted with a sliding weight calibrated from 4 to 15 grams; for any use where a force of 20 grams is required, the sliding weight is removed from its arm. Since all GE cartridges track at 6 to 8 grams, it is rare that a force of 20 grams would ever be required. The cartridge head has a convenient handle which facilitates lowering the stylus to the record and a terminal strip on the pressure plate provides for connecting the thin twisted pair from the pickup to a heavier shielded wire leading to the amplifier.

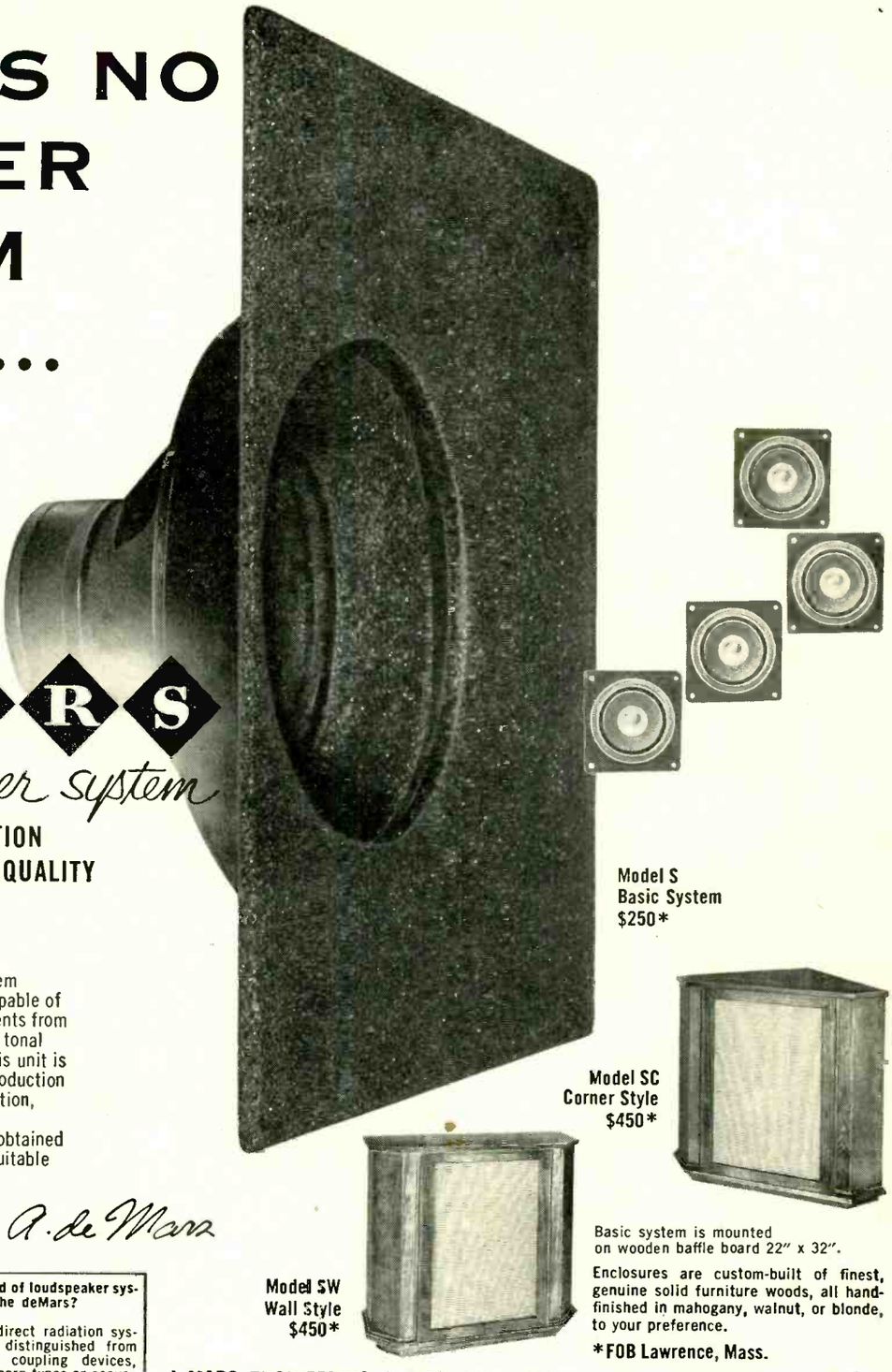
The Preamplifier-Control Unit

This unit is self powered, and draws 16 watts from the line. It uses a selenium-rectifier type of power supply, and employs

At left, top to bottom: Fig. 1, performance curves on the General Electric line; Fig. 2, Pickup Arm, A1-500; Fig. 3, Preamplifier-Control Unit, A1-200. Below. Fig. 4, schematic of the Preamplifier-Control Unit.



THERE'S NO SPEAKER SYSTEM LIKE IT...



the deMARS Loudspeaker system

AUTHENTIC BASS REPRODUCTION AND GENUINE CONCERT HALL QUALITY IN A COMPACT DIRECT RADIATION SPEAKER SYSTEM.

"I have developed a new loudspeaker system incorporating the "Styrocone" speaker, capable of reproducing the sounds of musical instruments from the lowest bass notes through the entire tonal spectrum, into the highest frequencies. This unit is distinguished by naturalness of sound reproduction and resulting excellence of musical definition, which permits listening at concert volume without fatigue. These characteristics are obtained in a unit so compact that it is eminently suitable and practical for home use."

Paul A. deMars

Model S
Basic System
$250*

Model SC
Corner Style
$450*

Model SW
Wall Style
$450*

Basic system is mounted on wooden baffle board 22" x 32".

Enclosures are custom-built of finest, genuine solid furniture woods, all hand-finished in mahogany, walnut, or blonde, to your preference.

*FOB Lawrence, Mass.

Q. What is the deMars speaker system?

A. A multi-cone system with a single voice coil mechanism, supported by an array of very high frequency direct radiators.

Q. What kind of loudspeaker system is the deMars?

A. It is a direct radiation system as distinguished from acoustic coupling devices, such as horn types or acoustically baffled systems.

Q. How does the deMars system achieve better reproduction?

A. Through the multi-cone principle, which presents the optimum vibrating surface for each area of frequencies over the tonal spectrum.

Q. Why was this new type of direct radiation system required?

A. To obtain authentic bass response in the home within acceptable sized enclosures, and independent of location in the living room.

Q. What is the opinion of the critics?

A. The new deMars system has been tested under many and varied room conditions. Critics have been unanimous in their enthusiasm.

Q. What distinguishes the deMars system from all others?

A. It incorporates a new device, called the "Styrocone", which enlarges the vibrating surface beyond that of any other single multi-cone type unit known today . . . much larger than any other direct radiation system on the market.

Q. What is the advantage of a direct radiation system, such as the deMars?

A. It performs better than other types of speakers, except when they are coupled with horns or baffles of prodigious size . . . and, it is much more flexible and practical for economical installation.

Q. Is the deMars system available, and what does it cost?

A. Yes . . . it is available now, in three models, each built under Mr. deMars' personal direction. The basic system comes pre-assembled and mounted . . . can be installed quickly and without difficulty by simply connecting 2 wires.

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AE-4

Fig. 5. 10-watt power amplifier, A1-300.

three tubes—a 6SC7 as a preamplifier, a 12AX7 as a cathode follower and tone-control amplifier and a 12AU7 as an amplifier and output tube. The schematic is shown in *Fig.* 4, and the external appearance in *Fig.* 3. Controls consist of a selector switch (which also adjusts for five equalization curves), bass and treble tone controls, and a loudness control which may be used as an uncompensated volume control by operating a switch on the back of the chassis. The input circuit is designed with the rolloff adjusted for GE cartridges, but an additional instruction sheet is supplied to indicate the changes necessary to adapt the unit for other pickups. The changes consist in substituting different values for R_5, R_8, R_{10}, R_{13}, and C_6. Tone controls are of the conventional type, with curves for the limits of the tone-control action—as well as for the five phono equalization curves—being shown in *Fig.* 1. The output impedance is 4000 ohms, with flat response when used with the 6-foot connecting cable furnished; a 40-ft. length of the same cable will cause a loss of 3 db at 15,000 cps. The loudness-control curves, shown in *Fig.* 1, effectively match the Fletcher-Munson curves.

Fig. 7. Dual-Coaxial loudspeaker, A1-400.

The over-all sensitivity is high, with slightly less than .002 v. being required at the phono inputs to provide a 1-watt output from the power amplifier, or a 0.42-volt output from the preamp-control unit. IM distortion at 2 volts output—well above the overload point for the power amplifier—is 1.15 per cent. An input of 0.182 volts at the radio and auxiliary inputs gives a 1-watt output from the power amplifier. A gain-adjusting control to permit balancing the output of the preamp section to the level of the radio or auxiliary inputs is provided, as is a hum-balancing potentiometer.

The Power Amplifier

The power amplifier, shown in *Fig.* 5, and in schematic form in *Fig.* 6 is intended

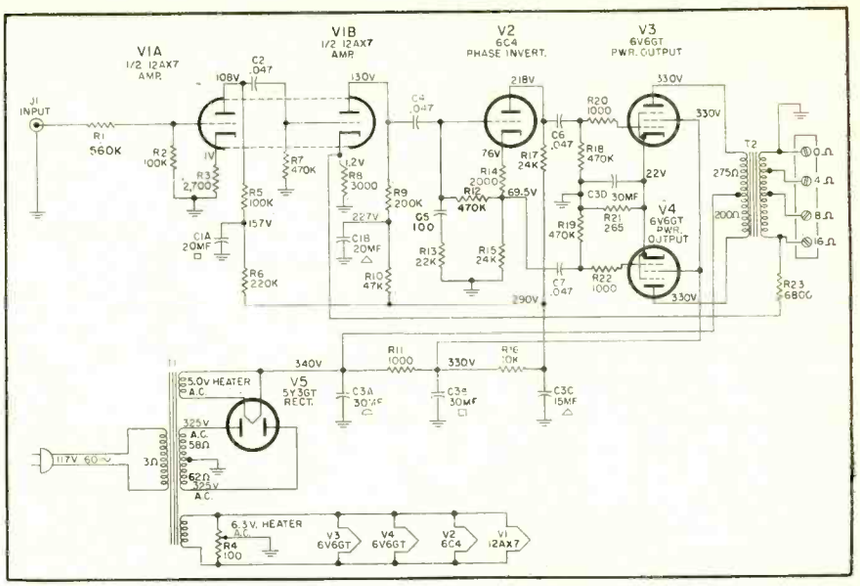

Fig. 6. Schematic of the 10-watt power amplifier.

for use with the preamplifier-control unit, but may well be used with other input sources—such as a tuner with preamplifier and tone-control sections. It is factory wired so as to require an input of 2.0 volts for its rated 10-watt output, but may be changed to provide full output from an input of 0.3 volts. The unit is attractively housed, and would be especially useful for sound distribution systems where no gain control was required. The screen covering furnishes ample protection for the tubes. Power consumption is 70 watts, and from the performance curves it will be noted that the IM distortion is 1.35 per cent at an output of 10.3 watts, which is low for amplifiers using 6V6 tubes in the output stage. Outputs of 4, 8, and 16 ohms are provided, and the hum adjustment across the filament leads ensures low hum output.

The Loudspeaker and Enclosure

The Dual Coaxial speaker (*Fig.* 7, consists of a 12-in. woofer and a 2¾-in. tweeter, using separate magnetic structures. The unit is covered by a slotted plate which reduces interference between the two units and forms part of the mechanical-electrical-acoustic crossover system. The tweeter is fitted with a loading plug which improves distribution and smoothness of output throughout the high-frequency spectrum. A capacitor in series with the tweeter prevents low frequencies from damaging the delicate cone mechanism. The impedance is 8 ohms, and when mounted in a suitable enclosure the frequency response is relatively smooth from 50 to 15,000 cps, with a gradual falling off below 50 cps. A potentiometer for adjusting the relative level between the two units could be added readily if the user desired.

A data sheet packed with the loudspeaker unit (as well as with the 1201A and 1203A GE speakers) provides sufficient information to enable anyone to build a suitable enclosure. Dimensions are shown for simple rectangular cabinets of 6 and 10 cu. ft. volumes, together with a drilling plan for the 18 ¾-in. holes comprising the distributed port. Dimensions are also given for corner enclosures of the same volume, with details for bracing as well as for the drilling. The 6-cu.-ft. model is essentially the same as the A1-406.

The speaker enclosure, shown in *Fig.* 8, is well built and solidly braced. It is designed to be located in a corner, but a flat back adapts it for a wall location if desired. The cabinet is of the bass-reflex type, but the "port" consists of eighteen ¾-in. holes, which total up to an equivalent area of 10.6 sq. in. Most instructions for constructing a bass-reflex cabinet stress the advisability of increasing the damping of the port by adding more thicknesses of cloth, but the use of a large number of small openings provides the damping in a much simpler manner. Padding inside the cabinet is adequate to eliminate internal reflections, and the back is screwed down with enough wood screws to reduce vibration to a minimum. Cabinets are available unfinished, or finished in either mahogany or blonde.

Fig. 8. Six cubic foot loudspeaker housing, A1-406.

On the whole the GE line gives the impression of having been well engineered to provide good quality at a reasonable cost. And as a final word of commendation, mention should be made of the instruction booklets accompanying the amplifier units. Both are well illustrated, thoroughly clear as to installation and operation, and both include a complete parts list. These book should serve as a model for all audio equipment manufacturers.

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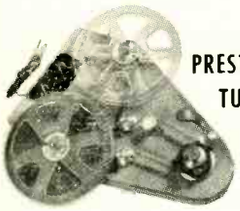

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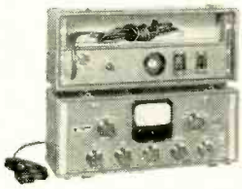

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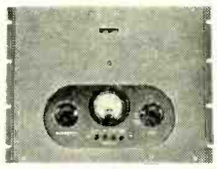

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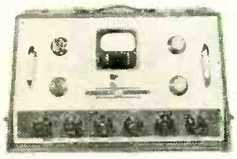

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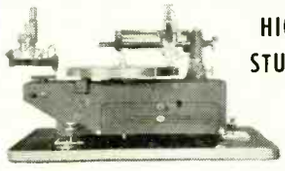

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EDWARD TATNALL CANBY*

Small Print

THOUGH MY OWN EYES aren't entirely 20-20, I am personally enthusiastic about the small print we've been using for these reviews—it's legible enough, yet allows for a kind of comment that is really vital in these days when space requirements and the flood of new records combine to force too many reviewers into doing one-line commentaries on four-hour scores.

I'm sure most readers will agree that the near-doubling of capacity is well worth a bit of eye strain now and then. We must not allow ourselves to accept the easy idea that musical criticism can be condensed to news broadcast conciseness and still be invariably profound. My own feeling (and you may if you wish categorize me as one who likes the sight of his own words. . . .) is that we grossly underestimate the complex values, the sheer *content,* of much music on records; we assume falsely that because there is so much of it available, we can't be bothered to go into detail.

I insist that merely because there are twenty Beethoven Fifth Symphonies available is no reason whatsoever for underestimating the potential value of number 21—and giving it all the space it needs for a respectful evaluation, taking into account the imperishable bigness of the work itself and the long hours of preparation on the part of the players and the conductor that must have gone into it if the record is any good at all.

One could, I suppose, "evaluate" the Empire State Building in a few brief words of praise or blame or categorization. But even if there were a thousand such edifices at hand, one could never avoid the plain fact that this particular building is a vast and unbelievably complex work of man, that its design and construction involved millions of incredibly skilled man-hours of work, of toil and trouble and, too, whole centuries of accumulated background know-how. You may dismiss all of that effort with a few words—at your own risk. So it is with music.

I, for one, will never allow the urgent desire to "cover all the new records" to force me into superficial quick evaluations that are disrespectful to the music and to the performers and technicians who have worked to make it available. I've been working myself for almost a year, on and off, on just one LP that may perhaps appear later on—among the thousands. We've made endless mistakes, back-tracking, the discouragements have been overwhelming at times. I'd hate to put a price on the time I've spent on this and other similar projects. But it is worth it, if only to promote a healthy perspective on my part!

I'll be the one to howl, you see, when some hard-pressed reviewer, conserving space, writes glibly, *"Recording adequate, performance good."* Adequate-schmadequate, as we say hereabouts or, in other words, phooey!

* * *

Which brings me to the erratum that started all this. In the April issue, p. 36 top, somebody with momentary eye strain accidentally pulled the switch on me in the middle of a sentence. The end of the review of Esoteric's organ record ES 522 should say "Organ of St. Paul's chapel, Columbia University, where the earlier Columbia Biggs albums were made, and a fine job technically." The Esoteric, I meant, though the Columbias of Biggs were good too. Thanks to Esoteric for inquiring.

ORGAN TO TASTE

Franck: Organ Music. Robert Noehren.
Audiophile AP-4/5 (2 LP)

Two releases, here and below, of the refurbished tracker-action organ of Grace Episcopal Church in Sandusky, Ohio, which "old timers" in LP will remember was featured on the ex-Allegro LP line with the same organist.

The Franck works are far from the "Baroque" in every respect, belonging to the rich, ultra-chromatic churchly school of 19th century France in its greatest exponent. Franck was a saintly, sweet man, honest in his music where others of his time were flashy and noisy, particularly in organ music. The over-long meditations—Chorales—here recorded are of a sort unto themselves, vaguely related to the chorale variations of Bach and built each as a set of free variations, but there is an introspective, almost absent-minded kind of improvisation about them that is both their greatest beauty and at the same time—on records at least—their easiest fault.

One feels the need for the timeless and silent interior of a cathedral to make leisured sense of this long-drawn-out music. It is more often faint and distant than loud and triumphant, atmosphere music par excellence, the mood being that of the cathedral. Perhaps we should listen at home in a subdued light with curtains close drawn. Four LP sides' worth, beautifully recorded. The somewhat classic Sandusky organ adapts beautifully to Franck, its stained glass colors very much those of the music.

Bach: Toccata and Fugue in D Minor; Prelude and Fugue in E mi. Robt. Noehren.
Audiophile AP-9 (78 mg)

This special hi-fi Bach disc (all Audiophiles are hi-fi, but this is extra-special because of the 78 microgroove) gives us a straight-forward playing of a pair of Bach works, done in a median style neither of the pompous and roaring school nor in the dry and twittering manner of some extreme "Baroque" interpretations. The tempo is a bit rigid and the phrasing could be more plastic for my ear, but the playing is far from unmusical and the registration is always interesting and well styled.

Hi-fi? Well, bless me, I'd almost forgot. I tend to hear the music first. On direct comparison the 78 Audiophile record is definitely a shade cleaner and more brilliant than the slower LP recording. No one will deny the difference. But to me other factors, even beyond the music (a great enough difference) are more interesting.

For one thing, though the bass is stated to be recorded with a 300-cycle turnover which should provide more than usual solidity in that region, it sounds to my ear rather thin relative to other records in this group. I find the NARTB bass setting more satisfactory and can enjoy the record just as much with an 800-cps playback turnover—adding a large measure of extra bottom. How come?

I can only speculate and offer two possibilities. First, the lack may actually be a quality of the original sound, as picked up by the mikes. The mike location can easily affect the apparent balance between highs and lows. Secondly, Bach is a bass man. If ever the juke box effect were to be used elsewhere than in the corner drug store, it would be most appropriate in the music of Bach, especially on the organ. The bass line is tremendously strong and tremendously important. A bass boost, even a distortion technically speaking, may actually add to Bach's recorded effectiveness. It does here.

The treble end is boosted to around 10 db in the 10,000-cps region, slightly less than the newer AES and New Orthophonic curves. I find that a slightly greater roll-off in this case helps bring the bass into balance. However—to show you how ears can differ in the listening—the jacket states that "a majority of listeners in our experience seem to prefer the 'flat' equalizer position."

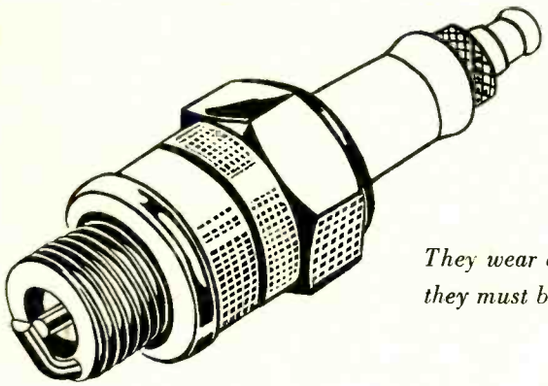
Not this listener! A flat playback of a boosted treble is a manifest distortion and particularly is unjustified when there is the slightest question of an unbalance in the direction of too little bass, as here. (To my ear, anyhow)

Better experiment for yourself. There's room for disagreement of an interesting sort. It all goes to show, I'd say, that equalization for listening will still provide us with audible puzzles long after we have all adopted an identical and invariable recording curve—if we ever do.

Samuel Scheidt: Selections from the Tabulatura Nova (Mid-17th century). Luther Noss, Holtkamp Organ, Yale Univ.
Overtone LP-3

Here is a new example of the classic organ, restoring the organ principles of the 17th and 18th centuries, and the music is of the period as well. This organ is only a few years old and has replaced, as is happening far and wide now, an earlier instrument of more nondescript virtues.

A fine disc well recorded and the bass end is distinctly more solid than in the above Audiophile. You tell me why. The music, let it be said quickly, is of great interest in itself if you are "on to" this period but this is no disc for hi-fi fans who are looking for big noises and 30-cps



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they must be replaceable

Because a jewel point, be it diamond or sapphire has only a limited playing life*.

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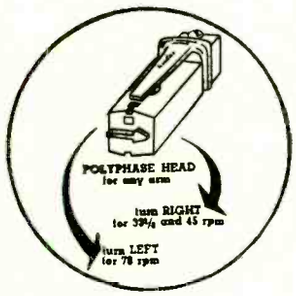

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bass. Samuel Scheidt, one of the three "Schs" of 17th century Germany (Schein and Schutz are the others) writes here mainly the typically ornamental and somewhat static variations that flourished in the period, based partly on sacred melodies, German chorales and Gregorian chant, and partly on popular folk songs such as the jaunty tune "Est-ce Mars" which appears on this record and in numerous works of the period. The sharp colors of the old organ are perfectly suited to the technique of variation—or, should I say, vice versa.

One recorded band here is of great interest. The Magnificat Noni Toni (in the 9th Mode) is done with the alternation of a group of unaccompanied male singers who sing the original repeated Gregorian melody between the variations. The effect of perspective is quite statling; the quite singing voices make the organ's tones seem tremendous in contrast, as in plain fact they are. A good example of the subtlety of the recorded illusion.

Concert Music for Organ and Chimes. Richard Elsasser, Organ of John Hays Hammond Jr. Museum, with Celesta-Chime.
M-G-M E3066.

Chacun à son goût or You go Your Way and I'll go mine! If you shy from Scheidt and you're bored by the Baroque, this is your record. None of that classical stuff here—this is a good old fashioned power organ, pepped up with an electronic device called a Dynamic Accentor which, I'd guess, is a very special sort of sound reinforcement. This organ roars with the biggest sound you could ask for, both low and high. The swell boxes open and close, the music comes out in great gusts and tornadoes, the all-electronic celesta-chimes sound just like real ones, slightly cracked.

As you may infer from this, I don't like the stuff. Neither the music nor the sound. But by this very token I may sell a batch of records to those of you who enjoy disagreeing with me. You won't be dissappointed in the effects and the recording is excellent of its kind, so I honestly recommend it as a good demonstration disc.

J. S. Bach: Orgelbüchlein (Little Organ Book). Finn Videro, Organ at Saro, Denmark. **Haydn Society HSL-D (2 LP)**

Mention of this monumental set is in order for those who like both Bach and the Classic organ. Of all the recordings of this type so far issued, those by Finn Video on Danish organs (a number of others besides the above) are the finest to my ear on every count. The organs have the most wonderfully alive and interesting colors, the playing is natural, well registered, musical and the Danish tape recording is superb. (Lyrec recorder, type Tra 2; single Reslo mike.)

This set is one of those made at rather close mike range, picking up the hiss and plunk of the mechanical tracker actions. A fine hi-fi sound and I think it highly musical, though as always many will respectfully disagree. The music is a collection of no less than 45 hymn tune elaborations (chorale preludes is the proper term) of every variety, one of the monuments of the entire musical literature, and I do not mean to imply by this that the music is not highly listenable! But for the most part these are quite, fluid, undemonstrative pieces and you must know the melodies themselves well before the elaborations make much sense. Plenty of people do know a good many of them. (Lutherans will find almost all of them familiar as regular Lutheran hymns, in use still today.)

AUDIANA—MUSIC PLUS

Vivaldi: La Stravaganza, op. 4 (12 Concerti for Violin). Reinhold Barchet; Stuttgart Pro Musica Orch., Reinhard.
Vox DL 103 (3 LP)

The new movement towards the revival of unplayed 18th century music and the tendency these days to "document" the music itself with an increasingly elaborate "get up," of scores, notes, articles, is typified to make one gasp, in this resplendent album. Bound like a book in a leatherette-and-gold spine plus a separate cover box, the three records are supplemented by a booklet of analysis and background that is almost 40 pages long, in small type with multitudes of musical illustrations, diagrams, foot notes and (happily) reproductions of old prints of Venice! An extravaganza indeed.

The twelve concerti in this set, averaging slightly less than ten minutes apiece, are another group "rediscovered" from the fabulous quantity of such works that Vivaldi left, virtually all of which until very recently have been unknown in modern performance. (There are reputedly well over eighty concerti for violin not counting large numbers of others of numerous sorts.) This set is not unlike the already familiar series called "The Four Seasons" which appeared for the first time just after the war on 78 and is now, after centuries of silence, a widely popular and well known work familiar to thousands of music listeners. (Indeed there are musical themes here which are strikingly like parts of the other work.) No descriptive details indicated in the present case, but my feeling is that there is considerably more real stuff to this group than to the "Four Seasons," speaking musically. It should quickly find a place for itself.

Each new group of previously unknown Vivaldi works (they were customarily written in groups of six or twelve) raises this man's musical stock nearer to the ultimate heights of greatness. Vivaldi has been a great "name" for a long time, with plenty of official mention in text books and in roman letters around the ceilings of our fancier concert halls, but the plain fact fact is that until LP and the new attitude we now have, came along, this powerful composer was actually represented in sound for us by a pitifully small arbitrary fraction of his vast output. Most of us, actually, have known Vivaldi mainly through the transcriptions of a few of his works that Bach made for keyboard. The very existance of his large choral works was unknown to the musical public that heard the Messiah and the Bach Mass as regularly as the year rolls around. Now, all that is changing fast. We're discovering the man himself, in terms of actual sound.

Yes, these twelve newly activated works are outwardly just "more of the same" and there are already something like ninety Vivaldi concerto performances alone in the LP catalogues. Why go on? Can't a few of the "best" be taken to represent the composer? Haven't we got enough and more?

That, indeed, was once our guiding philosophy about music, in the old "Music Appreciation" days. Take a few "great" works, the cream (supposedly) of each great master and you have automatically a rounded cultural picture. Leave the rest to the musty scholars.

But we are changed. If, as we now discover, regardless of the ultimate number each of these works has a new and equal pleasure to provide in the listening, then our new point of view insists that there is no excuse for not recording every last work until the supply is exhausted! If the quality continues as high as this group shows, we'll have a lot more Vivaldi. Similarly, though we already have more than half the 104 Haydn symphonies, there will be no stopping until every one is available, because there isn't a one that hasn't plenty of listening interest at the price of an LP or a half-LP. No, we can't all expect to hear all of these works. Only reviewers have that dreadful responsibility. But, on the other hand, we have the fine privilege of starting anywhere in this vast musical territory with equal prospects for good results, and we may go as far as we wish, as we wish, with not a hint of "ought" involved.

You'll do well, then, to start right here with Vivaldi's Extravaganza which is perhaps the finest group yet unearthed, in a performance that is quiet, limpid, highly musical if perhaps not as masculine as it might be. Beautifully balanced string recording, the solo violin subdued, blended with the ensemble, as is entirely correct for this kind of music.

Beethoven: Variations opus 105, 107 for piano with flute; Bagatelles, opus 126, etc. Wallace Mann, Richard Dirksen. Esoteric ES 525/6 **with score.**

An ambitious album of interesting and, again, unknown Beethoven pointing up the thoroughness with which these LP ventures are now customarily being done. This boxed set of two records contains not only the complete miniature score for the entire recording assembled in a specially printed booklet but in addition the flute part printed out in a separate booklet—presumably in case you want to whistle along on your own flute with the record!

The musical bulk here is the two groups of sets of variations opus 105 and 107, each consisting of a few variations on each of a whole batch of semi-popular tunes of the day, many of

(*Continued on page 61*)

ABOUT MUSIC

HAROLD LAWRENCE

Old Wine in New Bottles

ONE NIGHT about four months ago, near a place in the hill regions of Indo-China called the Village of the Protruding Stumps, a French ethnologist discovered the oldest known musical instruments in the world. They consisted of eleven stone plates, seven of which were pitched in a complete ancient eastern scale. It would not be a gross exaggeration to state that the tones struck on this Stone Age "marimba" were no more familiar to the average music lover of today than the overwhelming percentage of pre-Bach works. Such composers as Dufay, Palestrina, Machaut or Josquin might very well have lived some 5,000 years ago for all it matters. To the layman, music begins with Bach, or with "the man who freed music"—Beethoven. Most books on the master composers seldom explore pre-Bach music devoting at best an introductory chapter to sketch in a rough background.

For those brought up on the standard symphonic diet, the prospect of listening to medieval *chansons,* Ambrosian hymns, Gesualdo madrigals. or thirteenth-century Norman polpyhony, is as appetizing as attending a lecture on the conjugation of Latin verbs delivered by some stuffy octogenarian professor. Latin verbs and Gregorian chants ay constitute parts of our linguistic and musical inheritance, but once acknowledged, they are left to the historians. As in all other arts, however, our music is based on an inescapable heritage which, though most of the time thoroughly absorbed, will crop up here and there, revived by some composer or another scrummaging around in the musical attic.

The varieties of musical quotation are endless; they range anywhere in intent from irony, reverence, nostalgia, patriotism, etc. (Let's not mention the poor plagiarist here.) In the area of the direct quotation, probably the oldest and most popular of all themes is the *Dies Irae* (Day of Wrath), part of the Mass for the Dead. We are not certain who composed it or when it was composed, but it probably dates from the twelfth or early thirteenth century. Originally the *Dies Irae* was designed to "be full of gravity. . . . Let it move the heart." During the Romantic era, however, it was used to create an atmosphere of terror in works dealing with the "supernatural, with wicked powers, with witches, madness, bad dreams, and the lower elements of darkness." It is the latter treatment in which Liszt and Berlioz revealed. The "frightful crowd of ghosts, sorcerers and all manner of monsters" provide an eerie background to the *Dies Irae* intoned by the funeral bells in the "Dream of the Witches' Sabbath" from the *Symphonie Fantastique.* Liszt's hair-raising opening of the *Totentanz* (Dance of Death) is another grotesque example. Rachmaninoff is a little more faithful to the meaning of the original sequence in his *Isle of the Dead.*

In spite of the uses to which it has been put, the *Dies Irae* has pretty much retained its individual personality. At 800, it shows no signs of dying out and seems certain to outlive Methuselah. The secret of its longevity lies in the stark simplicity and adaptability of its pithy melody. It has been called upon by Berlioz in his *Requiem* to conjure up death with "yards of bass and acres of drums"; by Vaughan Williams to be ushered in quietly in the bass with "soft twittering sounds above" for the funeral of a bird in the fourth of *Five Tudor Portraits:* "Lament of Jane Scroop for Philip Sparrow;" and by Turina to evoke the memory of his dead child in "À la memoire d'un bébé" from his piano suite, *Niñerias.*

But enough of funerals, nightmares and infernos! Let's turn from the quotation to the transcription. A new species of hyphenated composer sprang up during the late nineteenth century when, in his wisdom, the Romantic musician took it upon himself to "improve" on antiquated scores. This arranging fever reached its peak during the first three decades of this century and spawned some interesting name combinations: Bach-Busoni, Boccherini-Françaix, Scarlatti-Tommasini, Handel-Wood, and, of course, Bach-Stokowski. One of the most prolific transcribers of pre-Bach music was Ottorino Respighi. In his orchestral works, *The Birds* and the three suites of *Antique Airs and Dances,* Respighi claimed to have "respected all the harmonic characteristics appropriate to the period and character of the music." He explored the lute music of the sixteenth and seventeenth centuries and came up with a number of very effective melodies which he skillfully arranged according to rhythmic and tonal contrasts. Respighi also went in for a freer treatment of older music, an example of which is the *Concerto Gregoriano.*

But we're getting ahead of ourselves. The *Concerto Gregoriano* leads into another form of musical "quotation" in which the spirit, rather than any specific theme, of a period is woven into the musical fabric. A striking illustration is the recent recording of Hovhanness' Concerto No. 1 for Orchestra. The subtitle of the work, *Arevakal,* signifies the Lenten season in the Armenian Church. Throughout most of its six movements, the music hovers around Gregorian modes but, like the Respighi concerto mentioned above, seems devoid of form and might be described as a moody improvisation. Its lack of formal unity, on the other hand, reflects the spinning out of uninterrupted melody so typical of Gregorian chants—melody, by the way, that could be interrupted at almost any point without any serious damage.

Another imaginative musical archaeologist, Ralph Vaughan Williams delved into native folk songs and the music of Tudor England. Aside from his numerous "folksy" scores, two works of Elizabethan inspira-

tion stand out. In the *Fantasia on a Theme by Tallis,* Vaughan Williams scrupulously adheres to the rhythms and harmonies of the original. Taking a cue from Tallis who had a strong predilection for antiphonal effects (he once composed a motet for eight five-voice choirs) Vaughan Williams scored his *Fantasia* for solo string quartet and two string orchestras. The overall effect is magical. Added dimensions supplied by the echoing strings evoke the atmosphere in which the "Father of English Cathedral Music" (as Tallis was dubbed) must have worked. Far removed from the Tudor period in terms of actual harmonies and stylist mannerisms are the *Five Tudor Portraits.* Vaughan Williams' setting to music of some very earthy poetry by England's fifteen-century poet-laureate, skeleton, is nevertheless a highly evocative impression of the half-timbered period.

The primitive combination of chorus and brass as employed by Bologna (13th century) and Machault (14th century) have fascinated a number of contemporary composers, particularly Stravinsky and Hindemith. Stravinsky's cool, impersonal style and deliberate disregard for the meaning of the text lend a properly austere quality to his *Mass for Double Wind Quintet and Chorus of Men and Boys.* Hindemith's obvious affection for the music of the Middle Ages is displayed clearly in his *Apparebit Repentina Dies,* a work for brass and chorus.

Probably the most talked-about musical excursion into the past is the recently issued Deutsche Grammophon recording (released in America on Decca) of *Carmina Burana* by Carl Orff. Ever since its premiere in 1937, the work has been enveloped in a controversy aggravated by two factors: 1) it has been given more than 400 performances in Germany to date; and 2) the sale of the Deutsche Grammophon set exceeded that of any other contemporary score during the past year. Parenthetically, its commercial success in this country came as somewhat of a surprise to Decca's A and R director.

On the face of it, a work with the esoteric title of *Carmina Burana,* containing settings to music of thirteenth-century Latin and German secular poems from a monastery collection, is hardly calculated to raise the blood pressure of the average discophile. The reverse is true.

Before getting down to the recording at hand, a few scraps of information on Carl Orff. Born in Munich in 1895, Orff became a prominent opera conductor there and in Mannheim and Darmstadt. From 1925–36 he was music director of two of the most important schools in Munich. Since 1950 he has been teaching composition at the Akademie der Tonkunst in his native city.

So much for statistics. As for the man and his style. Orff is passionately interested in the music and culture of the past. His research led him to make three different arrangements of Monteverdi's *Orfeo.* He also composed a work for five orchestras and organ in the manner of William Byrd—a natural for a spectacular hi-fi recording! Orff is a perfectionist; he has written no less than three separate scores of incidental music for *A Midsummer Night's Dream,* and has taken the drastic action of withdrawing from circulation all his music written before 1940.

The combination of pedagogue, musical historian and composer usually results in the composer taking a back seat. There have been some notable exceptions. Béla Bartók, for one, compiled Roumanian and Hungarian folk songs and then proceeded to use them as inspiration for his later works. As for Orff, his genuine love for things medieval also led to composition. The twenty-five songs comprising his "scenic cantata" are

as vibrant and red-blooded as Chaucer's *Canterbury Tales*. Orff has divided them into three parts: 1) In Springtime, 2) In the Tavern, and 3) The Court of Love. A "moral" about Fortune's wheel begins and ends the work.

Orff employs the large musical forces at his disposal with a fine sense of economy, reserving the entire ensemble for crushing climaxes. Over this aspect of the score, there can be no disagreement: Orff is obviously in full technical command. At all times his effects come off handsomely. There are no tonal or acoustical miscalculations; the work "sounds" well from beginning to end.

Orff's melodic ideas derive from three main sources: 1) Gregorian chants, 2) dances of the period and 3) German folk songs.

Side by side with these musical allusions to the Middle Ages—and here is where the work bears the brunt of its critical attack—are to be found the most eclectic use of material ranging anywhere from Moussorgsky and Stravinsky to old-fashioned German "Yatz" (Jazz to you). One gets the feeling, however, that Orff is making conscious use of many sources, in the same manner as do Poulenc and Ibert. Despite its eclecticism, *Carmina Burana* holds together surprisingly well.

The question now is: do such neo-medieval, neo-Baroque, neo-Renaissance compositions reveal anything essential about early music? In most instances, it is just the other way round. We learn more about Vaughan Williams, Hovhaness and Stravinsky than the composers they treat. The older models turn out to be vehicles rather than guides. Their real value lies in stimulating the development of new sounds out of old.

In his peppery style of writing, Frederick Goldbeck put the "neo-ist" in his place. "They live under the delusion that Bach's and Mozart's and the Elizabethans' works are lost and have to be replaced, as we replace with tears in our eyes, our great-grandmother's broken china: by something similar, but modern." We can assume that Mr. Goldbeck's barbs are not aimed at all works of this sort. Rip away the thin layer of Mozartean skin from the *Classical Symphony* and the body is pure Prokofiev. The same applies to any number truly original scores written "in the matter of. . . ."

Parallel cases exist in the allied arts where the fusion of styles may result in a "new" form of expression—a sort of musical cross-pollination. The musically curious, however, will want to enjoy the original species thereby doubly enriching his appreciation.

3M RELEASES TAPE OF "DESERT SUITE"

The Minnesota Mining and Manufacturing Co. recently announced the availability of a high-fidelity tape recording of the "Desert Suite" from the score of Walt Disney's first full-length adventure film, "The Living Desert." The music, from the score by Paul Smith, is an eleven-minute series of musical vignettes which depict the dramatic occurences that take place daily in nature on the desert. The instrumentation includes such seldom heard instruments as the bass flute and Persian finger cymbals.

The recorded tape is being made available nationally through music stores, photo shops, appliance dealers, and all other retail outlets where "Scotch" brand magnetic tape is sold, in addition to the nation's "hi-fi" dealers. The tape can be had at 15-, 7½-, and 3¾-in. speeds.

AUDIO ETC.

Edward Tatnall Canby

On the Gadget Front

THIS IS NOT going to be an "equipment report" on the umpteen dozen preparations and gadgets now available for improving the play of your plastic records, but it does seem worthwhile to bring the perpetual subject of static up again for a bit of going over.

Don't ever forget that the basic answer to the problem of static and the consequent collection of dirt and lint on records is one of manufacturing—not of post-operative treatment in the home! As I've said before, my one-track mind says "give us static-free records," and I'm far from ready to quit this particular Message yet.

The present state of the economy of record manufacture—I say that deliberately—evidently does not permit the wide use of static-free plastic mixes. I had a brief conversation with an expert at New York University who has a new mixture that he says solves the problem (that is, can be put to commercial use) and I strongly suspect that there are experiments going on all over the place with new plastic formulas intended to solve this problem cheaply and without compromising record quality in the sound and in durability and hardness. But, as of now, most of our records are still as static-prone as ever.

A static-free plastic, I gather, can be concocted with no more than a very small additive mixed with standard material—say two or three per cent. It is thus not a question of throwing out the present plastics and finding altogether new ones. Indeed, the purely mechanical and physical problems are not too great; there seem to be a number of ways in which the desired results may be obtained without serious complications. The problem, though, is how to finance the new material. An additive consisting of only a few per cent of the total, if it costs several dollars per pound as against something like 20 cents a pound for the average present stuff, would still add too much to the final cost of the record to be tolerable—as of now. That, if I guess rightly, is the economic key to the situation.

(For those who may find it of interest, the static-free record mix mentioned above is available under the trade name *"Nef-O-Lac"*—it is not lacquer in spite of the name but ordinary vinyl with the special additive—a product of the J. W. Neff Laboratories in Easton, Pa. The material is already in use commercially and record labels mentioned to me were Musical Masterpiece, an off-shoot of Concert Hall, and the newly reborn Allegro label. The stuff is alleged to be "better" than that used by RCA Victor as to static reduction but you'd better try for yourself; I'm definitely taking no sides!)

Crazy, isn't it. Even with the above exceptions, I still have on hand a whole shelf of assorted spray cans and bottles and brushes to treat discs, representing a parasite industry, so to speak, that has legitimately grown up because of this one fundamental weakness in the basic plastic. If I were seriously to apply any one or more of these home remedies to all records that come my way I would be in not only for a sizeable extra cash outlay but, worse, an unconscionable lot of plan old fashioned, time-consuming trouble and nuisance. I protest, and so will you.

The Two Answers

Economically there are only two ways in which this situation can be altered. Maybe both are going to happen together—who knows.

1. Somebody will figure out a really cheap additive that will render good plastics static-free at *low* cost and without serious complications; by some miracle the involvements of patent protection and rights will be unraveled so that we record buyers can get the stuff not on a few exclusive record labels but generally, as a matter of course, on all labels as we do the present plastic materials.

2. Or the Mountain can slither right over and meet Mohamet. If the public wants static-free records enough they'll get them—or else. To tell the truth I'm always suspicious of that old argument that such and such a development "isn't economic or practical."

Too expensive to produce? Anything is "too expensive" if the public will buy something cheaper. But once somebody lets a cat out of the bag and the public gets the idea it must have that kitty but quick, then all of a sudden everybody has it and expense be hanged. It's profiable. Record album "art covers" are an example. They are very expensive, but every company now uses them. Sealed records were much too expensive and uneconomical—only yesterday—until people decided they wanted sealed records.

And so my feeling is that if somebody can really get the idea over to us buyers that *a static-free record is worth any three highly charged ones* in anybody's bush, then we'll get them and fast, on every label. And at that moment most of the static removing and cleaning preparations will be gently retired to a permanent spot on the shelf. Not the home shelf, either. How about it, somebody?

Remove the static generating power from *new* records in the manufacturing and you have added I'd guess three times the life and twice the enjoyment to every disc,

right from the beginning. I'm sure that the greatest basic shortener of a record's life and usefulness now is not bad needles, not mere playing, but the side-effects of that basic static charge. Enough? Let's add that additive, quick.

Meanwhile. . . .

Meanwhile, there are the home cures, ready and waiting, and I don't mean to run them down except on the above matter of principle, that there shouldn't be any need for them.

I suggest for those who may be wondering where to begin among the proffered remedies that there are several distinct functions to these assorted devices which should be kept apart in the mind even though in practice they usually overlap.

1. *Static removal or prevention.*
2. *Cleaning of the record grooves.*
3. *Lubrication.*

The emphasis on these three factors varies considerably in the instruction booklets and ads and labels; frankly I am left in a state of some confusion and I doubt if many of us on our own can get much satisfaction as to the *exact* operation of the anonymous ingredients. I, for one, would welcome a really informed and unbiassed discussion of the factors involved—the detergent, the lubricant, the chemical, the electrical effects. A very abstruse subject, and we very much need authoritative information.

As for me, I can give you only a practical man's immediate experience, as usual. I do use and have consistently used a number of record treatments, simply because something just has to be done. In producing a recorded broadcast I must use batches of LP records that necessarily sit exposed and out of their jackets in our fair and filthy city, New York, for hours at a time. The dust and grit collection is appalling. The records are unplayable in their nude and native state even after a couple of minutes of indecent exposure.

I find that whatever the claims and the facts, I cannot possibly dodge the glaring importance of numbers 1 and 2 above, static and dirt. Lubrication is a moot question, one that I have no immediate way of getting at—I don't even know whether my records *are* lubricated or not except when someone tells me they are. But the other two points —wow!

One without the Other?

And so I ask, what is the point in cleaning your records without insuring that the static charge will stay away for awhile? If not, just as soon as the record is dry and in use the charge builds back and the grit collects. Spend a half hour wet-washing your records and in thirty seconds they're as bad as ever again.

And I ask, too, why remove the static charge if you don't also remove the dirt that is thus loosened from its electrical fasteners?

Specifically, I find a plain washing of limited usefulness, though it helps in an emergency. And this whether via a wet rag, dunking in the kitchen sink, or even the super new products that are added to water in order to float away even more accumulated dirt such as the new *K-33* liquid. An excellent material, I have no doubt, and I believe the claims for it, which will, I am sure, be backed up by anybody's microscope; add a few drops of K-33 liquid to a lot of water and dunk your records—they'll come out cleaner than clean, and a lot cleaner than in any ordinary soap or detergent or plain water wash. Good. But what then? This particular material, I gather, is not a static preventive though of course the existing static charge is removed in the washing. What next?

Maybe the *Mercury Disc-Charger.* (It *dis*—charges discs, though the name would seem to suggest the opposite.) This gadget attachment is a decided improvement on the older Polonium de-staticizers. A tiny bit of radioactive something-or-other, harmless and with a half life of some thousand years or more (Polonium is one half dead after a few months) is embedded in a bit of plastic that hangs on your pickup and "scans" the record, *dis*charging the static ahead of the stylus. Good—*if* the dirt problem is taken care of. On a dirty record this gadget does an excellent half-job, but I would strongly suggest that to allow the stylus to push the loosened trash around and around into little heaps is not a wise procedure. If you use this device, be sure to wash your dirty records. (The company says the loosened dirt "collects harmlessly" on the stylus tip. I don't feel at all happy about that idea.)

There are numerous liquids that are supposed both to clean and to de-static your discs for an indefinite time. Speaking generally (and avoiding the highly technical complications) I gather that a genuine problem in all such materials is that of a "gumming up," a change of some sort in the stuff or a mixing of it with dirt and other foreign matter which, in ordinary parlance, would tend to clog the system. Soapy materials can do this. Oils which change chemically into gummy materials might cause similar trouble. Materials which harden or dry are bad.

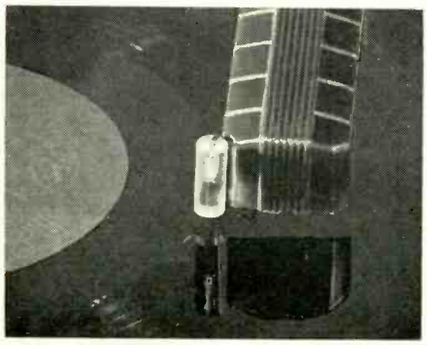
(*Continued on page 60*)

NEW PRODUCTS

● **Pickering Record Compensator.** A re-engineered version of the Model 132E Record Compensator, which furnishes full

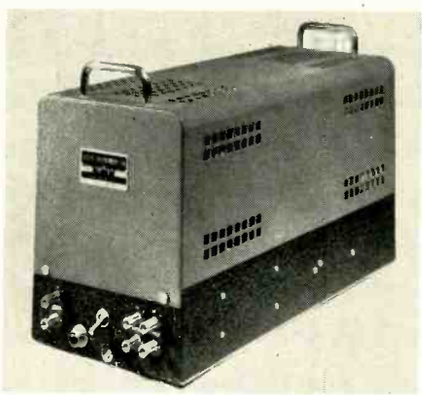
compensation for the most recent recording curves adopted by the record industry, is a new item introduced by The Pickering Company, Oceanside, N. Y. A new position on the unit matches the Orthophonic-AES recording curve which is now used by many major companies and which is being discussed as a uniform curve for the entire industry. Other positions on the revised 132E are: European 78; London 33-Old LP (for most makes of 33 1/3's made before June 1953); Old Capitol-Old AES; Maximum Highs-Maximum Bass; and Noisy Records (for older records with high surface noise). The compensator is designed for connection between pickup and preamp. It requires no power and can be mounted in any position.

● **Record-Static Eliminator.** Operating on the principle that radio-active materials produce radiations which ionize the surrounding air and thus prevent formation of dust-attracting electrical charges, the Mercury Disc-Charger is a tiny capsule which is fastened to a pickup arm and "scans" the revolving record, setting up a constant field which repels dust. It contains a minute and harmless quantity of radio-active substance. Featherweight and easily attached to any type of arm, the Disc-Charger does not affect normal operation of the turntable or record changer. Operating life of the unit is virtually infinite as there are no moving parts and half-life of the radio-active material is



1600 years. The Disc-Charger is produced by Mercury Scientific Products, Inc., 1725 W. 7th St., Los Angeles 17, Calif.

● **Auto-Sweep.** With this new instrument the user of a cathode-ray oscilloscope is spared the necessity of constantly readjusting coarse- and fine-frequency and synchronizing controls while making a series of tests in the frequency range of 20 to 30,000 cps. In operation, the oscillator, amplifier, or similar device under test is fed directly into the Auto-Sweep whose output in turn is fed to the X-axis 'scope amplifier. Test frequencies may be swept throughout the 20-to-30,000-cps range without any adjustment of the 'scope, two cycles showing on the screen at all times. The Model 54 Auto-Sweep locks onto any signal in its normal frequency and voltage range, synchronizes automatically, and generates a sawtooth sweep voltage of constant amplitude at one-half of the input frequency. This sawtooth voltage is then fed to the X-axis



amplifier of any 'scope, to provide a sweep showing two cycles of the input signal. Both positive and negative sweep polarities are available. Full details are available from Audio Instrument Co., Inc., 133 W. 14th St., New York 11, N. Y.

● **Miniature Hi-Fi Package.** Suitable for use wherever high-quality reproduction is desired, the new table-model hi-fi component package recently introduced by

Asco Sound Corporation, 115 W. 45th St., New York City, N. Y., need only be connected to a quality speaker system to perform as a hi-fi phonograph. Compact in design, the unit is an integration of the Brociner Mark 12 amplifier which includes both equalization and tone controls, and the Swiss-made Lenco three-speed record player. Set within a typical table-model phonograph enclosure, the unit measures 9"h x 16"w x 13¼"d. The "Miniature" is available in ebony, black lacquer, cherry mahogany, and natural birch.

● **Low-Cost Tape Recorder.** Many deluxe features are included in the new Model 1290 portable tape recorder recently

placed on the market by the Mitchell Manufacturing Company, 2525 Clybourn Ave., Chicago, Ill. Response is stated by the manufacturer to be essentially flat from 65 to 10,000 cps. The unit is of the dual-track type and accommodates 7-in. reels. Recording speed is 7.5 ips. Fast forward and rewind speed permits rewinding a full 7-in. reel in 90 seconds. Power output is two watts undistorted. Two inputs are afforded, one for microphone and one for tuner or phonograph. Outputs are provided for external speaker and amplifier or monitor. The recorder is entirely self-contained in an attractive luggage-type case and weighs but 18 lbs; dimensions are 11½"w x 14¾"d x 8"h. It is supplied complete with microphone and 600-ft. reel of recording tape.

● **"Lipstik" Microphone.** Deriving its name from a striking similarity in size and appearance to an average lipstick, the new Altec Lansing Model M20 condenser microphone measures but three inches in length and is only five-eighths of an inch in diameter. Its remarkable performance is in sharp contrast to its minute size. Perpendicular incidence is flat within 3 db from 15 to 15,000 cps. The M20 system provides an output level of minus 48 dbm and can be operated into any impedance from 30 ohms to high impedance. The "Lipstik" is of stainless steel which, plus the use of the same type of vacuum tube employed in guided missiles, makes it extremely rugged. The flexible cable is considerably smaller than standard microphone cable and is covered with fibre-

glass cloth to assure maximum resistance to rough handling. Descriptive literature is available from Altec Lansing Corporation, 161 Sixth Ave., New York 13, N. Y.

hrc HARVEY
the House of Audio

REK-O-KUT
12-inch, 3-Speed TURNTABLES
Model L-743

A broadcast quality turntable designed for discriminating users . . . professionals and audiophiles. Driven by 4-pole motor. Turntable itself is made of cast aluminum, and exerts no pull on magnetic cartridges. It is precision machined with a heavy rim for dynamically balanced flywheel action.

A single knob permits instantaneous selection of any record speed: 33⅓, 45, or 78 rpm. Record slippage is eliminated through use of new mat material. There is virtually no rumble, wow or flutter. Complete with 45 rpm record adapter..... **$59.50**

MAGNECORD
PROFESSIONAL
TAPE RECORDER
M80 Series

Provides full range response: 30 to 15,000 cycles at 7½ inches/sec., and 30 to 20,000 cycles at 15 inches/sec. Has new, slot-loading feature, and automatic tape lifter. After loading, all operations are pushbutton control. Starts and stops within 1/10 second. Accommodates 10½ inch reels. Flutter and wow are less than .1% at 15 inches/sec. Employs high quality, low noise amplifiers with direct-coupled cascode input stages. Can be adapted for remote operation.

M80-ACX chassis only for rack mounting..... **$1185.00**
M80-AC portable, with cases..... **1265.00**
M80-ACC console complete with cabinet..... **1345.00**

FAIRCHILD
Moving Coil
PICKUP CARTRIDGES

Designed to professional quality standards, these playback cartridges permit the highest quality record reproduction thus far attained. Unusually high lateral compliance has reduced tracking error distortion to an absolute minimum. Each Fairchild cartridge has a carefully selected diamond stylus. The moving coil design provides a linear, smooth, wide-range response. Dimensions are such to permit ready installation in most pickup arms and record changers. The Fairchild cartridge is used with conventional preamp-equalizers. Its impedance and output are designed to work into a high quality transformer, such as the Fairchild Models 823-A and 826-A.

The Model 823-A is a fully shielded transformer with multi-tap primary. It is intended for use with pre-amplifiers where an all-purpose input transformer is desired. **The Mode! 826-A** is a special transformer of small dimensions designed for use between Fairchild cartridges and a grid input preamp. *(illustrated)*

Cartridge Model 215-A for microgroove records..... **$37.50**
Cartridge Model 215-C for standard groove records..... **37.50**
Transformer Model 823-A..... **13.85**
Transformer Model 826-A..... **8.75**

Visit the HARVEY AUDIOtorium
If you want to See and Hear the finest . . . the widest selection of high fidelity equipment . . . be sure to visit the HARVEY AUDIOtorium. It will thrill you.

NOTE: Prices Net, F.O.B., N.Y.C. Subject to change without notice.

MARANTZ
AUDIO CONSOLETTE
CONTROL PREAMPLIFIER-EQUALIZER

An unusually high quality unit permitting complete control of response characteristics. In flat position, frequency response extends from below 17 cycles to 50,000 cycles ±1db. Unit features a 7-input selector switch . . . VOLUME CONTROL . . . independent, continuously variable BASS and TREBLE CONTROLS . . . independent TURNOVER SELECTOR and TREBLE PRE-EMPHASIS EQUALIZER . . . continuously variable LOUDNESS COMPENSATOR . . . 3-position LOW-PASS FILTER . . . and other features to provide the utmost flexibility.

Cathode follower output permits long line to main amplifier. An independent, isolated output is provided for recording on tape or disc. Furnished with power supply. Supplied in gold finished metal cabinet with stained wood end-blocks. **$155.00**

Complete with tubes

JIM LANSING
Model D-31050
SPEAKER SYSTEM

One of the few truly front-loaded horn enclosures, augmented by two independent Helmholtz resonators to provide unusual realism of response to extremely low frequencies. Equipped with two Model 130B 15 inch low frequency units, one Model 175DLH high frequency driver, horn, and Koustical lens assembly, together with a Model N-1200 dividing network, the entire unit operates as an effective three-way system with balanced, clean response over the entire audible spectrum. Height 50"; Depth 28"; Front Width 37". Shipping Weight 215 lbs. **$522.00**

Model D-31050M (mahogany)
Model D-31050B (blonde)..... **529.50**

THE NEW REL
Precedent
FM TUNER

Unquestionably the finest FM tuner ever made. This successor to the famous 646B incorporates every important advance developed in the art of FM reception. Sensitivity is 2 microvolts for better than 40db quieting. Frequency response is 30 to 40,000 cycles ±1db. Waveform distortion is less than .5% for 100% modulation. Provides 2-volt output to high impedance, and .2 volts to 600 ohms. Front panel includes slide-rule dial, tuning meter, signal strength meter, tuning control, radio frequency and audio gain controls, and power switch. Power supply is self-contained. Supplied complete with tubes. **$325.00**

Chassis only (for custom installations)
Relay Rack Model..... **335.00**
Cabinet Model (Mahogany, Walnut or Blonde)..... **360.00**

GRAY
Model 108-B
Viscous-Damped Arm

A transcription arm of radically new design. Provides perfect tracking for all records: 33⅓, 45, and 78 rpm. Has stylus pressure adjustment from 5 grams. Mechanical resonance is virtually eliminated. Prevents damage due to dropping. Accommodates most makes of magnetic cartridges, and permits instant interchange from one type to another. Can be used for records up to 16" in diameter. **$56.00**

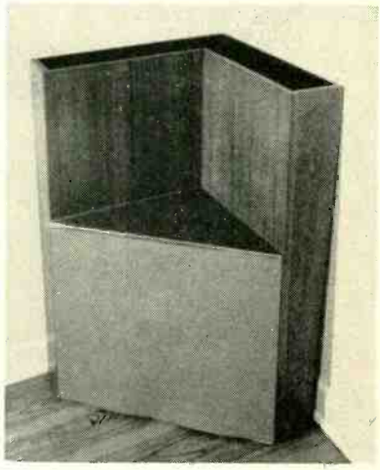
Gray 108-B Arm

HARVEY RADIO COMPANY, INC.
103 W. 43rd Street, New York 36, N. Y. JUdson 2-1500

• **Hi-Fi Chassis.** Combining an AM-FM tuner and a 10-watt amplifier on a single chassis, the new Model P-717 is the first instrument in a new line of equipment which marks the re-entry of the Freed-Eisemann trade name into the high-fidelity field. The unit features AM and FM

circuits which are designed for maximum gain at minimum noise level to meet reception requirements in fringe areas. Frequency response is stated to be 20 to 20,000 cps within ± 1 db at full output. Treble and bass controls afford both boost and cut. Selector switch provides equalization for various types of recordings. The panel is tastefully finished in baked ebony with brushed-brass trim. Manufactured by Freed Electronics and Controls Corporation, 200 Hudson St., New York 13, N. Y.

• **Unique Corner Horn.** Vertical design, which permits full use of unobstructed wall surfaces with resultant high speaker efficiency, is featured in a highly original speaker enclosure recently announced by Product Development & Research Com-

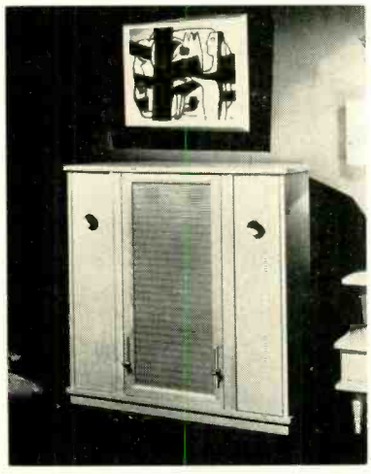


pany, 2365 Le Forge Road, Ypsilanti, Mich. It represents the first time an exponential horn of this type has used a top opening to take advantage of wall space. Designed for use with a 12-in. speaker, the enclosure has space for an additional high-frequency speaker. The cabinet is 36 ins. high by 24 ins. across the face. Inside the "V" formed by sound passages as shown in the illustration there is a triangular shelf 14 ins. below the top which can be used for flowers or magazines. Back surfaces are slanted in at the bottom to clear moulding and quarter-round. Effective sound source at the mouth is 225 sq. ins., or roughly three times the area at the throat.

• **Professional Transcription Arm.** A number of important advantages not

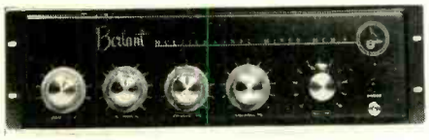
found in previous models have been incorporated in the new Model 202 Fairchild Transcription Arm. As in earlier models, the 202 has viscous damping but the method of application has been radically changed; it has been eliminated entirely from the vertical plane and is used only in the lateral plane. The resultant lower vertical moment of inertia allows excellent tracking of warped records. Over-all length is considerably shorter than earlier models for added mounting convenience. The turret-head arm will mount up to three Fairchild Series 215 cartridges. Merely turning the knob at the end of the arm will rotate the desired cartridge into playing position; at the same time stylus pressure is correctly adjusted. As a service to broadcast stations and other users of the now obsolete Model 201 arm, Fairchild is offering to re-work the older arms and bring them up to date for a small charge. Inquiries should be directed to Fairchild Recording Equipment Company, 157th St. and Seventh Ave., Whitestone 57, N. Y.

● **Adjustable Speaker Enclosure.** A built-in adjustment permits the user to transform the new Angle Genesse Fold-a-Flex cabinet into a folded horn, infinite baffle, or

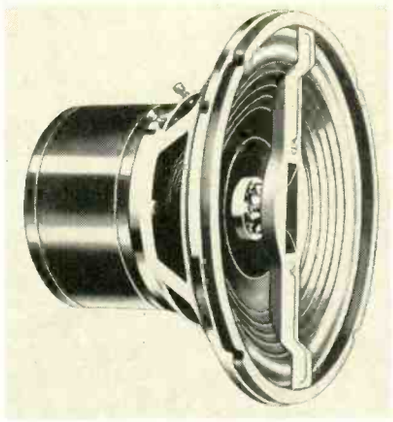


bass reflex enclosure at will. The change from one type of enclosure to another takes less than one minute and may be performed as often as desired. The cabinet is equipped with mounting board for either a 12- or 15-in. speaker, and a sealed compartment is provided at the top for tweeters and mid-range speakers. Space also is provided for a crossover network. The Fold-a-Flex is styled to match other Angle Genessee audio cabinetry. Standard finishes are blonde oak and mahogany, with custom finishes available on special order. Detailed information on the Fold-a-Flex may be had by writing Angle Genessee Corporation, Dept. Æ, 107 Norris Drive, Rochester 10, N. Y.

● **Multi-Channel Mixer.** Plug-in accessories permit an unusual degree of flexibility in the new Model MCM-2 4-channel



mixer recently introduced by Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif. Normally a basic high-impedance mixer, the unit can be easily adapted to accommodate low-impedance microphones, variable-reluctance pickups, and high-level signal sources such as tape recorders, tuners, etc. Any of these can be mixed in any desired combinations. The cathode-follower output of the MCM-2 can be changed to a 600-ohm balanced zero-level line by the addition of a plug-in output transformer. Where more than zero output is required, the mixer can be furnished with an additional stage of amplification feeding a special push-pull output transformer, which supplies plus 15 vu to a 600-ohm line. In this manner the unit can be transformed into a compact mixer-line amplifier for remote use. Power supply of the MCM-2 is built-in, thus affording complete independence of other equipment.



● **Triaxial High-Quality Speakers.** Concentric in design, the new Electro-Voice TRX Triaxial 3-way reproducers—available in both 12- and 15-in. models—combine the Super-Sonax very-high-frequency driver, the Radax principle, the new treble propagator, and a large bass cone with a heavy magnet in one compact assembly. This new combination provides augmented bass response, a full-bodied midrange, and smooth upper octaves to the highest audible frequencies without masking effects or distortions. An adjustable brilliance control for remote mounting permits matching to room acoustics for optimum over-all performance. The unit can be installed in direct-radiator cabinets or in folded-horn enclosures. Full one-half section m-derived crossover network minimizes distortion products, and edge-wise-wound voice-coil design affords 18 per cent more efficiency. Frame is die cast, and capable of supporting the heavy magnet structures without warping. Frequency response is 30 to 15,000 cps in E-V Regency or Aristocrat enclosures. For full details, write for Bulletin 204. Electro-Voice, Inc., Buchanan, Mich.

NEW LITERATURE

● **Shure Brothers, Inc.,** 225 W. Huron St., Chicago 10, Ill., has recently issued a revised General Catalog No. 44B. Contained in the book are illustrations and data on Shure microphones, microphone accessories, magnetic tape and wire recording heads, and phonograph pickups and styli. Imprint space is provided on the front cover for Shure distributors.

● **Radio Receptor Company, Inc.,** 251 W. 19th St., New York 11, N. Y., describes its complete line of germanium diodes and germanium transistors in Bulletin No. G-23, a comprehensive new 8-page catalog just issued by the firm's Seletron and Germanium Division. The booklet is fully illustrated with charts, voltage curves and diagrams, and lists many product applications. Requests for copy should be addressed to the Sales Department.

● **Triad Transformer Corporation,** 4055 Redwood Ave., Venice, Calif., features 11 new hi-fi amplifier kits in its recently-published 1954 catalog. Product listings include more than 500 transformer models, of which 60 are new items. Shown for the first time are two new photo-flash transformers, also a complete line of geophysical transformers which are incorporated in a special section. When writing for your copy specify Catalog TR-54.

● **The Daven Company,** 191 Central Ave., Newark, N. J., includes a great deal of previously unpublished basic design information on precision wire-wound resistors in a new 32-page catalog covering the entire line of Super-Davohm resistors of this type. The book is divided into sections starting with broad general data on all Daven types and continuing into specific information on each. Many engineering drawings and photographic illustrations make the catalog of particular value to users of precision wire-wound resistors. Copy is available on request.

● **Technology Instrument Corporation,** 531 Main St., Acton, Mass., has available another of its interesting laboratory reports. This one, Report No. 9, covers applications of the company's Type 310-A Z-angle meter and Type 320-AB phase meter in school laboratories. Enclosures with the report include descriptions of representative experiments conducted at various colleges. Copy will be mailed on request.

● **Heli-Coil Corporation,** 1467 Shelter Rock Lane, Danbury, Conn., has recently announced availability of Bulletin No. 664, which contains suggestions for the designer of electrical equipment on how to provide strong wear-resistant threads of stainless steel in soft insulating and conductive materials. Contained in the publication are three actual cases where wire screw thread inserts have produced threads for adjustable screws in acrylic and phenolic insulators, and in copper conductors. Copy will be mailed on request free of charge.

● **The Clough-Brengle Co.,** 6014 Broadway, Chicago 40, Ill., has presented to the electronic- and audio-equipment industry one of the most effective pieces of catalog literature to pass this desk in many months with its new Catalog No. 54A. Beautifully illustrated and intelligently written, this booklet does full justice to the fine instruments it represents. Illustrated and described is the entire line of Clough-Brengle test and measuring equipment. Address request for copy to Dept. Æ.

● **Goody Audio Center, Inc.,** 235 W. 49th St., New York 19, N. Y., is now distributing its first annual catalog of high-fidelity equipment. The 88-page booklet, completely illustrated, lists Goody's entire selection of phono equipment, tuners, amplifiers, speakers, cabinets, and tape recorders. Items are presented alphabetically-by-manufacturer within each major grouping. Copy will be mailed on request.

● **Geo. Stevens Manufacturing Co., Inc.,** Pulaski Road at Peterson, Chicago 30, Ill., has recently published a 46-page booklet of distinct interest to transformer designers and manufacturers in its new Catalog No. 54. Illustrated and described are machines for winding practically every type of coil, including toroidal, transformer, bobbin, and field coils. Of essential value to designers and production engineers is an entire page devoted to winding formulae. Many accessories also are pictured and described.

BROADCAST CONSOLETTE

(*from page 20*)

Two monitor systems are needed, an amplifier-speaker system so that the announcer can hear the program as it goes on the air, and a meter-flasher system for visual measuring of the output volume.

The monitor amplifier controls (14) provide great flexibility. When down, the key connects the monitor amplifier to channel A, and when up, to B. In the center position, the key connects the monitor amplifier to a multiposition rotary knob (left of the key) which makes possible switching the monitor amplifier and speaker across any remote line, the network, the turntables and tape recorders individually, or to other program sources. The control to the right of the switch is the speaker volume control.

The most important thing the monitor amplifier system can tell the announcer is how his program sounds on the air; it must, of course, tell him *if* his program *is* on the air. Thus the most usual setting of the monitor amplifier controls will be with the key in the center position and the knob set in the extreme counter-clockwise position, connecting the amplifier to a tuner. While always important, "off-the-air" monitoring is particularly vital when the announcer is also responsible for the transmitter.

The headphone jack and pushbuttons (9) connect the headphones across channels A and B or the network. The latter is particularly important because many network programs are sponsored locally, and the announcer, while reading his commercial, must listen to the network announcer for the rejoin cue. The fourth button connects the phones across the input of the monitor amplifier for headphone-monitoring of other channels when desired.

The volume indicator (3) is the standard level meter now in general use. Located just above the copy rack, it can be seen easily when the announcer has time to look. When he is reading, a two-colored peak flasher to the left of the VU meter indicates improper level adjustment. A bright red flash indicates peaks too high in volume, and a softer blue flash signifies that the level is too low. Both register on peripheral vision, making direct observation unnecessary. The meter-range switch is located to the right of the flasher.

The key and knob at the right of the meter are similar to those used with the monitor amplifier. The key down puts the meter across channel A, and up, across B. The center position connects it to the knob which selects a number of circuits.

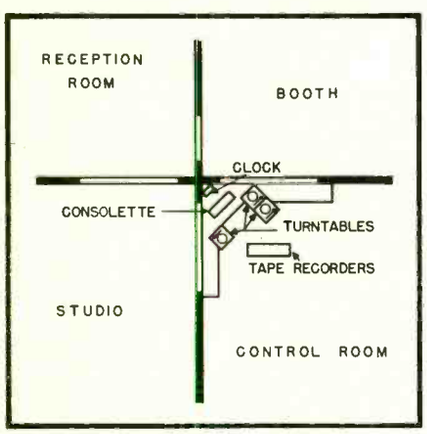


Fig. 3. The consolette in the control room. The announcer faces the clock at eye level just above the consolette, and can see into both the studio and the news booth by turning his head 45 deg. Adequate table space must be provided for phonograph records and transcriptions that are about to be played or have just been used. The tape recorder stand must include tape-storage space.

Additional Features

A number of small improvements make this consolette easier to use and maintain. All volume control shafts, for instance, are *drilled* to receive the knob set-screws; this prevents the knob from moving in and out or rotating on the shaft. All components are accessible for servicing without moving the consolette; preamps are located behind the copy rack, which swings out, and the program, monitor, and cue amplifiers are located in the cabinets at the ends of the the rack. If plug-in amplifiers are used in keeping with modern design, a small auxiliary power supply must be available in the station workshop when servicing is required. The main power supply for the consolette is located in a separate cabinet.

Some might object that the consolette is too high for the announcer to see over into the studio. However, in small stations, it does not seem to be general practice to mount the consolette facing studio windows. For one thing, employees and visitors looking straight into the announcer's face while he is working distract him; for another, many stations have two studios or a studio and a booth, both controlled from one consolette. These are usually located on each side of the control room. In any event, the studios are used infrequently; all programs, however, require split-second timing. It appears desirable, therefore, to mount the consolette facing the *clock* rather than a studio. In such a situation a higher consolette has no adverse effects whatsoever, while a low consolette represents time wasted in design.

Figure 3 shows a control-room layout planned for effective production of local programs with this consolette.

References:

[2] A. Chapanis, W. R. Garner, and C. T. Morgan, "Applied Experimental Psychology," John Wiley and Sons, 1949.

[3] Paul M. Fitts, editor, "Psychological Research on Equipment Design," U. S. Government Printing Office, 1947.

[4] H. A. Chinn, "C.B.S. studio control-console and control room design," *Proc. IRE*, May, 1946.

TRANSFORMERLESS AMPLIFIER

(from page 23)

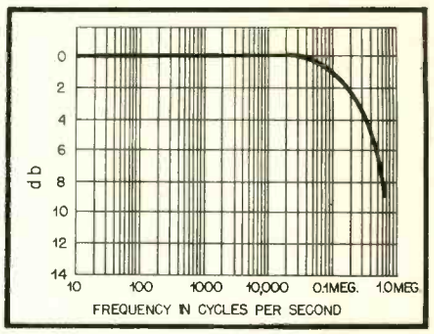


Fig. 2. Frequency response of this amplifier is flat at the low end and less than 3 db down at 200,000 cps, making it one of the widest-band designs in use today for audio.

Performance

The operational results of the prototype model of this amplifier are shown by the curves and photographs.

The frequency response, which is shown in *Fig. 2*, is flat over a very wide range. Since resistive-capacitance-coupled circuits are used throughout, there is no serious limitation on response. To keep circuit complexity down, and to achieve the best feedback stability, a reasonable amount of gain per stage is desired. This, of course, will determine the high-frequency limitations, while the interstage coupling networks determine the low-frequencies limitations. While the bandwidth without feedback would be wide in this design, the use of 40 db of inverse feedback extends the ends of the range manyfold. Most good amplifiers exhibit a flat response well beyond the limits of audibilty, and this unit probably ranks as one of the widest-band designs intended for audio use.

As shown in *Fig. 3*, the harmonic distortion even at full rated output is exceptionally low and virtually independent of frequency. The ability to deliver 25 watts at 20 cycles and below with negligible distortion is practically impossible in a transformer-type amplifier of similar mid-frequency power rating. The low-frequency performance is directly attributable to the use of circuit components whose nonlinear properties are in no way dependent upon

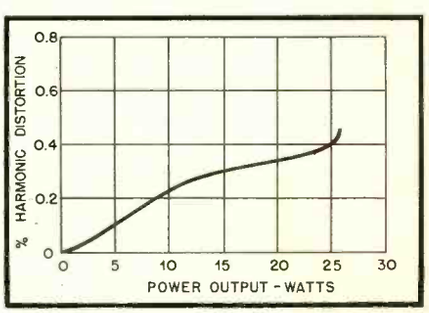


Fig. 3. Harmonic distortion is less than 0.4 per cent at the related output of 20 watts into a 16-ohm speaker. Intermodulation measurements would mean little since there are no frequency-sensitive nonlinear elements in the design.

frequency. Thus the 40 db of feedback remains at that value over the entire usable frequency range and satisfactorily reduces the distortion without regard to the frequencies involved. Even if the distortion in the amplifier without feedback were as high as 10 per cent, the 40-db figure, corresponding to a voltage ratio of 100 to one, would reduce this to 0.1 per cent.

While dealing with the tested results it is worthwhile to mention the subject of intermodulation distortion. IM is a very good and rapid means of evaluating distortion in an amplifier. It is, however, at its greatest value in testing systems where there is apt to be a marked dissimilarity in the nonlinear performance of the amplifier at the particular pair of frequencies used in the test. In an amplifier such as this where there is no frequency-sensitive distortion characteristic, IM testing would yield little to the total fund of information.

The efficiency with which a 16-ohm loudspeaker may be driven directly to produce these large power outputs is due not only to the extremely high perveance of the output tubes but also to operation aproaching class B. Sufficient quiescent current flows in each tube to ensure good small-signal linearity. That is, the operating bias is sufficiently low to ensure that the no-signal operating point is outside the curved region of the tube characteristic near plate-current cutoff. The resulting efficiency is about the same as a transformer-type class-A amplifier.

The square-wave performance of an amplifier is an indication of its ability to reproduce signals of a transient nature. The low-frequency square-wave response is a measure of the ability to reproduce extremely low frequencies. The amount of "droop" in the square-wave response is the important feature in this respect. A negligible droop at a particular square-wave frequency means that the amplifier will reproduce well down to frequencies which are only a fraction of the fundamental. The loudspeaker damping, however, will probably be the ultimate factor in low-frequency transient performance. While it is impossible to secure unlimited amounts of damping through reduction of the output impedance of the amplifier, it is important that this internal impedance be at least several times lower than the speaker's nominal impedance. Reductions of amplifier internal impedance beyond this point are not necessary but can do no harm. The internal impedance of this amplifier, due to the large amount of feedback, is only a fraction of an ohm. This provides excellent electrical damping.

The high-frequency square-wave performance is a good indication, not only of transient response, but also of the stability of the feedback system. A tendency towards instability (not necessarily oscillation) will manifest itself as a decaying train of oscillations following the rapid rise and fall of the square wave. Of course, if these oscillating overshoots do not decay or die out, the system will oscillate continuously. It is important to have ample stability in the feedback system to prevent any form of "ringing" or overshoot on a rapidly rising square wave. The actual rise time of the square wave itself in the output is largely a measure of the high-frequency response.

Several square-wave frequencies are shown in *Fig.* 4. Although the highest frequency shown (50 kc) is only of academic interest, it was included to indicate that the performance was not greatly deteriorated at a high frequency ordinarily used to test video amplifiers.

The extremely light weight and small size as well as the low cost of this amplifier stem principally from the absence of heavy and costly components. The only items of major expense are the tubes, the four selenium rectifiers, and the two large electrolytic capacitors. The remaining components are small resistors and capacitors of the sort encountered in most amplifiers. The three output tubes are considerably more expensive than the normal receiving type, but are still reasonably priced. The other tubes are of widely used variety and inexpensive. Only two of the selenium rectifiers are the 500-ma type, while the other two are the small 75-ma variety. The total cost, computed from the catalog of a large parts supplier, is approximately the same as that of a single high-quality output transformer of the type originally designed for a currently popular amplifier.

The hum level in this amplifier is

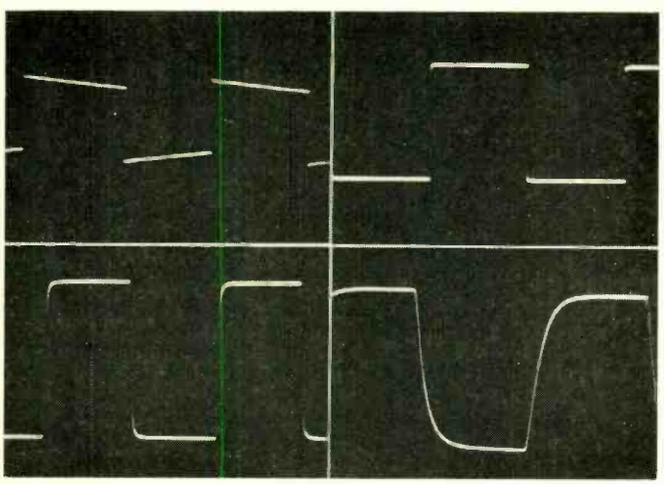


Fig. 4. These photos of oscilloscope traces show square-wave response at four frequencies—top row, left to right, 20 and 1000 cps; bottom row, 10,000 and 50,000 cps. Note the unusually short rise time even at 10,000 cps and the complete absence of evidences of instability despite a full 40 db of feedback. Effective output impedance is a fraction of an ohm, eliminating any tendency toward overshoot on transients.

about .02 volt across the load. This is 60 db below the rated power output. This value was found to be exceeded by the extraneous hum of the supplied source material from the preamplifier, which in itself was acceptably low.

The qualitative results of an amplifier are generally the results of listening tests. While it is impossible to attribute specific attributes of good reproduction to particular links in the system merely by listening, some indication of performance may be had by comparative methods. As one would suspect from the features, the way in which this design excels is when handling large amounts of power at low frequencies. Even at moderate listening levels, an exceptional clearness of reproduction was noted on organ music. An RCA LC-1A in its standard studio console phase-inverter cabinet was used for listening tests. It was neither feasible nor desirable to employ anything near the full output of this amplifier with this loudspeaker, but at reasonably high room levels, the low-frequency reproduction seemed exceptionally smooth and realistic. The use of a horn-type low-frequency loudspeaker, which would more efficiently load the cone, would permit the use of higher and more realistic levels of, say, a pipe organ. While this has not been tried, it is thought that here is where the amplifier would excel. Since it is capable of delivering large amounts of low-frequency power, low-frequency signals such as those developed when tuning through an FM signal may cause excessive cone excursions in speakers which are inadequately coupled to the air. If such is the case, the coupling capacitor between the first and second 12AT7's may be reduced to attenuate these effects.

Parts List

Capacitors

1	.05	µf, 600	v. paper
4	0.1	µf, 600	v. paper
2	10	µf, 150	v. electrolytic
2	15	µf, 150	v. electrolytic
3	40	µf, 150	v. electrolytic
2	300	µf, 150	v. electrolytic
3	40	µf, 350	v. electrolytic
2	5	µf, 450	v. electrolytic

Resistors

1-watt

6	100	ohms	
1	680	ohms	
1	1000	ohms	
1	1500	ohms	
1	1800	ohms	
2	10,000	ohms	
1	15,000	ohms	
2	18,000	ohms	
1	33,000	ohms	
1	39,000	ohms	
1	47,000	ohms	
4	56,000	ohms	
1	0.1	meg	
1	0.15	meg	
1	0.27	meg	
3	1.0	meg	
1	1.2	meg	
2	1.5	meg	

2-watt

4	10	ohms	
1	560	ohms	
2	8200	ohms	
1	12,000	ohms	
1	27,000	ohms	

10-watt

1 2500 ohms

20-watt

1 40 ohms
1 10,000-ohm wirewound potentiometer
2 75-ma, 130-volt selenium rectifiers
2 500-ma, 130-volt selenium rectifiers
1 6SN7
2 12AT7's
6 6082's

PATENTS

(from page 4)

The actions of extinguishing and lighting the beam must have the nature of instantaneous switching actions so that the film will be either dense black or quite clear at every instant; any variation in density would add harmonic components to the reproduced sound. This is taken care of by a high amplification factor for V_3 and V_4 (note that they are pentodes) and rectifiers V_5 and V_6. These two rectifiers, properly biased or "delayed," clip the positive and negative pulses of V_3 to standard values, so that the on-off beam signals reaching the c.r. tube grid are all of the same amplitude. The high gain of the tubes makes for quick transition from positive to negative, giving steep sides to the switching pulses, with resulting switch-type action.

This invention is much simpler than the length of the foregoing explanation might at first indicate. It does two very important jobs in such a way as to do away with moving parts. First, it gives variable-area recording without any variation of density, which would take place if the beam were continuously illuminated and the deflection excursion controlled. Second, it makes possible recording to a lower limit of zero cps and an upper limit determined only by the shortness of persistence of the c.r. tube phosphor, far exceeding in any case that common in motion pictures today, with an amplitude and frequency linearity which can probably not be achieved by anything of an electromechanical nature.

Copies of this and other U. S. patents can be obtained for 25 cents each from the Commissioner of Patents, Washington 25, D. C.

Employment Register

Personnel may be listed here at no charge to industry or to members of the Audio Engineering Society. For insertion in this column, brief announcements should be sent to Chairman, Employment Register Committee, P. O. Box 629, Mineola, N. Y. before the fifth of the month preceding the date of issue.

★ **Positions Open** ● **Positions Wanted**

★ **Audio Design Engineer**—Young man, married or single, with some experience in electrical and mechanical design of amplifiers, consoles, relay switching, and similar broadcast equipment. Much of the time would be spent on new development and on custom engineering for specific requirements. Requisite amount of paper work demands good attention to detail. Degree desirable but not necessary. Position is permanent, and advancement depends upon effort and results. Starting salary around $5000. Reply, giving full particulars regarding experience and education, to Box 601, AUDIO.

● Engineer, E.E.—With 15 years' experience in development of handsets and 5 years' experience in the physics of precious metals, representing more than 75% of his experience thus far, seeks appropriate development, research, or sales position in New York Metropolitan Area. Write Box 602, AUDIO.

AUDIO ETC.

(*from page 49*)

Again, an outsider is really in no position to judge—I merely present the problem as an important one. I once used a soap-based material and judged after awhile that it really was gumming things up. I am aware that the kerosene-like oil base of some liquids evaporates quickly—but might leave an undesirable residue along with the desirable agents. All of which sounds very unpleasant and may discourage you no end —until you think, as I do, of the alternative, as of now. *Anything* is better than a charged-up record plastered with clinging grit! Most products are a lot better than that, limitations or no. Let's not lose sight of the forest for the trees, throw out the baby with the bath, jump from the frying pan into the fire, *et al.*

The Canby Treatment

What am I using? Alternatively two products at the moment and, so far, I haven't had the nerve to mix them on one record. *Record Spray,* in a spray can, has one positive and satisfying property; it deposits a silicone lubricant which definitely stays liquid and unchanged, in an extremely thin layer. It clearly does lubricate—if lubrication is necessary—and it clearly is not going to harden or gum up. Silicones are well known elsewhere by now for these properties. Whether Record Spray helps with static I'm not so sure; the claims are, to say the least, modest—"reduces cause of static." Also ambiguous; I honestly don't know what that implies. But note that the instructions suggest that after the dust and lint are "wet down" by Record Spray you should clean the stylus carefully, especially at first. Agreed, definitely.

For most of my work with exposed records I've been using an old standby, *Walco Stati-Clean,* for some time. Not because it is the best by test—I haven't run any elimination contests—but because it does a job which is useful. The spray can version seems to me clumsy and wasteful. Too much liquid is sprayed, tending to leave oily blobs that must be wiped over. The accompanying spray perfume is not exactly bewitching either. But the plain little bottles, non-spray, suit me fine and I've devised a private aplication method that gets the dirt off neatly without grinding it into the grooves. It's applicable to any other similar liquid treatment:

The Slanted Forefinger

Put the record on the table and revolve at 78 rpm. Drape your forefinger with a soft cloth and apply a drop of liquid to the end. In order to lift the dirt off the record as it is picked up, lean or roll your extended finger as far as you can sidewise against the direction of turn, towards "upstream", normally on your right, and apply the wet end to the record's outer edge. As you move your finger slowly towards the center, spiralling on a thin streak of liquids, gradually rotate it to the extreme opposite slant, lifting the dirt off the record as it piles against the cloth. Take a clean spot on the cloth and run your finger back again to the outside edge to complete the job, then flip and do the other side. (Always treat both sides.)

Why from outer edge to inside? Because then the cloth hits the faster moving outer portion when it is wettest with fluid, making for an even distribution. You can allow fifteen seconds a side, which is quick enough for anybody.

Though Stati-Clean does leave somewhat of a "smeary" effect to the eye on the disc. I find no audible adverse effect upon the recorded sound. I've tested this directly by aplying a single streak across a record, no change in sound quality being in any way audible as the streak passed under the stylus. Static definitely departs with treatment and stays away as long as I've had the records around so far. The surface hash noise is very noticeably lowered after application to a dirty static-charged record. I have no evidence so far of any adverse change in the material over longer periods of time.

All this of course is strictly a report on practical home experience and observation, in normal use. Take it for what it may be worth to you.

FM NETWORKS

(*from page 21*)

net treble boost at 10,000 cycles for various R-C time constants, assuming the transmitter to be using the required frequency characteristic. The table indicates that appreciable deviation from flat output may be expected when the time constant is less than 52 microseconds, using the criterion that deviations below 3 db are likely to escape notice.

TABLE 1

De-emphasis at 10,000 cps for Various R-C Time Constants

R-C Time Constant In Microseconds	De-emphasis at 10,000 cps	Net FM Treble Boost At 10,000 cps
10	1.45	12.21
20	4.11	9.55
30	6.58	7.08
40	8.64	5.02
50	10.35	3.31
51.9	10.66	3.00
60	11.82	1.84
70	13.08	.58
75	13.66	.00

Based on 75-microsecond (13.66 db at 10,000 cps) pre-emphasis by the FM transmitter.

RECORD REVUE

(*from page 42*)

them Scotch (i.e. British—Beethoven didn't know the difference) and some even Russian. The music was strictly a commercial undertaking and some of it sounds that way. This accounts, too, both for the tunes, which are for the most part rather sappy ones, and for the cagey way in which old Beethoven wrote his piano parts so that they are always complete without the flute, in case that instrument (amateur, of course) got lost or there just wasn't any flute around. Strictly commercial but musically a very nice job; the man knew his business.

Business or no, there's some top ranking Beethoven to be heard here, every so often. It's always interesting to listen to the back work of a great man for at any moment he is likely as here to burst forth in spite of himself with some of the real stuff, amid the musical padding. Excellent recording.

MusiQuiz of 100 Famous Themes. Developed and Produced by Bernard Lebow.
Period SPL 600(2)

Games, games. The musical memory contest is as old as music appreciation itself in our schools and though plenty of people enjoy guessing at themes the organization of this kind of thing into systems, examinations, contests, has been carried to preposterous lengths in our educational system. (Did you ever have to memorize themes by doggerel rhymes—"This is the symphoneee, that Schubert wrote and never fin—isshed.?")

What with Scrabble and its imitators, the Game was bound to hit LP, and here it is. 100 "excerpts," each and every one gracefully faded out just as it begins to hit its musical stride. Tally sheets, answers, papers to cut up, columns of directions, even a way to play "solitaire"—and of course, scoring methods.

As to whether the Game is fun, you can make up your own mind. I enjoy guessing as much as the next guy, but I've sorta grown too old to play around with scoring and all that stuff. Kid's business, I'd say. But what I really can't take is the chopping off of every piece just as I begin to rise to it, so to speak. A deadly, murderous treatment of music that was composed to be played whole, not in ripped-off chunks.

Of the 100 selections here excerpted, some seventeen are from complete Period label recordings, regularly available. That leaves eighty-odd selections completely unidentified, which as far as I'm concerned induces a feeling of decided uneasiness. From where? By whose permission? I couldn't say and quite possibly, all may be well. In any case, you will hear a variety of recorded sounds, some of which say, to my ear, "dubbed from disc;" in one overture there is a full-blooded cough that speaks volumes anent a large assisting audience in a big hall. Radio broadcast? Who knows.

Speaking generally, I must say that I am increasingly uneasy each time I receive an LP record with uidentified music on it, or music attributed to such orchestras as "State Symphony" or other evident euphemism. I am uneasy because there is no positive way for me to know (or you) just what sort of arrangement has been made for the publication of said music in recorded form, and—since I know very well the ease with which recorded music can now be taken from tapes, films, discs, lines, broadcasts, air checks, all quickly and easily copied and edited ad lib, it is only too easy to assume that a record with doubtfully identified music is by that fact, of doubtful ancestry. I am especially suspicious when the price is low, as in numerous widely advertised new "Record Club" series now available.

Sometimes we can be quickly reassured, as in the case of RCA Victor's Camden line of low priced LPs. Under various pseudonyms, this label features reissues of the company's major items in the old 78-r.p.m. catalogue. The intention is frankly competitive of course, but the music is easily identified and there is no intent to deceive —most of the recordings will be recognized quickly as familiar items from the past. But in other cases—well, I just keep wondering.

It would be nice if we could collect some solid reassurances from the companies involved, including the present one, Period, and we will be glad to publish any such reassurances of the sort that may be submitted to us, as a service both to readers and to the companies themselves. As I say, all may be well. But I'd just like to know it, definitely, and will feel a lot better when I do. Wouldn't you?

Loring Nichols and His Band.
Audiophile AP 7,8 (78 mg.)

These two 12-inch 78 microgrooves are clean, but the miked sound is somewhat dead and flat acoustically speaking. The music—if I dare get in up to my neck—is a mild, less blatant sort of jazz, either more or less to your taste according to the way you feel.

Howard Rumsey's Lighthouse All-Stars, vol. 4.
Contemporary C 2510

This is modern and experimental jazz, duets for oboe and flute with assorted backing. Interesting but somewhat diffident, a bit on the intellectual side to my ear though, admittedly, the oboe and flute are not exactly robust instruments in the jazz family. But compared to the old Alec Wilder group (with Mitch Miller, oboe) this music while more complex and contrapuntal and more in the "modern jazz" style of brief motives, doesn't have the musicality, the emotional directness of the Wilder music. So I feel anyhow, for what it's worth. Excellent hi-fi recording, unusually heavy bass at the recommended NARTB setting.

TRY THESE FOR SOUND

Vaughan Williams: The Wasps; Old King Cole. Philharm. Prom. Orch., Boult.
Westm. WL 5228

Walton: Belshazzar's Feast. London Phil. Choir, Philh. Prom. Orch., Boult.
Westm. WL 5248

Westminster's new British hi-fi sound, big but with ultra-close-up brilliance in the high instruments. Exaggerated but exciting. The choral effects in the Walton are terrific. (see last month)

Handel: The Messiah, Complete. London Symph., Philh. Choir, solos, Scherchen.
Westm WAL 308 (4)

Indubitably the first super-hi-fi Messiah, with sound similar to the above, very close but nicely live. The interpretation, following the original scoring, is highly personal and even eccentric but this doesn't bother the fi at all.

Stravinsky: Rite of Spring. Minneapolis Symph., Dorati. **Mercury MG 50030.**

An oddly dead acoustics, almost studio-like, but not at all bad for the music, bringing out "hi-fi" details relentlessly—and it is a relentless, driving interpretation too.

Liszt: Piano Concerti #1, #2, Frugoni; Pro Music Symph., Swarowsky. **Vox PL 8390.**

Superbly huge sound, both orchestra and piano, perfectly suited to these spectacular high-Romantic works. One of the top piano-and-orchestra recordings yet as to miking.

Tchaikowsky: Romeo and Juliet. Liszt, Hungaria. Bamberg Symphony, Leitner
Decca DL 7544 10"

Two more big pieces recorded with more than Decca's usual somewhat modest sound—for a good effect. Decca surfaces remain often substandard.

Modern French Music (Milhaud, Ravel, Satie, Honegger). Concert Arts Orch., Golschmann. **Cap. P-8244**

Relative to most newer orchestral sounds this U.S. made Capitol is on the dead side and the "size" is smallish; other than this it is a first rate record and the music is all easily enjoyable.

American Life (Orch. pieces by North, Siegmeister, Jacobi, Antheil, Cowell). Vienna Philharmonia, F. F. Ch. Adler. **SPA-47**

Light big-orch. stuff—Saturday Night at the Firehouse," etc.—folksy American, played surprisingly well by the Austrian ensemble, in a thoroughly American way. Is the "Philharmonia" a pseudonymn? Nice hi-fi sounds.

Beethoven: Symphony #6. Amst. Concertgebouw, Kleiber. **London LL-916**

About the best current Sixth in interpretation and a typical ffrr product—big, golden liveness with that familiar sharp, close-to edge to the strings.

Britten: Young Person's Guide to the Orchestra; Sea Interludes from "Peter Grimes". Amst. Concertgebouw, Van Beinum. **London LL-917.**

Same sound as above; this music could stand a drier, closer pickup especially from the percussion and brass, which are more distant for the ear than the ever-close ffrr strings. A superb piece for instrumental effects.

Rimsky-Korsakov: Cap. Espagnol, Fl. of Bumble-Bee, Dance of Tumblers. Tchaikowsk: Cap. Italien; And. Cantabile. Phila Orch., Ormandy. **Col. ML 4856.**

A new pot-pourri in the now typical Philadelphia sound, huge, handsome, heavy, the strings (unlike London's ffrr) at some distance and honey-smooth, the percussion relatively close.

Mendelssohn: Symphony #5 ("Reformation"). Beethoven: Symphony #8. L.A. Philh. Wallenstein. **Decca DL 9726**

Marked "especially recommended for hi-fi fans," the new Los Angeles series of which this one is a part do not seem to merit the designation in the usual sense though both music and recording are certainly of interest. To begin with, the works themselves are mostly of a sort that is of slight hi-fi interest as to "sound effects," notably the two early Schubert Symphonies, the fourth and fifth, on another of the series. Mendelssohn and Beethoven are only somewhat more hi-fi-genic. (Of course I'd rather hear this music than a dozen of the super-hi-fi pieces that are most popular with the fans, but that's not the point.)

To add to this, the recorded sound is on the dead side in the familiar West Coast manner, the effect somewhat lacklustre compared to the gorgeous exaggerations of competition. Moreover, the LP sides are very long and the grooves consequently cut at a lower than usual level, where most "hi-fi" show-off discs are cut loud. Inner grooves verge upon distortion. With surfaces that are not the very best, this leads to some noise. All of which adds up to the proposition that these discs might seem not to be of especial interest to the hi-fi fan—though to anybody else they are well worth a listen. Funny that Decca should enter the hi-fi game so anti-climactically, but I'm not so sure I don't approve, sort of secretly. Nice records.

CLASSIFIED

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FM ANTENNAS. Standard and custom designs. Installation accessories. Wholesale Supply Co., Lunenburg 10, Mass.

CAREER OPPORTUNITY: Wanted—experienced Sound Sales Engineer to begin work as assistant to division manager in fast growing organization pre-eminent in High Fidelity industry and specializing in manufacture of electro-acoustc products. Position requires ability to answer technical correspondence, participate in designs to meet consumer requirements, assist in conduct of trade shows, write some copy, and gradually to assume administrative duties. Some travel. Degree desirable but not necessary if backed by experience in associated industry. Requires moving to suburb of South Bend, 90 miles east of Chicago. Contact Souther, Electro-Voice, Inc., Buchanan, Michigan.

WILL PAY CASH IN FULL for your Ampex 400 single-case portable half-track tape recorder. State hours of use, condition, and where it can be seen. Peter J. Helffrich, Wescoesville, R#1, Pennsylvania.

WANTED by campus radio station—broadcast audio console. WESU, Wesleyan University, Middletown, Conn.

SELL Altec Lansing forty-watt theatre speaker, professional phono, tape recorder, associated equipment. Oscar Taylor, 4448 Kingswell Ave., Los Angeles, Calif.

SELL: Amp. Corp. of Am. amplifier 100DC, Stephens 800-cps crossover. Both in perfect condition. Box CK-1 AUDIO.

WANTED—Craftsmen RC-10, C-10, C-800, or Fisher 50-R FM/AM tuner in good condition. H. C. Reed, 1668 Hiawatha, Grand Rapids 6, Mich.

WILLIAMSON BUILDERS—Precision resistors, capacitors, chokes, transformers for that "super" job. Nicely Associates, Kenton, Ohio.

SPECIAL on tape recorders and tape. Brush "Soundmirror" tape recorder Model BK-442, brand new (sealed carton) $129.75; regularly priced at $259.50. Brush 1200-ft. plastic tape on 7-in. metal reels, $2.50 each; regularly priced at $5.50. Asco Sound Corp., 117 West 45th St., New York 36, N. Y.

MAGNECORD PT63 in cases, $500; extension arms $25; three-channel mixer, $40; extra synchronous motor, $25; extra head assembly, $35; Weston VU meter, $25; M. E. Boyd, 903 Salmon Drive, Dallas, Texas.

SELLING OUT: Perfect condition. Complete Brociner audio control center consisting of A100 preamplifier-equalizer and CA-2 control amplifier, $65. Hartley 215 speaker, $40. Kelton Diplomat speaker system, $35. T. Hofmann, 90-A Kirkland, Cambridge 38, Mass.

WANTED: Good woofer. Sell 18-in. Cinaudagraph. Box CK-2, AUDIO.

MANUFACTURER'S SALE: 60-watt power amplifier. British KT-66 tubes, Acro Ultra-Linear transformer, lustrous chrome plating, extra a.c. outlets, newest Williamson Circuitry. At 30-watt price, only $139.50. C.O.D., check, or money order to BALEN ELECTRONICS, 512 E. Thompson St., Philadelphia 25, Pa.

TRADE electronic equipment for new Hi-Fi components at Audio Laboratories, 2111 Camden Avenue, Los Angeles, California.

ALTEC 600B, $30; 603B in Stephens cabinet, $80. RCA MI-4875-G pickup and equalizer, $100. Presto 92-A amplifier, $250. Pilot T-601 FM tuner, $25. Robinson 16-in. arm, $12. RECO-ART, 1305 Market St., Philadelphia 7, Pa.

PROFESSIONAL DIRECTORY

POSITION WANTED

Young Cuban audio engineer, with working experience in all mixing and recording techniques used in radio, television, film, and tape. Also tape editing, montages in multiple recordings, etc. Seeks employment in U. S. of South American recording studio or broadcasting station. Complete resume in Spanish or English sent on request.

Reply to Box 603, AUDIO

Industry People...

Paul Sampson and **Arthur Adelman**, sons and business associates of **Harvey E. Sampson**, president of Harvey Radio Company, and **Leon Adelman**, prominent New York factory representative, became members of U. S. Armed Forces in June . . . **S. Klein**, of Audax, Paris, inventor, and **A. E. Falkus** of The Plessey Company, English manufacturer of the French Ionophone speaker, here to give the speaker its first American showing—plans are to license its manufacture in this country.

Dick Shahin, formerly of Sun Radio and Eelectronics Corporation, is newest addition to audio sales staff of Asco Sound Corporation . . . **Elton Nachman**, another Sun alumnus, has opened a New York office for Cinema Engineering Corporation . . . **Bob Paulson**, New York district audio sales manager for The Ampex Corporation, doing a tremendous job of stirring up enthusiasm for the new Ampex Model 600 portable tape recorder—reports that orders on hand exceed most optimistic forecasts.

Frank Robbins and **Bill Joseph**, co-inventors of the R-J speaker enclosure, planning legal moves against infringers—actions will probably include sales outlets as well as manufacturers . . . **Paul Marantz**, manufacturer of the Marantz preamp-equalizer, stepping up facilities to meet unforeseen demand . . . **John S. Boyers**, former president of Magnecord, Inc., has been appointed chief engineer of the Magnetic Memory Devices Division of The National Company, Inc., which has announced impending entry into the magnetic recording field. **Richard McQueen**, also formerly with Magnecord, is National's new advertising and promotion manager.

George W. Bailey, executive secretary of the I. R. E., has been chosen president of the Armed Forces Communication Association—other new officers include **W. W. (Wally) Watts**, veepee of RCA, and Rear Admiral **E. W. Stone**, president of American Cable and Radio Company, both of whom were elected to AFCA vice-presidencies . . . Dr. Burton Browne, head of Burton Browne Advertising, Chicago, announces promotion of **James P. Cody** to agency vice-presidency . . . **Henry Mandler, Henry Guggenheim** and **David Young** have joined the sales staff of New York's Hudson Radio and Television Corporation—will report to **Ray Bellinson**, manager of Hudson's Sound department.

Ralph C. Seiler has been appointed assistant sales manager for Triad Transformer Corporation—will concentrate on giving technical assistance to jobber and dealer service men . . . Executive realignment at Brook Electronics, Inc., finds **Max Baume** promoted to general manager with **Evelyn J. Horne** becoming advertising manager. New additions to the Brook engineering staff include **Harold J. Krollman** who has joined the company as production manager, and **Monroe Goffman**, project engineer.

Dr. Wilfred E. Campbell, formerly of Bell Telephone Laboratories, Inc., is new director of chemicophysical research for The Brush Laboratories Company . . . **Nat Welch** has been named vice-president in charge of sales by ORRadio Industries, Inc., manufacturers of Irish brand magnetic recording tape . . . **Laurence B. Lueck**, formerly with magnetic products division of Minnesota Mining and Manufacturing Company, appointed vice-president and general manager of the E. M. C. Recordings Corporation, St. Paul, Minn.,—many basic patents in magnetic tape construction have been issued in his name.

Industry Notes...

Allmetal Screw Products Co., Inc., inaugurates new home in neighboring village of Garden City with gala party. Over 1200 guests merrymaking from 4:00 p.m. to ? Company's products include nuts, bolts, screws, washers, etc. in stainless steel, titanium, molybdenum, nickel, and most any other metal.

Tung-Sol Electric Inc. celebrated "Fifty Years of Progress" at a dinner given on May 11 at the Military Park Hotel, Newark, N. J., with almost 300 in attendance. Guests received LIFE-like **"Life at Tung Sol"** which detailed history of company, portrayed interesting incidents in employee life, described unique tube and lamp-making machinery. AUDIO's best wishes for a second fifty years as successful as the first.

ADVERTISING INDEX

Compare

Collaro

FULLY AUTOMATIC

3-SPEED RECORD CHANGERS

for 7, 10 and 12 inch Records

WITH ANY RECORD CHANGERS IN THE FIELD REGARDLESS OF PRICE

for RUMBLE FLUTTER and WOW

These are the tests of high fidelity . . . not claims, not boasts. That's why Collaro, confident of the results, invites you to compare.

Collaro has developed an entirely new turntable drive mechanism, and thus has succeeded in achieving performance considered impossible in earlier record changer designs. Rumble, wow, and flutter are virtually eliminated. Mechanical operation is smooth . . . gentle to the record and to the delicate stylus.

And while you are comparing these, look at the construction. Note that there are no intermediate drive wheels employed and no belts to slip or to replace. Rotate the turntable and observe how freely it spins. This is the combined result of dynamic balance and ball-bearing suspension. Now lift the turntable. It's heavy . . . intentionally weighted to give flywheel action for constant, steady rotation. You'll notice that the turntable is rubber covered. Important... because unlike other materials in use this surface does not shed; and dust and grit particles cannot become imbedded. On the underside is a 4-pole motor with self-aligning oilite bearings for silent steady power.

You will also discover that the Collaro changers are absolutely jam-proof; that they automatically shut off at the end of the last record; that the tone arm is ball-bearing mounted, and tracks accurately with as little as 3 gram stylus pressure.

Remember these features . . . look for them, compare them . . . and you will agree that Collaro really makes *high fidelity record changers for high fidelity record reproduction.*

	LIST PRICE
Model 3/532 Intermixes 10 and 12 inch records	$65.00
Model 3/531 Non-intermix	54.50
Model 3/534 Single record player	33.60

Available at Radio Parts Jobbers, Distributors, and Hi-Fi Dealers.

Write for complete details to: Dept. JF-1

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Revolutionary LINEAR STANDARD AMPLIFIER

NEW HEIGHT OF FIDELITY
20 WATTS
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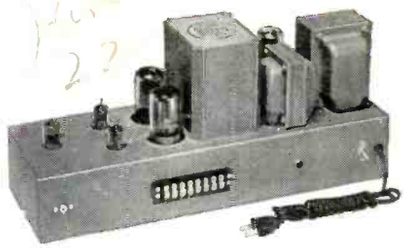
LINEAR STANDARD MLF AMPLIFIER



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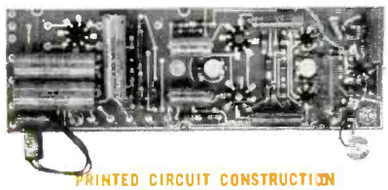
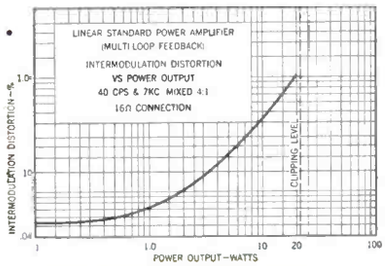
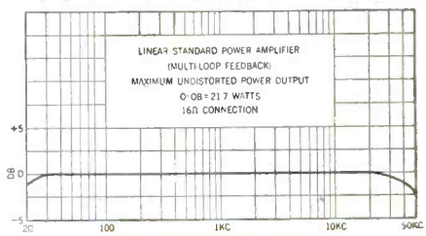


PRINTED CIRCUIT CONSTRUCTION

SUITED TO 7" RACK PANEL MOUNTING



INTERMODULATION DISTORTION CURVE



FREQUENCY RESPONSE CURVE

The Linear Standard amplifier climaxes a project assigned to our audio engineering group a year ago. The problem was, why does a Williamson circuit amplifier which tests beautifully in the laboratory seem to have considerable distortion in actual use? It took a year to fully determine the nature and cause of these distortions and the positive corrective measures. This new amplifier not only provides for full frequency response over the audio range but, in addition, sets a new standard for minimum transient distortion.

An inherent weakness of the Williamson circuit lies in the fact that its negative feedback becomes positive at subsonic and ultrasonic frequencies. The resultant instability in use lends to parasitic oscillation at the high end and large subaudio cone excursions both of which produce substantial distortions. The Linear Standard Amplifier uses Multiple Loop Feedback and network stabilization to completely eliminate these instabilities. The oscillograms below show comparative performance. The flat frequency response and extremely low intermodulation distortion provided by 36 db feedback, are self evident from the curves shown.

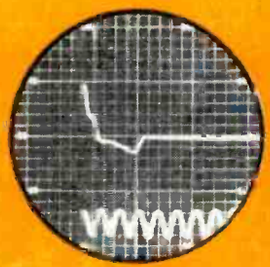
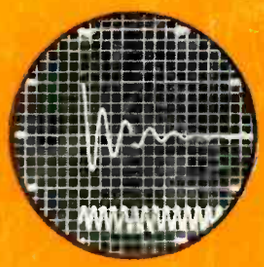
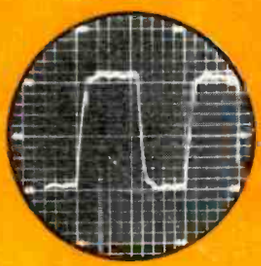
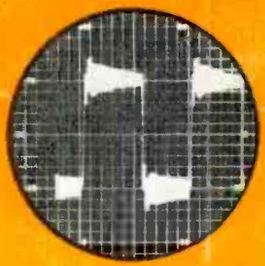
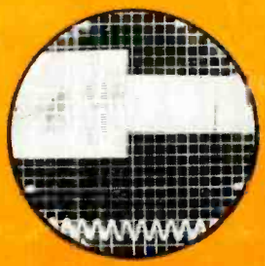
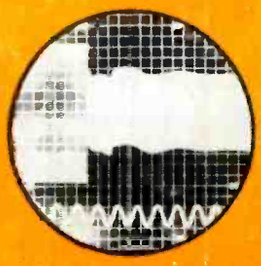
In addition to providing an ideal amplifier electrically, considerable thought was given to its physical form. A number of points were considered extremely important: (1) Size should be minimum (power and audio on one chassis). (2) Each kit must have identical characteristics to lab model. (3) Rugged, reliable, structure is essential.

This resulted in a rather unique construction employing a printed circuit panel as large as the chassis with virtually all components pre-assembled and wired. The result is that each kit, which comes complete, including tubes and cover, can be fully pretested before shipment. Additional wiring involves only the connection of 17 leads to screw terminals for completion.

LINEAR STANDARD TYPE MLF AMPLIFIER SPECIFICATIONS . . .

Rated Power Output:	20 Watts
Intermodulation Distortion:	.07%-1W, 1%-20W
Frequency Response (controlled):	1 db 20 to 20,000 cycles
Hum & Noise Level:	80 db below rated output
Feedback:	36 db
Output impedances (not critical):	4, 8, 16 also 2, 5, 10, 20, 30 ohms
Tubes:	1-12AX7, 2-6AU6, 2-5881, 1-5V4G
Dimensions & Weight:	5¼" x 8" x 17⅛", 24 lbs.
Net Price:	$108.00

COMPARATIVE PERFORMANCE

	LINEAR STANDARD	WILLIAMSON TYPE
Step function (low frequency) transient stability.		
High frequency oscillation stability. Average speaker wiring capacity.		
Overload recovery transients.		

United Transformer Co.
150 VARICK STREET NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"