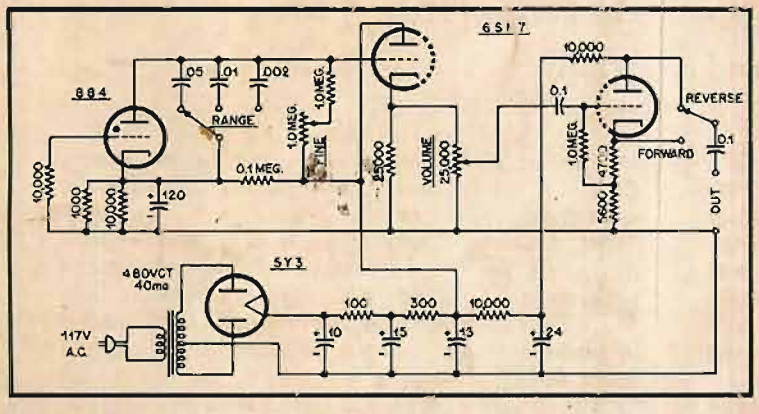
OCTOBER, 1954

50c

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION



The advantages of square-wave testing have been described by many authors, but the use of sawtooth waves is less known. A simple generator, such as the one above, will provide a signal source which can be fed to an amplifier and the output can be viewed on an oscilloscope. This author tells how the sawtooth signal can be interpreted to give reliable data on both high- and low-frequency performance. *See* Testing with White Sound, *page 41*

LABORATORY REFERENCE STANDARD LOUDSPEAKER SYSTEM

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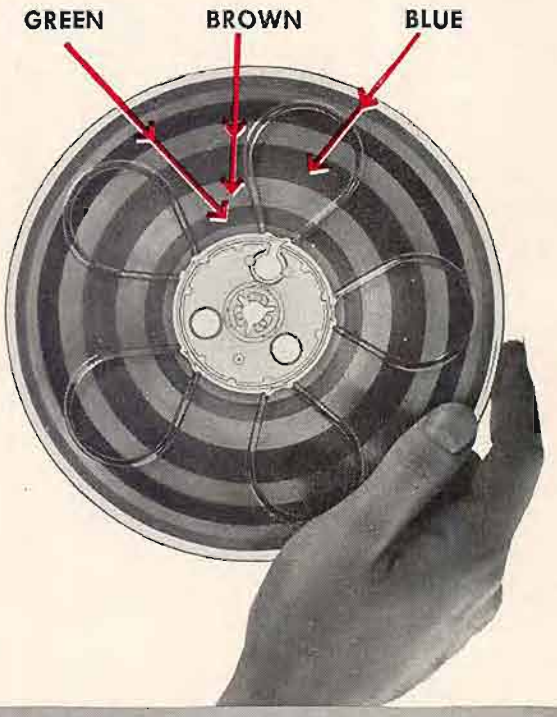

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OCTOBER, 1954 VOL. 38, No. 10
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

Audio Patents—*Richard H. Dorf* 2
New Literature 6
Letters 8
London Letter—*Richard Arbib* 14
Editor's Report 22
Revolutionary Loudspeaker and Enclosure—*Edgar M. Villchur* 25
Hi-Fi-manship at the Fair—*Charles Sinclair* 28
Feedback Filters for Two-Channel Amplifiers—*N. H. Crowhurst* 32
A Laboratory Reference Standard Loudspeaker System—*Daniel J. Plach and Philip B. Williams* 34
The Employer's Rights in Employees' Inventions—*Albert Woodruff Gray* 37
A Transistor Phonograph Preamplifier for Magnetic Pickups—*Basil T. Barber* 38
Testing with White Sound—*Richard C. Hitchcock* 41
Equipment Report—*Crestwood 401 Tape Recorder and 402 Power Amplifier and Speaker combination—Fairchild 280 Transcription Arm—Laboratory of Electronic Engineering "Catenoid" Loudspeaker—Pilotone AF-860 AM-FM Tuner* 50
AES Convention Program 53
Record Revue—*Edward Tatnall Canby* 58
About Music—*Harold Lawrence* 64
Audio Fair Exhibitors 66
New Products 80
Audio ETC—*Edward Tatnall Canby* 86
Industry Notes and People 102
Advertising Index 104

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AUDIO PATENTS

RICHARD H. DORF*

FOR MANY YEARS designers of electronic organs have had fond hopes that neon lamps operating as relaxation oscillators could be used as tone generators in a commercial instrument. To date no manufacturer has produced an instrument of this kind. A primary reason has been the nonuniformity of the firing voltages of commercially available lamps. A secondary reason, somewhat depending on the first, is that when only the lamps—no tubes or transformers—are used in frequency-divider chains, synchronizing any lamp by one of a frequency higher than double its own simply is not reliable; sync-circuit components must have too small tolerances and the whole thing may get of sync simply due to aging. It is also difficult to prevent a tube which is operating at frequency *2f* and giving sync signal to that operating at frequency *f* from also being synchronized in the reverse direction by the lower-frequency oscillator. This "feedback" tends to reduce stability since it does not give complete control to the high-frequency master oscillator. Neon oscillators are rather touchy and not a great deal of circuitry is possible to make for one-way sync transmission.

A helping hand may have been given to designers by John Bick of Moorestown, N. J., assignor to RCA of Patent No. 2,680,198. In the patent, Mr. Bick discloses a frequency-divider chain containing two neon lamps in each stage. Each stage is synchronized only by the stage operating at twice its frequency and there is no sync feedback. Under these conditions neon oscillators can be quite stable and standard-tolerance components can be used. This writer has some experience along that line, having used neon lamps as frequency dividers (but with vacuum tubes between stages for isolation) in his Electron organ, described in the new book "Electronic Musical Instrument."[1]

The way the new invention works is illustrated by the schematic diagram of *Fig.* 1. Two neon oscillators, that is, two stages of a frequency-divider chain, are shown. Each consists of two neon lamps (N_1 and N_2 in the upper-frequency stage), connected to ground through R_2, a small load resistor, and to plus 180 volts through R_1, the timing resistor. The timing capacitor is C_3. The circuit as so far described will be recognized as an ordinary relaxation oscillator. When B-voltage is applied, C_3 charges through R_1. When the voltage is sufficient across C_3 to reach the combined firing potential of both lamps, they fire. When unfired the lamps are open circuits; when fired their fairly low resistance short-circuits the timing capacitor C_3, discharging it. The waveform produced across C_3 is sawtooth; however, the usual sharp drop to zero after the gradual rise is somewhat slowed due to R_2, which delays the discharge slightly just as R_1 delays the charge to a much greater degree. The "flyback" time of the wave is therefore quite finite rather than being nearly zero as it would be without R_2 (the bottom of N_2 grounded). In *Fig.* 2, (A) shows what the voltage across C_3 looks like. Since current flows through the lamps and R_2 only during the discharge pulse, the voltage across R_2 is as shown in (B) of *Fig.* 2 and it is used for output. Output could, of course, be taken from other points to obtain sawtooth voltage, but all other points are at high impedance or would tend to affect frequency of operation, which is one of the drawbacks of neon oscillators.

A vacuum-tube master oscillator is provided as a stable generator of the topmost frequency to synchronize the neon-divider string. Its output is connected to the junction of the two lamps N_1 and N_2, through a capacitor C_1 which can be adjusted to a value theoretically equal to the stray wiring and socket capacitance C_2 between the lamp junction and ground. This being so, the injected master-oscillator voltage at the neon lamps is just half of the m.o. output.

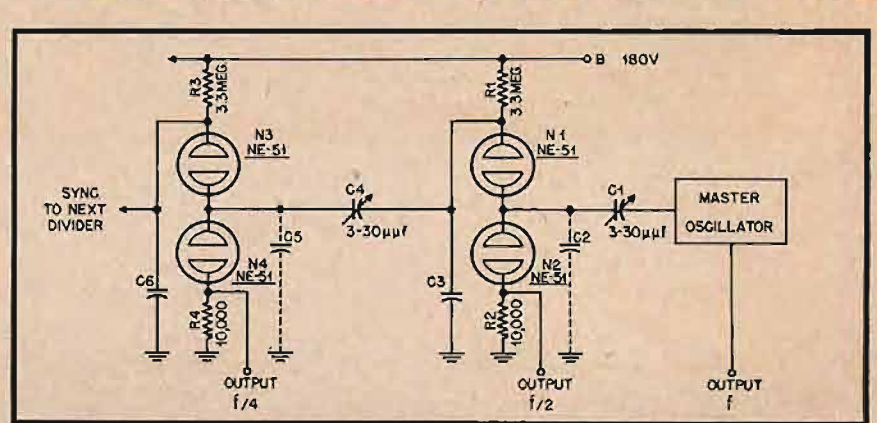

Fig. 1

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

[1] See advertisement, page 98 of this issue.

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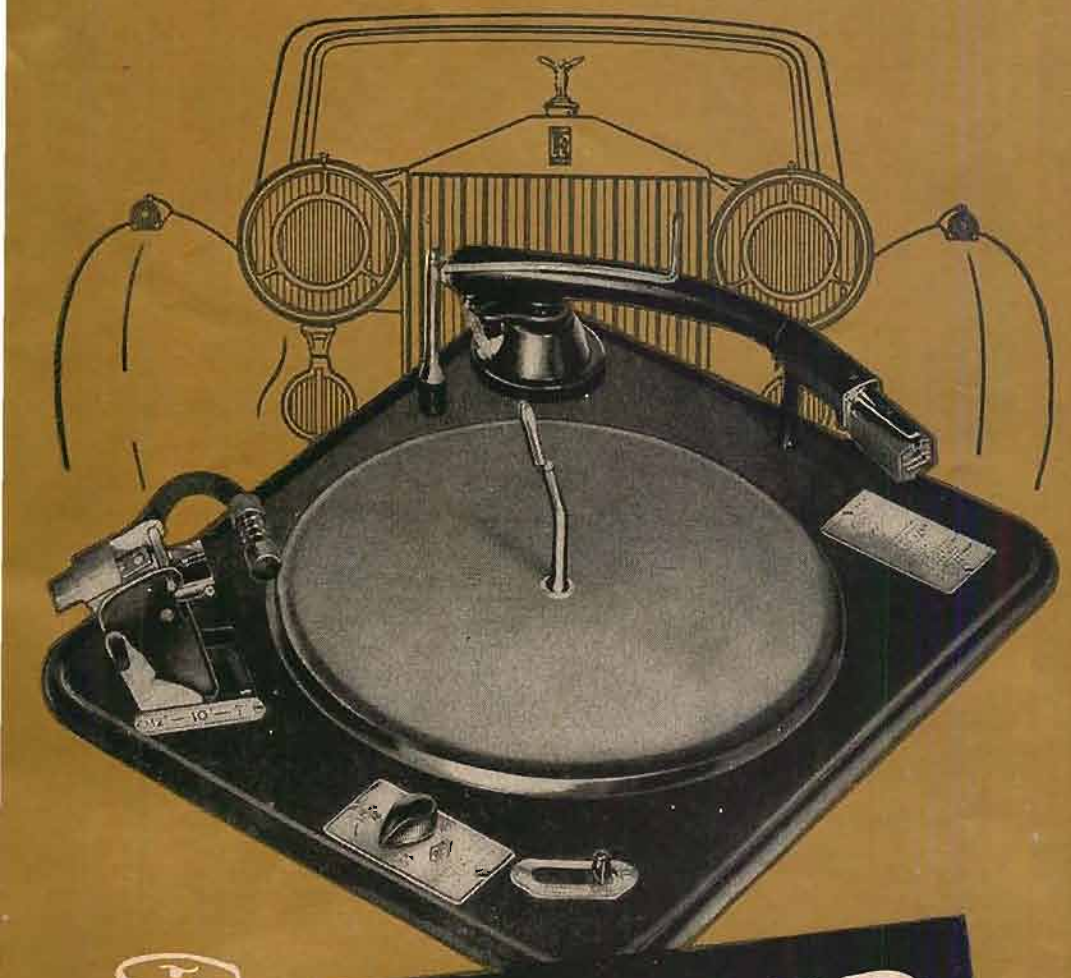

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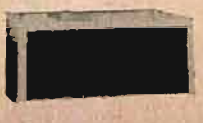

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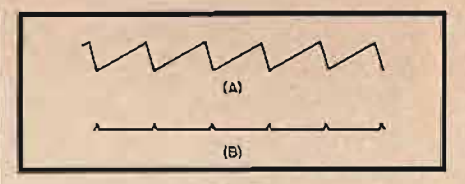


Fig. 2

The operation of the sync circuit is better typified in the next stage, so let us shift the spotlight to the sync connection there. For this purpose, the sawtooth output of the *f*/2 divider is connected to the junction of N_3 and N_4, again through the capacitor network, this time C_1-C_2. The value of C_1-C_2 in series is very small; therefore its being in shunt with timing capacitor C_3 of the first divider has negligible effect. However, because C_1 and C_2 are equal, fully half of the first divider output is impressed on the second divider as sync. Now, when N_3 and N_4 are not glowing, which is the case during their entire cycle except for the discharge pulse, they are effectively open circuits and do not load the first divider in any way, even through the very small C_4. Since the conditions at the lamp junction do not change until the firing time, nothing is fed back to the first divider. When N_3-N_4 do fire, it is because of the coincidence of their nearly being ready to fire because of almost high enough voltage across C_6 plus the presence of a sync pulse from the first divider. At the firing pulse, of course, the sync injection point is almost shorted to ground. However, at the same instant C_3 is being shorted by N_3 and N_4 (which is what produced the sync pulse in the first place). Thus the pulse of the second divider falls on a deaf first divider as it were, and there are no bad results.

Even if the second divider is misadjusted and/or there is some signal at the lamp junctions due to stray coupling, the transfer system between the dividers is one way in nature. Half the first-divider voltage goes to the sync point of the second because of capacitive voltage divider C_1-C_2. But voltage originating at the second divider can go to the first only through a capacitive divider composed of C_1 as a series leg (high reactance) and C_3 as the shunt leg (low reactance), so it can have no appreciable effect.

Only two divider stages are shown but of course as many as are wanted can be used to give the same number of octavely related tones. Typical values for C_3 and its corresponding capacitors down the line are 100 μμf for A-3520 cps, and 200 μμf, 500 μμf, .001, .002, .005, .01, and .02 μf for succeeding dividers in the string. The requirement in actual capacitor selection is, as always in synchronized relaxation oscillators, that the unsynchronized or free-running frequency of each oscillator be slightly lower than the synchronized frequency. In this design timing capacitor tolerance should be wide, perhaps even wide enough to allow use of standard-tolerance, unselected units, since C_3, C_4, and corresponding sync-circuit trimmers can be adjusted after construction to give the right amount of sync to bring operation into line.

A copy of any U. S. patent can be had for a quarter from The Commissioner of Patents, Washington 25, D. C.

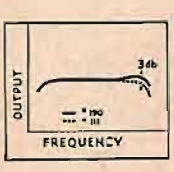
50% more tape on same size reel!

New, thinner magnetic tape cuts time-wasting reel changes!

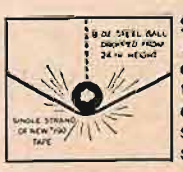
No more stopping for reel change when you're recording longer sports and news events, dramatic productions and musical works. New "Scotch" Brand Extra-Play Magnetic Tape No. 190A reduces time-consuming change-over breaks by giving you 50% more recording time on each reel.

Secret of new "Scotch" Brand's extra playing time is a more potent oxide coating which offers improved frequency response, yet is 50% thinner than many standard tape coatings. A thinner tape backing produces more uniform output—cleaner, crisper tones — while retaining critical strength factors to meet the demands of all professional recording machines.

EXTRA-THIN. 50% thinner, more potent oxide coating. 30% thinner backing permit more 190A tape to be wound on standard reel. One roll of new tape does job of 1½ reels of ordinary tape.



INCREASED FREQUENCY range of new Extra-play tape enables home machines to produce recordings with greater hi fi response than formerly possible with most conventional magnetic tapes.



STRENGTH TO SPARE. New 190A tape stands up under even grueling steel ball drop test. Naturally it's tough enough to withstand severe stresses of sudden machine stops, starts and reverses.

NEW! REG. U.S. PAT. OFF. SCOTCH BRAND Extra Play Magnetic Tape 190A

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NEW LITERATURE

• **Triad Transformer Corporation,** 4055 Redwood Ave., Venice, Calif., lists more than 500 transformers, of which 60 are new items, in its new Catalog TR-54. Featured among the new listings are 11 amplifier kits, a number of power and audio transformers, and two new photo-flash transformers. Copy will be mailed on request.

• **The R. T. Bozak Company,** Stamford, Conn., describes and illustrates crossover networks for the firm's B-302, B-305, and B-310 speaker systems in a new Data Sheet which will be mailed on request. The networks have a slow crossover rate of 6 db/octave, which is permitted by the fact that the drivers used in the multi-speaker systems are all direct-radiating units with equal velocities of sound propagation. The sheet illustrates the networks as sold ready-made by Bozak, and also gives full instructions for those persons who wish to assemble their own.

• **J. W. Miller Company,** 5917 S. Main St., Los Angeles 3, Calif., has published a veritable directory of coils, chokes, transformers, and similar items, in Catalog No. 55, which will be furnished upon request to engineers, purchasing agents, buyers, and company executives. Most of the items listed are carried in stock by leading radio parts distributors throughout the country.

• **Radford Electronics, Ltd.,** 149 Newfoundland Road, Bristol 2, England, introduces a new line of transformers specially designed for the electronics industry in a 6-page brochure which will be mailed on request. An interesting feature of the brochure is its departure from convention in rating high-voltage output. Instead of giving an rms a.c. rating as is usual, Radford lists d.c. output voltage with current, together with the d.c. regulation for a given transformer, tube, and capacitor combination, thus providing the means of determining voltage and current accurately at any load over the transformer's working range.

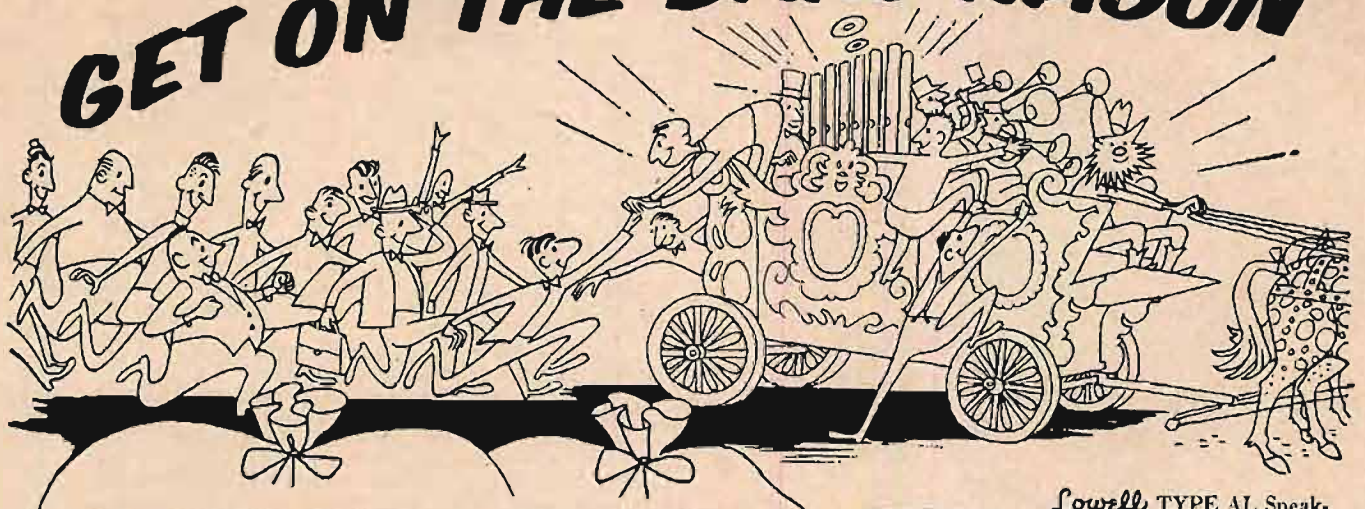
• **Sargent-Rayment Co.,** 1401 Middle Harbor Road, Oakland 20, Calif., has given the title "C'est Magnifique" to a 4-page descriptive folder describing and illustrating the company's new Model SR-808 FM-AM Tuner-Control system. For those who are shopping for such an item, this sheet will be extremely handy, as it is entirely complete in its description of operating characteristics.

• **Burnell & Company, Inc.,** Dept. H, 45 Warburton Ave., Yonkers, N. Y., has aptly applied the title "Rotoroid" to a new technical bulletin which gives full information on a new series of variable toroidal inductors. Rotoroids, as the inductors are known, provide a continuous 3-to-1 maximum-to-minimum inductance range with 180 deg. shaft rotation. Typical Rotoroid applications include tunable audio oscillators, variable phase-shift networks, and adjustable filters. The bulletin will be mailed on request.

• **Romar Plastics, Inc.,** 1317 E. Main St., St. Charles, Ill., has just released Catalog E which covers the company's new line of standard control knobs for electronic equipment. Among the knobs shown are pointers, indicators, and round types in a variety of design treatments. Featured in the catalog are actual-size photographs and full-scale engineering drawings with all essential data to make knob selection easier. Catalog E is available free to designers, production engineers, purchasing agents, and other interested professional personnel.

• **Transitron Electronics Corporation,** Dept. AO, 402 Main St., Melrose, Mass., announces availability of a new line of subminiature glass-enclosed germanium diodes in Bulletin TE1319. Described and illustrated are diodes which offer significant advances in electrical characteristics; an example is the Type T8G which presents over 5 megohms at 100 volts inverse, and under 10 ohms at 1 volt forward. All users of germanium diodes should have these data in their files. Bulletin TE1319 will be mailed in response to all inquiries received.

GET ON THE BANDWAGON



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Many states are considering legislation requiring that sound systems be fireproof in all public buildings for reasons of safety.

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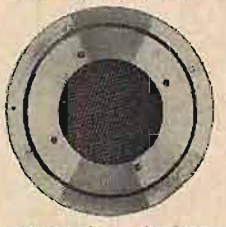

Lowell TYPE RS Speaker Baffles are especially adapted for use where speakers must be recessed in walls or ceilings. Widely used in wired music installations where directional characteristics are needed.

Lowell TYPE M8 Speaker Baffles are designed to match and replace standard acoustical tile block. They provide a completely hidden speaker system that is extremely easy to install and service.

The LOWELL line also includes a complete range of protective speaker enclosures such as the CP Series (for new construction) and the XCP Series (for existing construction). Protects speaker from dust or fire and falling mortar and prevents rodents from damaging speaker cone. Both types are also made in double-face and adjustable face models.

LOWELL, originators of low level sound distribution, manufactures a complete line of directional and non-directional speaker baffles and labor saving mounting accessories. See the LOWELL Section 31a/Lo in Sweets Architectural Design files.

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LETTERS

Tape Standardization

SIR:

After reading Mr. Canby's article in the August issue, I wish to offer the following comments.

The other day I was listening to various units in a local Hi-Fi studio. A (pre)recorded tape was played over a high-quality system consisting of a professional tape machine, an excellent amplifier, and a well known speaker. The reproduction was lousy, and no one seemed to know how to compensate for the recording characteristics.

As a result, I have decided to postpone the purchase of a tape machine until such time—when and if—the various manufacturers agree on some standard similar to the RIAA so commonly used on discs.

I have a friend who by experimentation has developed suitable settings on his good popular-priced recorder, and his tapes play back through my hi-fi set-up with excellent results. He doesn't know just what he is doing as to compensation, but just leaves the control at the one spot. This manufacturer uses a single-knob control that is marked HIGHS on one end and LOWS on the other; to say the least, this type of control is far from ideal.

If you can do anything toward influencing manufacturers of tape equipment and the producers of (pre)recorded tape it will be a great boon to the users—who, by the way, are your subscribers and the life blood of the manufacturers.

HUGH N. MONTGOMERY
541 American Life Bldg.,
Birmingham 3, Ala.

Built-in Speaker Mounting

SIR:

Your readers may be interested to learn of a practical way to construct an almost invisible infinite baffle which meets all the requirements laid down in your August section on LOUDSPEAKERS AND ENCLOSURES, and without necessitating the rather ungainly size and appearance usually associated with this type of enclosure.

My solution is to mount the speaker flush in the center of a wall, so placed that it backs into a closet. The volume of the closet far exceeds the minimum specified in the article; filling the space between the studs above and below the speaker with insulation prevents wall vibration; the clothes in the closet prevent the sound waves from bouncing around inside the enclosure. The principal advantage is that a competent carpenter can complete the installation in about two hours using less than $3 worth of lumber.

For the usual house, the speaker must not be larger than 12 inches, since studs are usually 14½ in. apart, but this doesn't seem to result in any compromise in quality. I have found that a good quality 12-in. speaker mounted in this manner far outperforms the 15-in. woofer-tweeter previously used in a bass-reflex cabinet. The improvement in bass response is attested by the fact that until I made the change I had never heard turntable rumble in my outfit.

This type of installation is strongly recommended to anyone who wants to try something better—or whose wife cannot be persuaded that a 15-cu. ft. box is a thing of beauty.

GEORGE F. T. GREGORY,
1405 Douglas St.,
Victoria, B. C.

Stereophonic Tape Exchange Wanted

SIR:

I have a stereophonic Concertone 1601 tape recorder with vertical head alignment, and I have transferred about everything available from stereophonic records. Would some reader in an area of stereophonic (binaural) AM-FM broadcasts be interested in running off material for me? I'm sure some kind of mutually satisfactory arrangement could be worked out and I would like to correspond with some one who has compatible equipment.

D. C. LANGDON,
Box 2538,
Juneau, Alaska

Embarrassing Questions

SIR:

As one whose experience with sound reproduction goes back to the Victory Loan Drives after World War I, where very good Telephone Engineers were quite thrown by acoustic feedback and spent much time making special filters to eliminate the howl,

After more than five years of study and development, we present our most prized accomplishment, the RONDINE. We are satisfied that it is the finest 12-inch turntable unit we have ever built . . . and that its performance is years ahead of high fidelity standards as we know them today.

The Rondine achieves almost complete acoustical isolation between motor and turntable. Rumble has been reduced to a minimum. Wow and flutter are virtually non-existent.

Features include: • Single selector-knob for setting speed: 33⅓, 45 or 78 rpm • Three-speed strobe disc, permanently affixed, for instantaneous speed-checking • Built-in retractable hub for 45 rpm records — no adapter required • Special cork-neoprene mat material to eliminate record slippage • Neon pilot light • Rectangular chassis fits most changer boards—pre-drilled and tapped for standard pickup arms.

The Rondine embodies other well known, time-tested, Rek-O-Kut features: The turntable is cast aluminum, and exerts no 'pull' on magnetic cartridges. An extra heavy rim is precisely lathe-turned and is dynamically balanced for smooth flywheel action. Internally rim-driven with a neoprene-compound idler, perfect drive traction is assured. All inter-moving parts are case-hardened, and ground to a micro-finish.

The Rondine is available in 2 models:

RONDINE, Model B-12—with specially designed 4-pole induction motor — noise level better than 40db below average recording level. $69.95

RONDINE *Deluxe,* Model B-12H—with new type custom-built hysteresis synchronous, self-lubricating motor — noise level better than 50db below average recording level. $119.95

See the Rondine at the
AUDIO FAIR
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I wish to offer some comments on the Forest which is getting somewhat obscured by all of the new audio Trees.

I see countless new and marvelous transducers (pickups and speakers) and power converters (amplifiers and equalizers huckstered about at very fair prices compared with the days when telephone-quality gain used to cost about ten dollars a TU[1].

However, I feel impelled to introduce some fact into what seem to be some dangerous fallacies. For some years I have stopped my hi-fi friends with two tough questions when they start talking about 20 to 20,000-cps systems.

(A) What do you use for program material?

(B) What kind of a room do you play it in?

Of course these questions did not really stop them; most were primarily interested in satisfying the famous criterion of Dr. Rumblehiss of Vienna[2]. However, my two questions are losing some of their force since tape libraries and Spiraslat Diffusers[3] became available. So now it is up to me to propound some new questions to show that the Old Man is not yet convinced. Thus come questions (C) and (D).

(C) Are transient and steady-state frequency responses within 3 db of each other?

(D) What does Intermodulation have to do with the ear?

As to (C), cone and diaphragm speakers can be equalized for the same steady-state response, but it may take 100 cycles of the 10,000-cps energy for the cone to build up a standing wave pattern and start radiating. Most good diaphragm tweeters are better transient responders. However, there is always the problem of cavitation in the throat and one foot is always dragging in the dividing network, so you may not be any better off than the boy with the $3.98 golden-throat surplus cone for a hi-hisser.

As to (D), it is a probable that the first use for intermodulation tests was to check laboratory processing conditions on optical recordings, and bore no relation to what the ear dislikes in delayed sound reproduction. (*We believe that current types of IM tests on equipment do have a close relation to the ear's acceptance of quality.* Ed.)

While Chief Transmission Engineer of the Sound Department at Walt Disney Studios late in the thirsty thirties—during the early Fantasia Stereophonic era—I was fortunate enough to have a captive audience of about 500 people available every day during the noon hour in the Disney Theater where the employees gathered to watch various reels of film which we ran for them. We tried all kinds of intentional distortion and picked up audience reaction cards to try to find a statistical basis on which to correlate distortion measurements with listening tests. After several months the audience got pretty sharp and learned to appreciate what we then called hi-fi.

We found that intermodulation, second-, and third-harmonic distortion measurements showed poor correlation with the listening tests. The best test was one suggested by George Downs (then of Lansing Mfg. Co.) where we measured the amount of *fifth*

(*Continued on page 101*)

[1] Transmission unit—predecessor of decibel.

[2] Rumblehiss criterion: The system is nowhere if you can't hear turntable rumble and preamp hiss.

[3] Spiraslat Diffusers—Invented by author. Consists of a number of Venetian blinds hung from ceiling with a twist so the bottom slat is 90 deg. or more away from the top slat.

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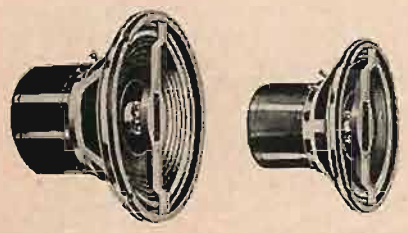

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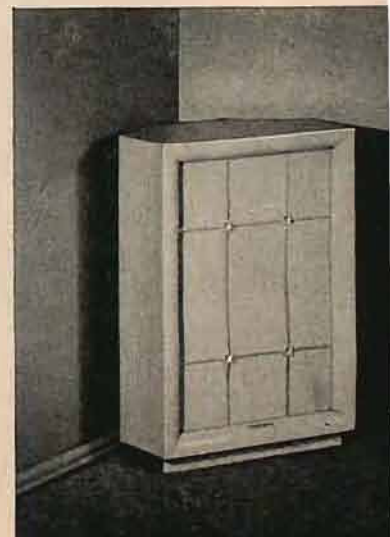

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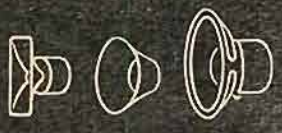

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London Letter

RICHARD ARBIB*

OF THE 300,000 MEMBERS of the British public who paid the equivalent of an American dollar to visit the 21st British National Radio and Television Show, it was evident that many were interested in High Fidelity reproduction. The Exhibition which closed recently at Earls Court, London, was quite unlike any similar show that is presented in the United States.

Nearly a year ago a full description of the 1953 Exhibition appeared in AUDIO, and this year our report will be confined to some of the equipment that was on view for the first time and is likely to be of interest to High Fidelity enthusiasts.

H.M.V. Recorded Tapes

The first British recorded tapes were shown by His Master's Voice and all the nine tapes of the initial issue are apparently British ones and not just an issue in England of RCA Victor recorded tapes. These tapes, recorded for playing on dual track equipment at 7½ ips are strangely enough not subject to purchase tax but yet cost almost double the price of the equivalent LP record including purchase tax of 50 per cent. One advantage over the RCA tapes appeared to be that the lead-in and run-off sections are all plastic instead of paper.

HMV had obviously rushed out the tapes in time for the Radio Show and in order to be able to claim that they introduced an innovation before Decca or any other British Record Company. They are in the rather awkward position of not yet marketing any machine designed for playing the tapes. The Emicorda domestic tape machine, marketed by an associate company for the past two years, has only single track recording and reproduction. Furthermore, the machine takes the tape off the reel with the oxide surface on the inside and winds it on the takeup reel with the oxide surface on the outside. It is difficult to understand how such a machine could have ever been designed. Presumably the company now have a source of income in persuading purchasers to allow them to convert the machines to dual track ones and by means of a pulley and a twist of the tape, wind the tape on the final reel with the oxide in. However, every high-quality tape machine will play the HMV tapes quite satisfactorily and before long HMV will undoubtedly bring out a range of domestic tape recorders and reproducers.

Novel Applications For The Tape Recorder

Wright and Weaire Limited who make the high quality Ferrograph tape recorder, of which very limited quantities are now being despatched to U.S.A., introduced a modified machine called the Ferrotutor on their stand at the Show.

Two variations of this model were shown. The Ferrograph of course is a dual-track instrument. Whilst it is normally used for recording on one track after the other, the Ferrotutor has a modification so that if need be both tracks can be reproduced at the same time.

The first application is for the study of foreign languages and particularly the aspect of pronunciation and the acquisition of correct accent. One track of the recorder is without erasing facilities and on this are pre-recorded suitably-spaced master sentences and phrases. The pupil can listen to these through headphones and after each phrase can record on the other track his own attempt at pronunciation. After a period he can wind back to the start and listen again to the master track and his own efforts, phrase by phrase.

In the special Ferrograph demonstration room it was also possible to see a further modification whereby the Ferrotutor could be used for audio-visual instruction. This is achieved by the addition of a simple pulse unit which provides a new approach to many problems.

In this system one pre-recorded track contains the actual subject matter of the lesson or lecture while the other has pulses recorded upon it at appropriate intervals for the operation of external mechanical devices. One of the most popular of such

**Multicore Solders, Ltd., Hemel Hempstead, Herts., England.*

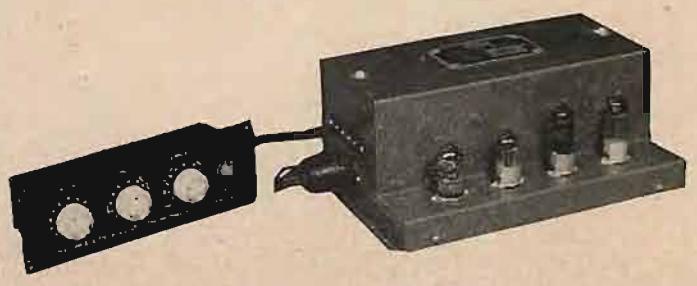

Fig. 1. Model T-41 Trixonic home music amplifier—the lowest-priced model shown with a separate control panel. Excellent quality is obtained.

devices is an automatic film strip projector. For giving instruction in French, amusing cartoon drawings of various items in the house were shown at the same time. The voices of the French teacher and his woman pupil were heard pronouncing correctly the items shown on the screen.

It is obvious that these advantages of the dual-track tape recorder are applicable over a wide field. The machines could be used for instructing pupils in music, for example. By further mechanisation it ought also to be possible to use the sound track and the pulse unit for advertising purposes.

With the exception of HMV, who showed a prototype of a tape reproducer in a fine walnut cabinet, none of the major radio and television manufacturers have yet really entered the tape machine market. However, with the impetus of the introduction of the HMV pre-recorded tapes it is extremely likely that before long many of the manufacturers who this year have shown so many radio phonograph combinations will add tape decks to their machines.

New Low-Price Amplifier

Among the demonstrations of high-quality amplifiers, possibly the most interesting for the visitor whose pocket is limited was that given by The Trix Electrical Co. who are one of the oldest firms specialising in high power amplifiers and portable electrical reproducing phonographs.

Believing that there is a large percentage of the public who do not require 10- or 12-watt amplifiers in small rooms, Douglas Lyons, Managing Director of Trix, showed for the first time his new Trixonic home music amplifier costing little more than half that of other British equipment familiar to U.S.A. enthusiasts. The new Trixonic equipment gave a very creditable account of its capabilities.

Although the power output is rated at only four watts, many members of the technical press who heard the amplifier at a private demonstration just before the Radio Show opened, were very favourably impressed with the quality at the level of reproduction preferred by the majority of hi-fi enthusiasts' wives, even if their husbands sometimes wish their equipment to be heard in apartments or houses a block or so away.

The Trixonic is certainly the most inexpensive amplifier on the British market with a separate control unit. As will be seen from *Fig.* 1, this unit incorporates a pilot lamp, on/off switch, and gain, bass, and treble controls. All connections are made direct to the amplifier which provides both high and low gain inputs for use on different pick-up cartridges. Speaker output tappings are incorporated to match 15 ohm and 3 ohm units.

It is obvious that at the price at which the Trixonic is marketed, it is not possible to include many of the refinements of the larger amplifiers in regard to switching for tape, radio, and different disc recording characteristics. However, the enthusiast requiring a modest amplifier of high quality could, if he so desired, easily add additional switches and shunts.

In their literature the Trix people state "the power output of this equipment is not designed to suit the requirements of a concert hall, but is intended for high-quality reproduction in the home, and this function it fulfills with the utmost efficiency." All who so far have heard this new amplifier can endorse the manufacturer's claim.

How To Load Records Easily

Another novel idea as far as England is concerned has also been introduced by Trix whereby they manage to produce an easily operated record reproducer by the application of a glass instead of a solid top to the cabinet, as shown in *Fig.* 2. In their new "Recital" model electrical reproducer which incorporates the Trixonic amplifier, the record changer is fixed instead of being mounted on a drawer.

Fig. 2. Trix "Recital Model" electric reproducer has glass top so user can load records on the changer without stooping down to see what he is doing.

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It's in a class completely by itself. For instance, the Ampex 600 records 30 to 15,000 cycles at 7½ in/sec. Signal-to-noise ratio is over 55 db. Flutter and wow is less than 0.25%. But what matters most is what you hear. There is a monitoring switch on the face of the Ampex 600. Turn it, and you can compare what goes in and what comes out. You will hear no difference. Fidelity is "perfect"—and this is a portable machine that weighs less than 28 pounds.

Though there is a wide selection of tape recorders that can be bought for less, there are great numbers of discerning high fidelity enthusiasts who will hear the difference. And they will want an Ampex 600 and no other.

The AMPEX 600—The first truly portable tape recorder capable of meeting the highest professional demands. It is usable either as a portable or in a custom installation—either vertical or horizontal. It plays through an external amplifier and speaker.
The AMPEX 620—A portable amplifier-speaker unit of comparable high quality. It is furnished in matched portable case, weighs 19 pounds and provides remarkable high fidelity in a convenient size.
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Here is what Yehudi Menuhin, world famous violinist, says:

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The user can see to load records easily without having to crouch down. Nevertheless the top of the instrument can still be used by the enthusiast's wife for a vase of flowers or other decoration. It is understood that this idea is the subject of a patent.

Luxurious Radio-Phonograph Combinations

Practically every British manufacturer of television and radio showed radio-phonograph combinations, many of them being in the hi-fi class. Previously most firms have included a line retailing at about $200 including tax. However with the increased interest in hi-fi many of the firms now showed much more ambitious equipments in most luxurious cabinets priced between $350 and $1800. It is difficult to pick out just a few of the firms concerned but radio-phonograph combinations of ambitious design were shown by Decca, Dynatron, Ferguson, Ferranti, HMV, Philips, Pye, and RGD. Some of these companies also showed similar equipment incorporating a television receiver but on the whole there seemed to be many less combined television, phonograph and radio combinations on sale in England than in the U.S.A., but many more combined radio and phonograph ones.

Many British "Radiograms" as they are called, still have the style of cabinet whereby the whole of the top which is the lid, is lifted up to reveal the radio unit amplifier controls, record changer and often a felt lined pocket for records. Undoubtedly this is the most convenient type of cabinet for the operator but is usually not preferred by the womenfolk. Pye have an ingenious design, *Fig.* 3, whereby part of the top and part of the front open simultaneously, being actuated by the same hinge. Many

Fig. 4. Typical example of the British "bureau type" radiogram. This ALBA combination sells at about $175 including tax.

of the other manufacturers showed bureau type cabinets for their lower priced "Radiograms." These have a front about an angle of 70° which is lowered to a horizontal position. Typical is the ALBA model shown in *Fig.* 4. This design has the advantage of enabling the cabinet to be used also as a writing desk, but the disadvantage that when the front is down, one is further away from the record changer.

Record Exhibits

Three of the leading companies devoted considerable space to records. EMI had a complete stand to publicise their HMV, Columbia, Parlaphone, and MGM labels. Decca showed discs of their Decca, Capitol, Brunswick and London trade marks. Philips on one of their stands showed, for the first

(*Continued on page 91*)

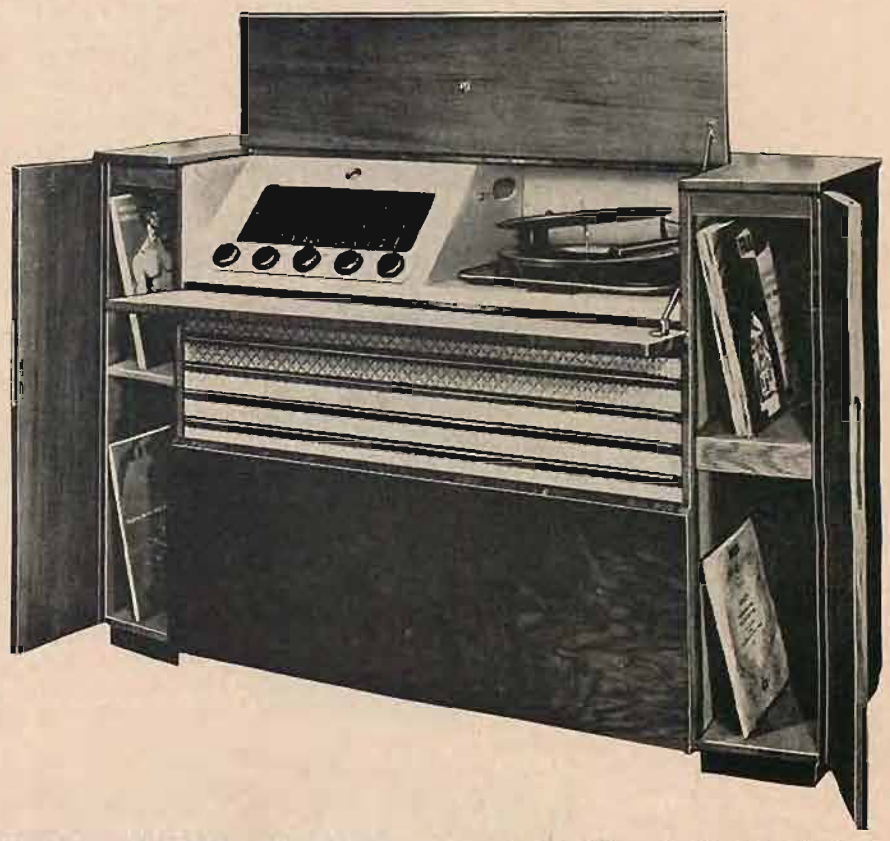

Fig. 3. Pye model "Radiogram" employs top and front panels which are interlocked so that both open when either is pressed. Unit covers 11 wave bands, stores 300 records, and includes a drawer to hold spare pickups and the 45-r.p.m. hub. All record storage spaces are felt lined and illuminated, and when control switch is turned to "gramophone," the record changer is automatically lighted; colored lights also indicate speed of turntable. Three speakers are used.

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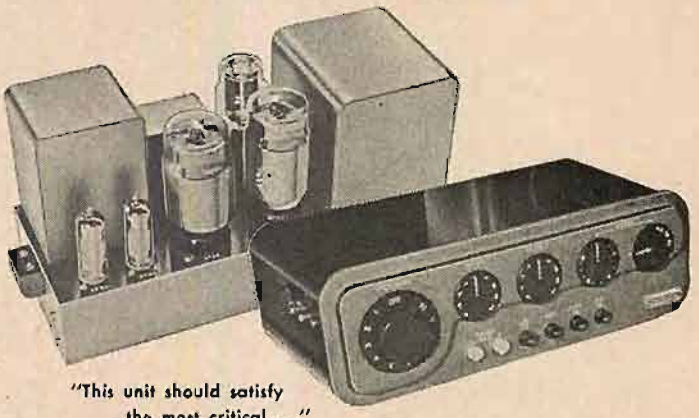

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Equipment Report, AUDIO, May, 1954

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EDITOR'S REPORT

YOUR MONTH OF SHOWS

OCTOBER HAS COME to be known as the "Month of Shows" among the audiofans, beginning a day early in Chicago with the International Sight and Sound Exposition, which is by now a Past Event, climaxed by The Audio Fair in New York—to which we all look forward throughout the year—and tapering off with the New England High Fidelity Music Show in Boston, making its bow this year at the Hotel Touraine October 22–24. Each event is of major importance to its local audiofans, and each one serves to give further impetus to the still-growing audio industry. Since considerable space in this issue is devoted to the New York Fair, we feel that this space might well be devoted to the Boston show because it doesn't have a month of its own in which to garner all the publicity and fanfare that it deserves.

While Boston isn't too far from New York for many of its audio enthusiasts to make the pilgrimage for the purpose of seeing what is new and exciting—with a few extra hours for the gradual dissipation of the audio budget in the Fifth Avenue stores by the fans' helpmates—there are certain to be many in the New England area who have been unable to take the time or unwilling to give up the possibility of having a new phono cartridge or amplifier or speaker just for the few days of looking and longing.

But now for pennies (we are told that the public transportation system in Boston no longer accepts peanuts) everyone in that city will be able to have his eardrums tortured with the wondrous sounds from an audio show. As for us, we have to go to all the shows, so one more is little added effort.

Just in case anyone thinks we deprecate the idea of audio shows, let it be remembered that the original scheme was born in Æ's offices 'way back in 1949, and we wouldn't miss one of the big shows for the world. We are undoubtedly envied by many of our readers, for we go to all the shows and we are there from opening to closing every day. But there is no denying that we learn something from each exhibit, enjoy meeting many of our friends whom we see only at these events, and the minute one show is over we start looking forward to the next one. Borrowing from a radio character, we "Love that Audio."

But if you live in the New England area, make your plans to visit the NEHFMS for as many hours as you possibly can—if it will be your first experience, you won't ever forget it. If you have already experienced an Audio Fair, we'll expect to see you there—nay, we'd wager on it (if it were legal in New York).

BROADCASTING FOIBLES

While all of us understand the advantages of limiting and compressing amplifiers in AM broadcasting, we will probably agree that they should be used with care and adjusted for reasonably unobtrusive operation. During the past baseball season, we have observed the performance of one of the New York stations on baseball broadcasts, and we can't help but think that a few words of unbiased opinion might improve quality. Compressors certainly have their place to protect against overmodulation due to unexpected high-level signals, but they should never repeat never be used to chop holes in crowd noise into which the announcer's words drop like pebbles into molasses. In our opinion, crowd noise should appear *behind* the sportcaster's voice, and at a relatively low level, and unless the voice is silent for long periods this level should remain constant.

Or are we to infer that the announcer's words are so important that the crowd silences itself for each and every syllable?

PRE-RECORDED TAPES

One reader brings up an interesting question in semantics. Why do we refer to tapes upon which musical programs have been recorded by a manufacturer or recording studio before the customer buys them as "pre-recorded" tapes? Reader believes it would be sufficient to refer to them simply as "recorded" tapes, in the interest of simplification of an already-complicated language.

We believe so too. Does anyone else?

TAPE RECORDER STANDARDS

We are pleased at the announcement that the Magnetic Recroding Industry Association is making some progress toward setting up standards for tape recorders. For too long now it has been something less than satisfactory to try to play a tape on one machine after it has been recorded on another, and when the user of a professional machine has occasion to play a tape made on a non-professional machine, he is really in trouble. (Or even if it were made on another make of professional machine.) Equalization varies all over the map, some tapes are spooled with the oxide in while others have the oxide out, and even the head position for dual track recorders in U. S. practice is reversed from foreign usage so that one is required to play the back of the tape to avoid reproducing it from end to beginning.

Let us hope that we do not allow tape to drift into as sad a state as did LP's over their first five years. Only now does it appear that the RIAA standard will really become an industry standard so we can have only one "phono" position on our preamplifiers.

WELCOME TO WKBS

Within the last month, radio station WKBS has begun to operate from our home town of Mineola, New York—having recently moved here from Oyster Bay. As a magazine devoted in part to broadcasting techniques, we have felt a little like the man who decries traffic conditions from the top of Mt. Everest. Now, at least, we do have a radio station in our own town, and we sincerely welcome it and its personnel.

USE FOR DOT-POINTED PEN

If you happen to be the proud owner of a ball-point pen, please take it in hand and apply one dot on the cover of the August issue and another on *Fig.* 4 of page 18 at the point where the leads from the suppressor and cathode of the 6SJ7 cross, just to the left of the 0.25-μf capacitor. The author says it will work better that way.

Zone Refining apparatus, showing tube and induction-heating coils. For transistors—tiny electronic amplifiers—germanium is made extremely pure. Then special impurities are added in controlled amounts for best transistor performance.

1 part in 10,000,000,000

To make the most of their revolutionary invention, the transistor, Bell Laboratories scientists needed ultra-pure germanium.

The scientists solved their problem by devising a radically new refining process. The germanium it yields may well be the purest commercially produced material on earth.

It has only *one part in ten billion* of impurities harmful to transistor performance. That's about the same as a pinch of salt in 35 freight cars of sugar.

Yet the new process, Zone Refining, is simple in principle. An ingot of germanium is drawn through a series of induction-heating coils that melt narrow zones of the substance. Since impurities are more soluble in the liquid than in the solid form of a metal, the molten zones collect impurities. They are swept along by the successive melts to the end of the ingot, which is finally cut off.

Zone Refining is also being applied to the ultra-purification of other materials useful to telephony. This single achievement of research at Bell Telephone Laboratories clears the way for many advances in America's telephone system.

BELL TELEPHONE LABORATORIES

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

Revolutionary Loudspeaker and Enclosure

The author describes a fundamentally new loudspeaker system whose 12-inch woofer utilizes an enclosure volume of only 1.7 cubic feet, but whose bass performance is claimed to be superior to that of a true infinite baffle installation.

EDGAR M. VILLCHUR*

THREE OUTSTANDING PROBLEMS that still plague the field of loudspeaker design may be categorized as:

1. How to keep harmonic distortion low in the frequency region below 70 or 80 cps, especially at high power.
2. How to keep frequency response *uniform* and extended at all power levels.
3. How to solve the above two problems without requiring architectural installations, very large cabinets, and difficult final adjustments.

The loudspeaker system here described is the fruit of an investigation that was primarily directed towards solving the first of these problems, that is, towards creating an electro-acoustic transducer that made no compromise with low distortion bass down to 40 cps. The solution to the distortion problem turned out at the same time to be a solution to the problems of uniform bass frequency response and of cabinet size.

The greatest source of distortion in a typical high-quality reproducing system is the loudspeaker. Speaker harmonic distortion in the bass range is tolerated in amounts far greater than would ever be allowed in the amplifier or pickup—values between 5 and 10 per cent below 60 cps and at moderate power are common even in high-quality units. The greatest single source of distortion in the loudspeaker itself is the non-linearity of the voice-coil and rim suspensions which hold the cone and voice-coil to the speaker frame. The elastic stiffness of the suspending members, a property which they must possess in order to perform their functions properly, does not remain constant over the excursive path of the cone; the further the cone moves from its central position the greater is the resisting force constant of the suspensions.

The design of these suspensions and of the speaker's moving system has been refined but not changed radically over the last twenty years or so. The situation is comparable to that of the acoustic phonograph in the nineteen twenties—there wasn't much further to go in the direction of improved performance until designers retraced their steps, back to the basic problems associated with converting needle vibrations to sound, and applied a new approach, the electrical one. In the present case, instead of attempting to re-design an already refined mechanical suspension system for a linear force displacement relationship, the elastic stiffness of the mechanical suspension system was substantially eliminated, and a linear, *acoustic* elasticity used instead. Thus, the domination of voice-coil motion by the non-linear elastic mechanical suspensions was also substantially eliminated. The phrase "substantially eliminated" can mean many things; here it is used to denote reduction by a factor between 6 and 10.

Acoustic Elasticity

The acoustic elasticity is provided by the enclosure's sealed-in air, which must be compressed when the cone moves back, and rarefied or stretched when the cone moves forward. In other words the air of the enclosure is used as an elastic cushion, which supplies to the special speaker the restoring force that the moving system is by design deficient in, and that it needs.

Such use of the enclosure's air turns out to have most fortunate consequences, and it is possible to reap large extra dividends over and above the reduction of distortion. The amount of acoustic elastic stiffness available is determined by the cubic volume of the enclosure; the cubic volume which must be provided (not as a minimum but as an optimum value) is of the order of one-fifth the volume of a conventional totally enclosed cabinet for an equivalent speaker mechanism.

The function of an infinite baffle or totally enclosed cabinet is to provide acoustical separation between the waves radiated by the front and back surfaces of the speaker cone, waves which are out-of-phase and would cancel at lower frequencies. One may ask then, why it has not been possible to simply house a speaker in any small enclosed box, or even to close up the back of the speaker frame so that it is airtight, in order to achieve the necessary separation. The answer lies in this same acoustic elasticity referred to, which increases the elastic stiffness of the speaker's moving system and raises its main resonant frequency. The nature of modern loudspeakers is such that below the resonant frequency response falls off rapidly—at the rate of 12 db per octave, in terms of pressure, in an undamped unit.

Suppose, for example, we have a 12-in. loudspeaker mechanism whose main resonance occurs at 50 cps in free air. If we now mount the speaker in a wall the resonant frequency will drop due to the air load mass, perhaps to 45 cps, and if the speaker has been well designed we can expect good response to something below 40 cps, with about 6 db of attenuation at 32 cps.

If we now take this same loudspeaker mechanism and mount it instead in a conventional totally enclosed cabinet (a second choice dictated by the landlord) we will find that the resonant frequency is raised by the additional acoustic stiffness of the enclosed air. Probably the best that we can hope for is to keep the resonant frequency at about 50 cps, an achievement that will certainly require a cabinet volume of over 10 cu. ft. A cabinet of 5 cu. ft. will raise the resonant frequency into the 60 cps region, and the system will suffer a corresponding loss of bass response.

The problem, then, resolves itself into these terms: how provide complete acoustic separation between the front and back of the speaker cone, without raising the resonant frequency above what we want it to be, and without a wall installation or a monster cabinet? The answer dovetails with the solution for suspension distortion referred to previously. We select the values of mass and elasticity for our speaker system as for a conventional speaker, on the basis of the resonant frequency we decide upon. We then design the speaker mechanism with perhaps only 10 per cent of the elastic stiffness that it needs, so that the resonant frequency for the unmounted speaker mechanism is subsonic, of the order of 10 cps. For reasons that will be apparent a little later, this speaker mechanism is useless as a bass speaker in any conventional mounting—which was not designed for 10-cps resonance but for 45-cps resonance.

The final step in the construction of the complete speaker system follows logically. We enclose the back of the

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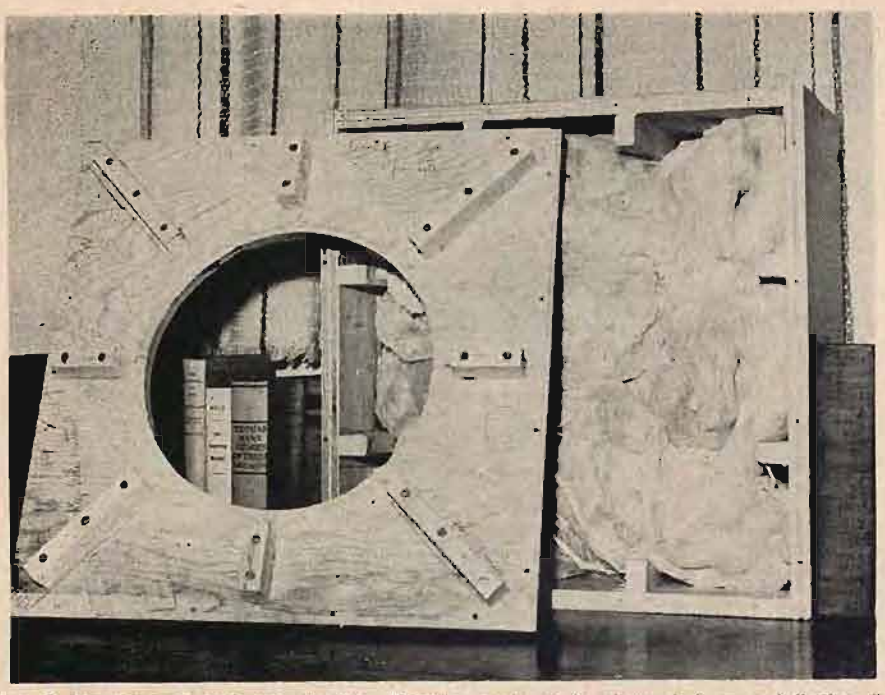


Fig. 2. Experimental enclosure, showing Fiberglas made up in cheesecloth-covered "pillows." The enclosed volume of air, rather than mechanical suspensions, supplies elastic restoring force to the special 12-inch speaker.

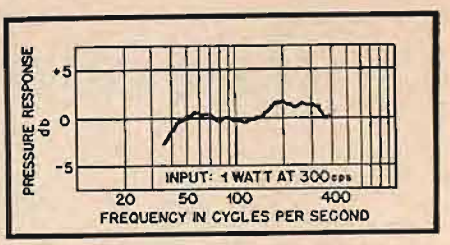


Fig. 1. Typical bass frequency response, on axis, of the acoustic suspension speaker under open field conditions.

speaker with an acoustically sealed volume of air which will supply the remaining 90 per cent of the elastic stiffness to the moving system, and which will raise the resonant frequency to 45 cps. The interior volume of the experimental acoustic suspension speaker, using a 12-inch woofer and designed according to this principle, is 1.7 cubic feet. Increasing the cubic volume will not improve the performance of the system, but will degrade it.

We can now compare the characteristics of the infinite baffle with corresponding characteristics of the acoustic suspension system. This is done in Table I.

Speaker Restoring Force

Speaker suspensions serve two purposes, that of centering the voice coil in the magnetic gap so that it does not rub, and that of providing elastic restoring force to the moving system. The restoring force of a particular speaker cannot be decreased below an optimum value for that speaker. Too low an elastic stiffness will result in increased bass distortion, as the voice-coil will travel out of the path of linear magnetic flux on high-amplitude low-frequency signals, or will actually "bottom" against parts of the magnet structure.

The same principle may be explained in terms of the main resonant frequency of the speaker, which, as we have seen, is determined by the values of elasticity and mass, both mechanical and acoustical, of the suspended system. Other things being equal it is desirable to have speaker resonance as low in frequency as possible, but too low a resonant frequency results in cone excursions too great for the length of the magnetic path provided by the particular speaker. Voice-coil excursion in the bass, for constant radiated power, must be quadrupled for each lower octave, and the attenuation of response below resonance protects the speaker against over-large excursions.

Thus when a speaker is designed with the correct resonant frequency, voice-coil excursion is always kept within the limits of linear flux for all signals, regardless of frequency, up to rated power. Small speakers which can only allow short voice-coil travel relative to their power rating, and which provide relatively poor coupling to the air are properly assigned high resonant frequencies, while speakers which allow greater excursion, or can radiate the same power with less excursion due to some special means for matching them to the air, (such as a horn, for example) can be given lower resonant frequencies.

With the understanding, then, that the non-linearity of the speaker's elastic restoring force cannot be cured by removing or reducing the restoring force itself, the necessity for substituting an acoustic restoring force for the decimated mechanical one becomes apparent. Boyle's law tells us that the restoring force will be symmetrical—that it will be the same coming and going. Acoustic pressure is a function of volume, and it makes no difference that the variations in pressure occur above and below normal atmospheric pressure as a reference level. When the cone moves back the enclosure pressure on the back of the cone is greater than the atmospheric pressure on the front surface; when the cone moves forward the atmospheric pressure on the front of the cone is greater than the pressure of the rarefied enclosed air on the back surface.

For twenty-five years the air in speaker enclosures has been considered an unavoidable evil. It has been unavoidable because of the necessity for providing acoustical separation between the front and back of the cone, and it has been an evil because of the effect of the added acoustic stiffness raising the resonant frequency of the speaker above its optimum point and cutting off bass response. Thus the enclosed air can be rendered innocuous by providing a very large volume whose acoustic stiffness is negligible; this means, ideally, an infinite baffle wall installation or a *very* large, well braced cabinet, both of which are impractical in most homes. Folded horns solve the problem, but again at the expense of large size—a horn that delivers clean, non-boomy bass requires a long flared path and an extremely large mouth diameter. Different methods of "tuning out" the stiffness of the enclosed air have also been used, some using Helmholtz resonance, as illustrated by the various and popular bass-reflex type enclosures, and some by air-column resonance. Critical adjustments are usually required for optimum results.

The enclosed air in the present system is not a necessary evil but an integral and indispensable part of the loudspeaker, without which the speaker could not operate properly. Since we cannot conquer the acoustic stiffness readily we join it and make it work for us. The enclosure volume is so regulated that in conjunction with the mechanical moving system of the speaker the final resonant frequency is precisely what has been intended—about 45 cps.

When the first experimental model of the acoustical suspension speaker was planned it was reasoned that the bass performance, at worst, would be equal to that of an equivalent conventional speaker in an infinite baffle. It was known that the experimental speaker would provide complete separation between front and back waves, that the cabinet used no acoustical resonators, and contributed no *unwanted* stiffness to the moving system, and that the resistive loading on the back of the cone in an infinite baffle would be more equalled by Fiberglas filling in the experimental cabinet. Accordingly a control twelve-inch speaker, identical except for the suspension system, was mounted in a stairwell.

The difference bewteen the experimental model and the infinite baffle installation, however, was immediately apparent. The experimental unit, because it did not flatten the bass peaks on large cone excursions, had a fuller and cleaner bass, especially in the 40 to 60 cps region. In the beginning it seemed a

little unreal to hear the fundamentals of organ pedal notes, which could be felt as well as heard, issuing from this little box.

Later measurements of frequency response and harmonic distortion indicated the reasons for the bass sounding as it did. *Figure* 1 shows the bass frequency response of the experimental model, taken under open field conditions. Bass response uniform within ±1½ db, as indicated in *Fig.* 1, would be ordinary for an amplifier, but is quite unusual for a loudspeaker system. This uniformity of response partly results from the fact that the restoring force is applied smoothly to the whole of the cone surfaces, rather than to the apex and rim of the cone by mechanical suspensions, and partly from the optimum damping of the resonant peak.

The practical result of such uniform response is the absence of boominess. Speech program material, which normally contains no energy below 100 cps, gives no hint of the fact that the woofer reaches down into the low bass. Organ pedal notes, bowed or plucked double basses, etc., are reproduced true in pitch and without ringing.

It must be emphasized that the reproduced response curve is for a complete system rather than for a loudspeaker mechanism alone, mounted as the testing laboratory sees fit. As an illustration of the necessity for care in interpreting response curves for loudspeakers alone, it has been demonstrated that variations in mounting the same speaker in different commercial cabinets can change the effective bass cut-off frequency by an octave, and the amplitude of the bass resonant peak by more than 10 db.

It must also be emphasized that the resonant frequency of 45 cps is for the complete system rather than for an unmounted speaker mechanism, or for a speaker mechanism mounted by the testing laboratory in an infinite baffle. The value of 45 cps was chosen to give full response down to slightly lower than 40 cps; this low-frequency limit was determined to be as low as practically required. Although the above determination was made on the basis of direct experiment with various types of program material, it is supported by authorities in the field, such as Olson.[1]

The harmonic distortion of the experimental model speaker was reduced, from that of the control model in the infinite baffle, by a factor of about three. The harmonic distortion of a later model was measured by an outside testing laboratory and found to reach 1.4 per cent at 46 cps, 10 watts input.[2] It will therefore be seen that this speaker system has not been designed as a compromise "small unit," and it was not intended that a handicap weighting of its performance be allotted to it because of the small size of its enclosure. It is the author's opinion that the bass performance of a speaker with given magnetic and electrical design will be optimum, at the present state of the art, when a moving system with the acoustical suspension is utilized; the small enclosure not only entails no penalties but contributes a tremendous advantage from the point of view of performance quality. It is anticipated that the acoustical suspension principle will become increasingly universal in the industry, and will have general application to speaker systems of all sizes. One obvious application is in electronic organs, where pedal note fundamentals of low frequency can be produced cleanly and at high power from a speaker system installed right in the console.

TABLE I

Comparative characteristics of an infinite baffle, a 12-cu. ft. totally enclosed conventional cabinet, and the acoustic suspension system, all using a 12-in. speaker mechanism

	Distortion due to suspensions	Raising of resonant frequency above desired value	Acoustic separation between front and back	Resistive damping on cone	Introduction of acoustic resonances
Infinite baffle and installation	Amount normal to speakers of current design	Very Slight	Complete	Good; air resistance loads both sides of cone	Possible resonance of space into which back of cone faces
12-cu. ft. totally enclosed conventional cabinet	Slightly less than above	Slight	Complete	Fair; air resistance does not load back of cone at bass frequencies	Possible standing waves in cabinet unless properly damped out
Acoustic suspension system	Practically non-existent	None	Complete	Optimum; air resistance loads front of cone and controlled acoustic viscosity applied to back	None

Damping

The amount of Fiberglas damping material in the enclosure (see *Fig.* 2) is fairly critical. The Fiberglas, in the amount used, completely damps out standing waves at higher frequencies (a task made easier by the small cabinet dimensions, since the standing waves that tend to form are shorter wave lengths, and such sound waves are more easily absorbed) and reduces the Q of the moving system so that the main

(*Continued on page 100*)

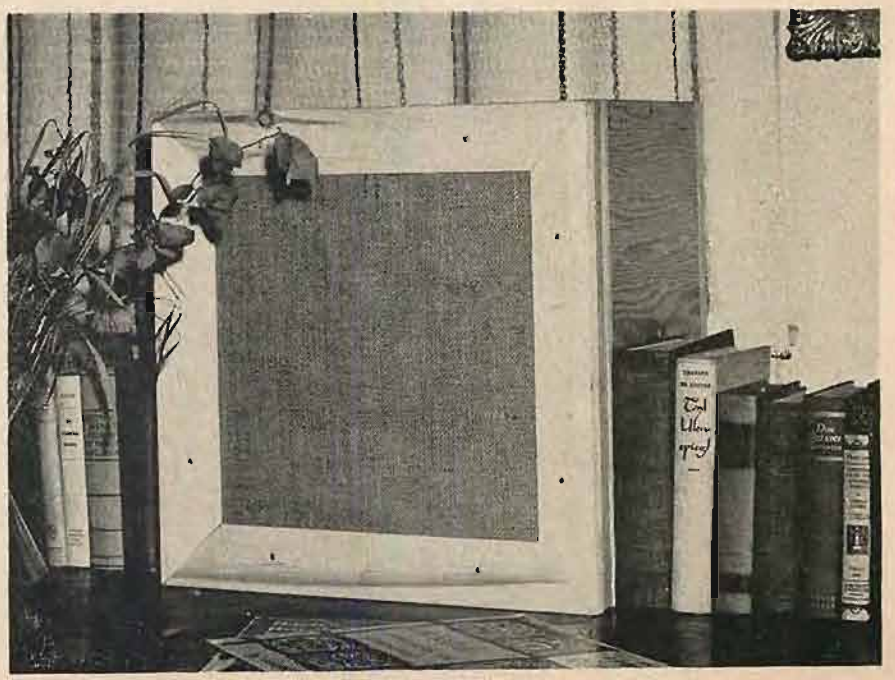


Fig. 3. The assembled experimental speaker and enclosure.

[1] Harry F. Olson, "*Elements of Acoustical Engineering*," D. Van Nostrand Co., 2nd ed., 1949, p. 477. Dr. Olson lists 40 cps as the low-frequency limit required for the reproduction of orchestral music with perfect fidelity.

[2] These figures were taken with the electrical input as reference level, and are therefore favored by the low efficiency of the system.

Hi-Fi-manship at the FAIR

Are you awed by audio exhibitors? At a loss when fellow hobbyists ask your advice about choosing components? Herewith some rules on how to get "one-up" at the fall audio shows.

CHARLES SINCLAIR*

MEMBERS OF THE GENERAL PUBLIC attending an audio show usually do so with an air of intense, often grim, concentration.

They twiddle with knobs and dials. They add and re-add the prices of components for projected hi-fi rigs. They trudge dutifully from exhibit to exhibit. They collect armfuls of leaflets, pamphlets, booklets, and catalogues with the thoroughness of Dept. of Sanitation men tidying up Fifth Avenue after the St. Patrick's Day Parade.

Psychologically speaking, these audio fanciers are almost completely in the "one-down" position. They are prey to the sales arguments of "one-up" audio exhibitors. They are fair game for the "prospect lists" so often compiled by audio firms at audio shows.

Exhibitors are well aware of their psychological advantage. Observe the smile on the faces of well-dressed audio sales executives as they suavely show off their firm's newest equipment. A familiar smile? It should be. It's the same smile you see on the faces of roulette croupiers at Monte Carlo when they hear that a tourist has just perfected another "foolproof" system of beating the wheel.

On the other hand, observe the skillful practitioner of Hi-Fi-manship in action at an Audio Fair.

He is cool and confident, even slightly amused. He easily gets "one-up" on the most knowledgeable audio experts and the sharpest salesmen, even though he actually has a minimum of audio knowledge.

He is unperturbed by exhibits of even the most *avante garde* audio specialties, such as transformerless amplifiers or trinaural sound. His advice is eagerly sought by novices who receive his words of *pukka sahib* wisdom with appropriate awe. Above all, he manages to make even the most enthusiastic exhibitors feel that perhaps a few more weeks in the laboratory wouldn't have done their new product any harm.

How can *you* advance from the "one-down" to the "one-up" audio position?

* *131 Riverside Drive, New York 24, N. Y.*

Readers of AUDIO may recall that in the May, 1954 issue I was privileged to reveal the basic rules of Hi-Fi-manship. It is, of course, a form of psychological warfare derived from Stephen Potter's *Gamesmanship* and is the electronic version of "How To Win Games Without Actually Cheating." The rules contained in that report, I feel, cover most normal hi-fi situations adequately.

But audio exhibitions present a special challenge. An audio show is to Hi-Fi-manship what a championship golf or tennis match is to *Gamesmanship*. With Audio Fairs now as much a part of the fall scene as pumpkin pie, it is therefore time to lay down the special rules of Audio Hi-Fi-manship, or "The Art of Listening to New Audio Gear Without Necessarily Buying Any."

Preparation Pays Off!

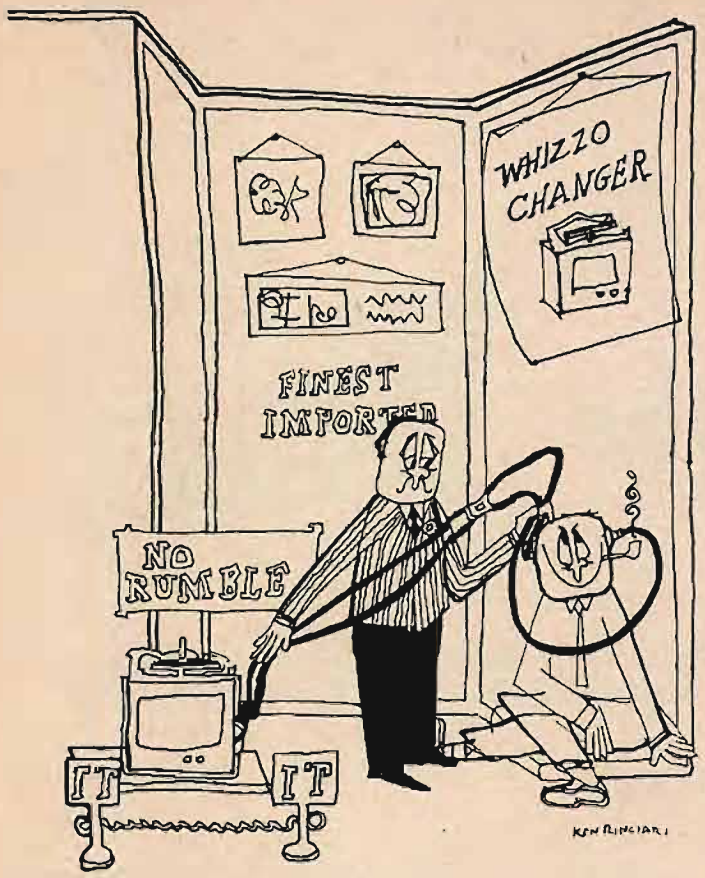
A certain amount of planning, as in any "war of nerves," is necessary. Let's look first at the matter of Correct Costume.

Wear a set of shaggy tweeds cut along unmistakably British lines. A few singes on it here and there, suggesting that you were careless with your soldering iron when building a stereophonic "front end," add to the effect. Don't wear a hat; your hair should have just the right amount of windblown look, indicating that you chose to drive to town that day with the top down on your Jaguar and that you wouldn't be found dead in a stock American car. A particularly smelly briar pipe completes the ensemble. The keynote you are trying to strike is "sophisticated informality."

Now for the business of Correct Equipment. In the various spacious pockets of your jacket, you will of course be carrying such time-tested Audio Showmanship props as:

1. *A reference text:* Don't bring along your latest copy of AUDIO—Too many people will have read it and will be thoroughly familiar with its contents. Track down instead an obscure and preferably out-of-print reference work on electronics in scientific German with a title something like *Der Einfluss der Telefunken auf die Wienerschnitzelindustrie* by Heinrich von Gesellschaft. This book will serve a double purpose.

ILLUSTRATIONS BY KEN RINCIARI



The "Dr. Kildareship" Approach

Ordinary medical stethoscope is a useful device for getting "one-up" on an exhibitor who is sure his turntable or changer is the very last word in rumble-free performance. Have salesman hold stethoscope against machine as you listen with air of Mayo Clinic specialist.

For one thing, you can use it to settle almost any argument on the finer points of loudspeakers and enclosures, since these two links in the audio chain afford far more opportunity for emotional discussion than do, say, amplifiers. You can ad-lib practically anything about speakers to suit your purpose (coaxials *vs.* single speakers; folded horns *vs.* infinte baffles, etc.) under the guise of translating from *Der Einfluss*, particularly if the text is printed in the hard-to-read "Olde English" type used in early Bibles.

For another, you can use the fly leaves as memo pads to jot down the model numbers and prices of audio equipment in which you are interested. Remember! The Hi-Fi-man attending an audio show *never* stuffs his pockets with literature given out by exhibitors. To do so is to betray that you are a novice in these matters.

2. *Recordings:* Audio firms of all sorts are always urging hi-fi fans to bring some "favorite recordings" to an Audio Fair so that "you can hear them in all their musical splendor." No Hi-Fi-man would dream of overlooking such an obvious set-up.

Bring with you not one but *two* tape recordings of, say, *Mozart's Concerto #21 in C Major for Piano and Orchestra*. Each of these tapes, which you will have prepared yourself, has special characteristics, vital to the successful practice of Audio Showmanship.

On the first tape, the low end falls off sharply at around 200 cps, so that all real bass is entirely absent. The other tape, containing the identical composition, has been prepared so that the low end is normal but the treble falls off to zero at around 3,000 cps. Drop rate should be at least 24 db per octave at either end.

Where the demonstration involves a fancy speaker system in an elaborate enclosure, a little adroit switching back and forth between these tapes can work wonders. The composure of even the most self-assured salesman will begin to crack under your dry comments (in the case of Tape #1) that "low end seems a trifle weak, don't you think?" or (with Tape #2) "You *did* say that tweeter went out to 20,000—didn't you?"

(Some Hi-Fi-men have experimented with a third version of this tape in which the music is recorded without the high-low tampering but where the turntable used in the dubbing process has some interesting "wows."

Thus, the tape acquires a built-in "wow" as well.

This is a particularly useful "ploy" to use against salesmen who are selling tape recorders, rather than speakers, since the impression is created that the drive motor is slipping. For other uses of the two basic tapes, see "Toscanini Ploy" below.)

The Grand Entrance

Since the position of "one-upness" at an audio show should be achieved as soon as possible, let everyone know immediately that you are not one of the common herd.

Look around at the registration desk for the Man In Charge. He is easily recognized by (1) his harassed look, and (2) the official-looking badge pinned to his lapel. Let's assume, for purposes of illustration, that the badge proclaims him to be John Q. Decibel.

He will be surrounded by a covey of people, but don't let that stop you. Walk up to him, cheerfully slap him on the back, meanwhile blowing a puff of smoke from your briar pipe (See "Correct Costume") in his face. He will turn and peer at you through the haze.

Shout "Good to see you, Jack." Pump his hand, warmly.

Then, *before he can speak,* say, "Seen Les Bogen or G. A. Briggs around anywhere?"

Observe the subtlety of this gambit. He will be so busy trying to remember where he last saw the two men you've mentioned that he will not have time to wonder who the devil you are. (Note: "Bogen" and "Briggs" are considered extremely "O.K. names" in Hi-Fi-manship circles. But the names of other recognized experts, from Maximilian Weil to Frank Ganci, can be substituted. At least two names, however, should be mentioned to weight the odds in your favor.)

He will make some stammering reply. Good-naturedly, you cut him short with "Never mind, Jack. I can see you're busy. I'll find them myself."

Stroll into the Audio Fair. If the Man In Charge is still looking after you with a puzzled expression, give him the *coup de grace*.

Shout back "Say, Jack . . . give my regards to Paul Klipsch, will you?"

You can now proceed in a state of "one-upness" to the audio exhibits.

"Out-dated Model Ploy"

Many an audio hobbyist makes up his mind about that new tuner or speaker at the Audio Fair, secure in the knowledge that he is listening and looking at the very latest equipment in the audio field.

As a Hi-Fi-man, your duty is to sow the seed of doubt in the minds of other hobbyists as you tour the exhibits.

Audio fanciers, like camera bugs and sports car enthusiasts, will hardly ever buy a piece of equipment if they feel that a more advanced version of it is just over the horizon. This is where the "Out-dated Model Ploy" is of great value.

Here's how the ploy is performed.

Walk into any room at an Audio Fair where the latest models of, say, the Dingbat Tuner are being shown. Look around for a Dingbat sales representative. When you've got his attention, dialogue can proceed along these lines:

Hi-Fi-man: "I'd like to see your new model. I've heard a lot about it."

Salesman: "Certainly, sir. Step over this way . . ."

Allow the demonstration to start. When a small crowd has gathered around you, suddenly stoop and examine the tuner closely. Then, straighten up and look the salesman directly in the eye.

Hi-Fi-man: (Firmly) "I beg your pardon, but I wanted to see your *new* model."

Salesman: (Taken aback) "But . . . this *is* our new model."

Hi-Fi-man: "Oh?" (Dramatic pause.) "What about the model that replaces this one?"

Salesman: (A bit tense) "There isn't any. *This* is our new model."

Hi-Fi-man: "Of course I may be revealing a confidence . . . but I was told by . . . well, never mind who told me . . . but I understand you're about to launch a *really* new tuner. I heard it had a binaural preamp, 10 inputs, 32 equalizing positions, and a circuit for color television." (At this point there will be some ugly murmurs in the crowd.)

Salesman: (Looking at hostile faces all around him) "Nobody told *me* anything about it."

Hi-Fi-man: (Graciously) "Well, I'm sure it's not your fault. I'll just wait a few weeks until the new ones come along. (Chuckle) Be tough to sell *this* one if *everyone* knew about the *new* job, wouldn't it?"

With minor variations, this ploy can be used throughout the Audio Fair. It is particularly useful against firms who sell fashionable "hi-fi," rather than high-fidelity, gear.

Special Audio Fair Tactics

Professional test gear, such as a portable oscilloscope and a square wave generator, are definitely "O.K. props" for creating the Hi-Fi-manship atmosphere of "one-upness." But such items are bulky, and act as a storm warning to salesmen and exhibitors that you are looking for trouble as you make the rounds of the Audio Fair.

Simple props used in conjunction with the "Mysterious 'H'mmmm' Approach" are equally effective and have the advantage of surprise. To illustrate:

A. *"Dr. Kildareship":* An ordinary medical stethoscope is an excellent psychological weapon to use against exhibitors of turntables and record changers. Enter an exhibit boldly. Listen awhile. Then, when the salesman begins to grow lyrical on the "absence of rumble," put the stethoscope in your ears and, *with a smile on your face,* put the "pickup" portion against the frame of the turntable. When the salesman can no longer keep his eyes from you, allow your smile to disappear *gradually.* Say, in a *plonking* tone, "H'mmmm. I thought so." Then leave.

B. *"In-the-Groove" Move:* Record companies have become major exhibitors in recent seasons at Audio Fairs, showing off their latest high-fidelity platters. At record exhibits, a simple jeweler's loupe—the kind pawn brokers hold in their eye when they are gazing critically at your Aunt Minnie's rhinestone earrings—is a useful device. Chat pleasantly with a record salesman about musical topics. Then, whip out the loupe, put it to your right eye, stare closely at any long-play disk, and say "H'mmmm." Then, *with the loupe still in your eye,* look up at the record man and say, firmly and clearly, "Cutting those grooves a bit deep, aren't you?"

C. *"Chippendale Ploy"* If you are trapped by a persuasive exhibitor who makes high-quality components, you immediately apply "Chippendaleship." This interesting tactic, relatively new in Audio Showmanship, requires only a slight knowledge of period furniture and a common tape measure. Look at the piece of equipment and mutter "H'mmmm."

Then, remove your tape measure from your pocket, and start to measure the height, width and depth of the object, ignoring any dimensions which may be stated in the free literature surrounding it.

Turn to the salesman and say, "It's a fine piece of equipment. But here's the problem. I've been planning to install my stuff in a Chippendale china closet I picked up recently. One of those mahogany pieces with the fretted cornices and latticework glazed doors 'Old Tom' made in 1754. You know the type, of course. I'm afraid this (indicate equipment) won't *quite* fit, and of course I wouldn't dream of *cutting* my cabinet to get it in. After all, it *is* a Chippendale."

D. *"Rule Brittania!" Gambit:* England has contributed, in recent years, much to the field of audio, and has helped greatly in bringing high-fidelity to its present degree of perfection. Every audio hobbyist is familiar with imported-from-Britain items such as Wharfdale and Tannoy speakers, Garrard and Collaro changers, KT-66 tubes, London ffrr recordings, and the like.

It is not amiss, therefore, to import the British Manner as well for use at audio shows. Allow the Mayfair accent to slip into your voice as you discuss new electrical equipment with American exhibitors. Use phrases like "Jolly good, what?" and "Positively smashing, that!" in praising gear. Refer, of course, to tubes as "valves," to phonographs as "gramophones," to tuners as "radiograms."

Then, when Anglo-American relations are at their best, pull from your pocket a copy of the latest trans-Atlantic airline schedule of British Overseas Airways Corp. Point to a checkmark made next to a BOAC flight leaving that very evening from Idlewild, bound for Central Africa.

Say to the salesman, "Look, old boy. I'm leaving in a matter of hours. Could one of your dealers crate up one of these tape recorders and have it expressed over to the field in time to make this flight?"

The salesman may do some figuring in his head and say yes, it's possible.

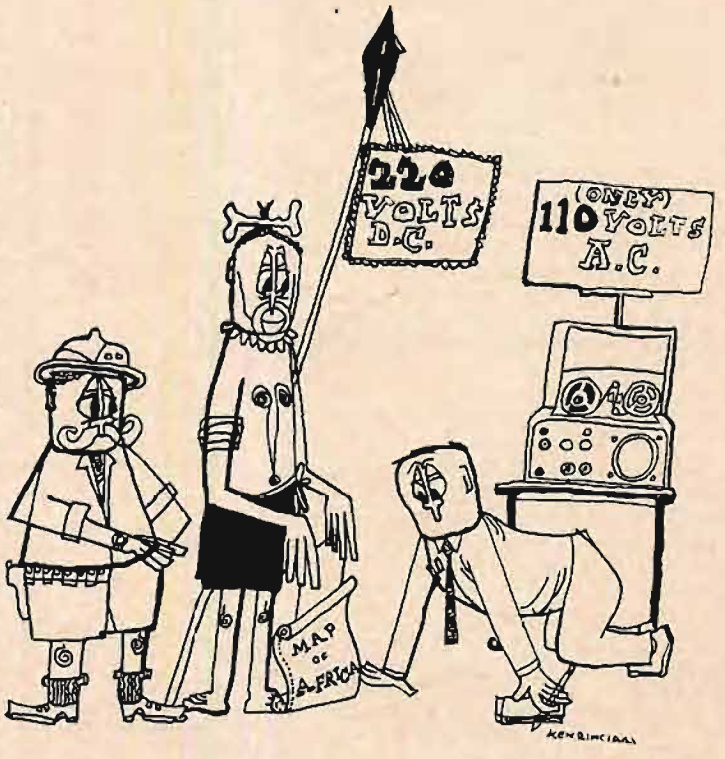
"Oh, I nearly forgot," you say. "It'll have to be a 220-volt model."

Then, if he's still standing, lower the boom. Say, "Naturally, that's 220-volts d.c. We don't have regular a.c. yet in *our* area of Kenya Colony."

Move in for the kill. Give him that Great White Hunter look and say, "You *do* have a 220-volt d.c. tape recorder, don't you?" He won't. That's your cue to exit.

E. *"Toscanini Ploy":* The odds are against it, but it *is* theoretically possible that in using the two gimmicked-up Mozart tapes (see "Correct Equipment" above) you will run into the following situation. Due to certain innate deficiencies of the audio system on which either Tape #1 or Tape #2 is being played—such as a speaker system with a super-strong "Juke box" bass or an extra-shrill treble—the trick tape you're playing will sound just fine. The built-in faults, in other words, will cancel each other.

(Continued on page 92)



The "Rule Brittania!" Gambit

"Reverse English" tactics can be worked effectively on Audio Fair exhibitors by those willing to prepare proper costumes. Pretend you are a Colonial Briton who wishes to have a 110-volt-a.c.-only tape recorder shipped to Darkest Africa for use with 220 volts-d.c.

Feedback Filters For 2-Channel Amplifiers

N. H. CROWHURST*

When crossover networks precede the power amplifier rather than following it the author's design principles will yield low- and high-frequency slopes of optimum values. The circuits employ no inductors.

THE MODERN TREND, following the development of dual- and multi-unit systems, seems to be to separate the frequency spectrum at desired crossover frequencies before the output amplifier. This procedure avoids any intermodulation of frequencies in the higher band by those in the lower band that may occur in the output amplifier. It also avoids the possible complications that can occur due to the complex loudspeaker impedances interfering with the crossover filter characteristics. It is more costly, because a separate output amplifier is required to serve each channel. However, the modern attitude seems to be: "Does it achieve noticeable improvement? Then hang the cost!" This—within reason—is a sound basis for progress.

To try out this scheme, several enthusiasts have asked the author for a design of crossover to insert between the preamplifier and output amplifiers that does not use inductors, and yet gives a steep cutoff—at least an ultimate of 12 db per octave. As each circuit has to be designed according to the whim of the enthusiast and to suit his particular arrangement, this article aims at aiding the enthusiast to design his own feedback filters. This presentation will have the added advantage that, knowing how the required response is built up, the builder can easily make adjustments to try out different crossover frequencies or other variations.

Design Theory For 12 db Per Octave

The 12-db-per-octave response is the simplest to achieve with the feedback method. As with the filter-type crossovers, the varieties giving steeper cutoff slopes are more critical of circuit values.

Figure 1 illustrates the method for the 12-db-per-octave case in theory. Two cutoff networks having identical turnover frequency, connected in cascade without interaction (separated by the amplifier in the diagram), will show a loss of 6 db at the turnover point (2×3 db). Taking the response of each as

$$D = 1 + jx \qquad (1)$$

the combined response without feedback is

$$D = (1 + jx)^2 = 1 - x^2 + j2x. \qquad (2)$$

With feedback this becomes

$$D_f = F - x^2 + j2x \qquad (3)$$

whence the attenuation response with feedback can be written

$$db_f = 10 \log_{10} \left[\frac{F^2 + (4 - 2F)x^2 + x^4}{F^2} \right]. \qquad (4)$$

This will have the maximum sharpness without introducing peaking when the x^2 term in the numerator is zero, or $F = 2$, representing 6 db feedback. The turnover point will then be when $F^2 = x^4$, or $x = \sqrt{2}$. This means that the turnover point for the low-pass unit will be $\sqrt{2}$ times the turnover point of each original network. Conversely, the original turnover point must be made 0.707 times the final turnover frequency required.

For the high-pass unit the frequency shift will naturally be in the reverse direction, so the original turnover should be 1.414 times the final turnover required, and 6 db feedback will again produce the correct over-all response.

Figure 2 shows a complete channel-separating stage designed for a crossover of 2,000 cps, which has been found to work perfectly. Recommended American tubes are the 6AU6, (the circuit was designed for the EF40) which will give a gain of about 100 with the circuit values shown. Other tubes could equally well be used, following the same procedure. A gain of 10 is thrown away in the input potentiometers, so there remains an over-all gain, without feedback, of 10, which is 20 db. When the 6-db feedback is applied, the over-all gain drops to 5, or 14 db. Now for the circuit values to produce the right response:

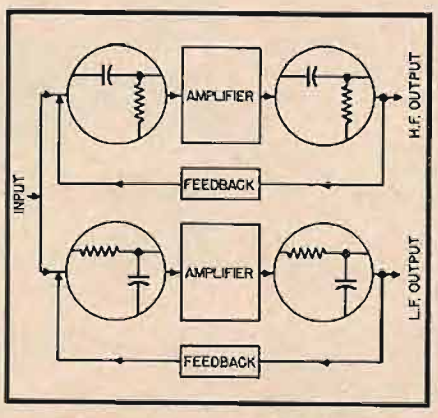


Fig. 1. Block diagram of feedback circuit to provide crossover with ultimate slope of 12 db per octave.

For the low-pass unit, V_1: The cutoff in the plate circuit is a capacitor C_1 in parallel with the plate load and following grid resistor. This parallel combination of resistance is about 70,000 ohms, so the capacitor should have a reactance of 70,000 ohms at 1,414 cps (0.707 × 2000), giving a value of about .0016 μf. In the grid circuit, the capacitor C_2 shunts a series-feed resistor of 0.1 meg giving a total source impedance of 0.11 meg so its reactance should be 0.11 meg at 1,414 cps, or about .001 μf.

For the high-pass unit: Cutoff in the plate circuit is a capacitor C_3 in series between the plate load and the following grid resistor, so its reactance should be 0.35 meg at 2,828 cps, requiring a value of about 160 μμf. In the grid circuit the capacitor C_4 is in series with a 10,000-ohm source and 0.1 meg load, so it should have a reactance of 0.11 meg at 2,828 cps, or 500 μμf.

Now the feedback: To give 6 db negative feedback, the fed-back voltage must be equal to the input voltage at the feedback point. Notice how simple the relations are. The gain of the stage is 100, so the attenuation in the feedback must be 100 to 1. The bottom end resistor R_1 and R_2 is already set at 10,000 ohms, so resistors R_3 and R_4 are 1 megohm. This will, in effect, be in parallel with the plate load, but the reduction in gain will be within the tolerance limits on resistor values. Stock components together will generally produced the right response. In some instances it may be necessary to do some trimming due to component tolerances. The method is as follows:

Trim the plate circuits first, to have cutoffs showing 3 db at 1,414 and 2,828 cps, respectively, for the low- and high-frequency units. To do this short C_2 and open C_3 to put the grid cutoffs out of action. Return the feedback resistors R_3 and R_4 to ground instead of to the grid circuits. Now adjust the capacitance values C_1 and C_3 for preference.

Next, replace C_3 and C_4. Short C_3 with 0.1 μf and open C_4. Trim C_3 and C_4 to give cutoffs of 3 db at 1,414 and 2,828 cps, respectively.

Finally put both sets of cutoffs into action, and check the gain of each filter, the low-frequency unit at, say, 250 cps,

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and the high-frequency unit at, perhaps, 10,000 cps, still with R_3 and R_4 grounded. Now replace the connections of the feedback resistors R_3 and R_4 to the grid circuits so as to bring feedback into action, and check the reduction in gain at these same frequencies. Adjust the values of the feedback resistors until the reduction is 6 db.

If all this has been followed correctly, the over-all responses will now both have a turnover 3 db down at 2,000 cps and will show an ultimate slope of 12 db per octave.

The advantage of this circuit is that the adjustments can, if necessary, be made in simple, independent steps, so that prolonged cutting and trying should never be necessary.

For the benefit of those who want still steeper cutoffs by this method, the author has investigated the theory of arrangements to produce ultimate slopes of 18 and 24 db per octave. The complete analysis will not be given here, because the author feels that the possible advantages in performance, which are open to argument, are scarcely worth the detailed trimming that will be necessary to secure the correct response. However, here's the information for those enthusiasts who want to try.

Investigation shows the only arrangement that will produce complementary responses having a maximum sharpness of 18 db per octave requires three cutoff networks, two with identical turnovers and one different. The response of such an arrangement can be written:

$$D = (1+jx)^2(1+jnx) = 1-(2n+1)x^2+j(n+2)x-jnx^3. \quad (5)$$

With feedback this becomes

$$D_f = F-(2n+1)x^2+j(n+2)x-jnx^3, \quad (6)$$

whence the attenuation response with feedback can be written

$$db_f = 10\log_{10}\left[\frac{F^2+\{(n+2)^2-2F(2n+1)\}x^2+\{(2n+1)^2-2(n+2)\}x^4+n^2x^6}{F^2}\right]. \quad (7)$$

This will have maximum sharpness without introducing peaking when both the x^4 and x^3 terms disappear. From the x^3 term, this requires

$$n=\frac{-1\pm\sqrt{13}}{4} \quad (8)$$

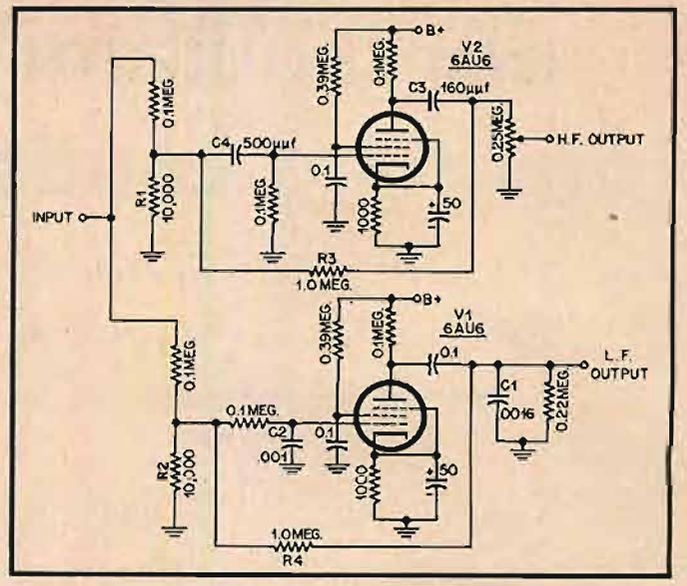

Fig. 2. Circuit devised to give crossover at 2,000 cps using principle of Fig. 1. Derivation of values is explained in the text.

of which the only positive root approximates to $n=0.6514$. This means that the odd network has a cutoff equal to the reciprocal of this times that of the other two (low-pass unit) or 1.535 times. Substituting this value of n into the x^2 term and equating to zero, the feedback required is given as $F=1.5264$, or 3.672 db. The 3-db turnover point will occur when $F=nx^3$, which by substituting values of n and F gives $x^3=2.362$, or $x=1.332$.

In terms of the final turnover frequency, the low pass unit requires two networks at 0.75 f_0 and one at 1.15 f_0. For the high-pass unit, using reciprocals, two networks are required at 1.332 f_0 and one at 0.87 f_0. In each case the over-all feedback to give the correct shape is 3.67 db. This information is illustrated in *Fig. 3*.

24 db-per-Octave Slope

Investigation of various combinations of over-all loop feedback shows that no arrangement of a 4-stage loop will produce the required response. It is possible, however, to synthesize the required over-all response by using two 2-stage feedback loops in cascade, with different characteristics. Starting in this case with the required final response, this can be written

$$db = 10\log_{10}[1+x^6] \quad (9)$$

which can be factored into

$$db = 10\log_{10}[1-\sqrt{2x^2}+x^4][1+\sqrt{2x^2}+x^4] \quad (10)$$

the first factor of which represents a combination giving a peak, while the latter is a more heavily damped arrangement.

Taking the first factor, representing the peaking loop,

$$db = 10\log_{10}[1-\sqrt{2x^2}+x^4]. \quad (11)$$

This can be resolved either in terms of the peak frequency or the point where the slope is 6 db per octave, about which the phase response is symmetrical. The latter proves more convenient for our purpose. Writing

$$D^2 = 1-\sqrt{2x^2}+x^4,$$

this point is found by equating

$$\frac{d\log D^2}{d\log x^2}=1=\frac{2x^4-\sqrt{2}x^2}{x^4-\sqrt{2x^2}+1} \quad (12)$$

whence $x^2=1$. Substituting this into *(11)* gives the attenuation at this point as

$$10\log_{10}(2-\sqrt{2}) \text{ or } 10\log_{10}0.586$$

meaning it is above zero level 2.33 db. Assuming two identical networks are used, the feedback factor F is given by

$$\frac{4}{F}=2-\sqrt{2} \text{ or } F=2(2+\sqrt{2})=6.828 \quad (13)$$

representing 16.69 db of feedback.

To find the original turnover frequency of each network in terms of the final 6-db-per-octave slope point, which is also the final turnover point, as shown by *(9)* and the fact that both occur at $x=1$, for this is given by $Fx^2=1$ for the low-pass unit, or $x=0.3826$.

(*Continued on page 95*)

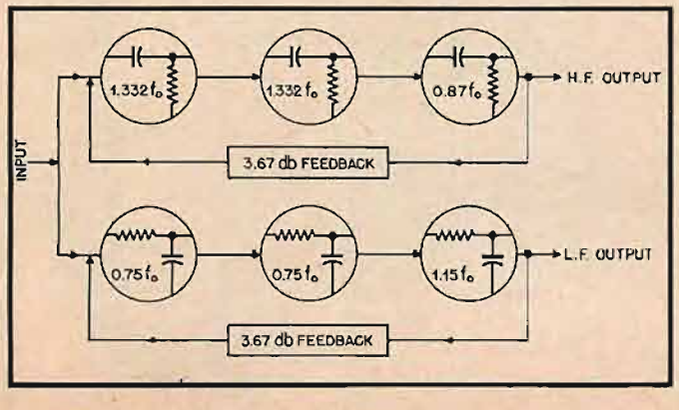

Fig. 3. Arrangement of 3-stage loops with feedback to give crossover with ultimate slopes of 18 db per octave. For simplicity the amplifier section has been omitted.

A Laboratory Reference Standard Loudspeaker System

DANIEL J. PLACH* and PHILIP B. WILLIAMS**

Design considerations for a loudspeaker suitable for high-quality monitoring applications in broadcast and recording studios, as well as for the discriminating listener who demands the optimum in performance and aural realism.

THE EAR IS A MECHANISM of relatively short "memory." It cannot record impressions accurately enough for close comparisons of audio reproducing systems if much time elapses between auditions. The most thorough and time-saving method of contrasting the sound qualities is to switch frequently between systems during the test.

A need was felt at our laboratory for a complete reproducing system which would constitute a standard of comparison for evaluation of speakers during design and development. In addition to the more ordinary requirements for response, distortion, smoothness, and so on, these performance factors were assigned paramount importance:

(1) Pure bass output to 35 cps, even at high operating levels, and at such efficiency as to require *no bass boost* in the amplifier.

(2) Elimination of colorations or spurious sounds.

(3) Uniformity and smoothness of output over the entire range, in such degree that with high-quality source material, no external electrical equalization would be required.

No restrictions were placed upon cost or on the components to be used. The number of channels incorporated in the complete unit was to be determined from extensive theoretical considerations and aural analysis of the practical results.

The evolution of this new speaker system has been accompanied by a growing realization of the uses for which it is eminently suitable. An intrinsically uniform sound reproducer can be of primary importance in analyzing recorded or reproduced sound in many phases of audio and associated industries.

Design Considerations

It is generally realized that the extreme ends of the audible spectrum are most difficult to reproduce. Furthermore, the requirements for high- and low-frequency speakers are incompatible. At low frequencies the excursions of a diaphragm are large and require large cones. These large amplitudes involve special designs to reduce distortion that may arise from nonlinearities in the suspension system or flux field surrounding the voice coil. Generally, a low resonant frequency is desirable to place distortion products at low frequencies where they are less objectionable to the ear. This last factor necessitates the use of compliant suspension and heavy moving-system mass.

While some similar problems occur in high-frequency units, they are not so pronounced, since amplitudes are small. The problem in maintaining good high-end performance is to minimize the effective mass of the moving system, and in the case of horn speakers to maintain small clearances between diaphragm and sound chamber. Additional complicating factors are the need for good spatial distribution and smooth response.

It is generally conceded now, however, that there are few occasions when treble boost is required in a reproducing system with an effective top-end tweeter and with record equalization. On the contrary, an efficient tweeter often must be padded down to avoid over-brilliance or to reduce noises inherent in the program material.

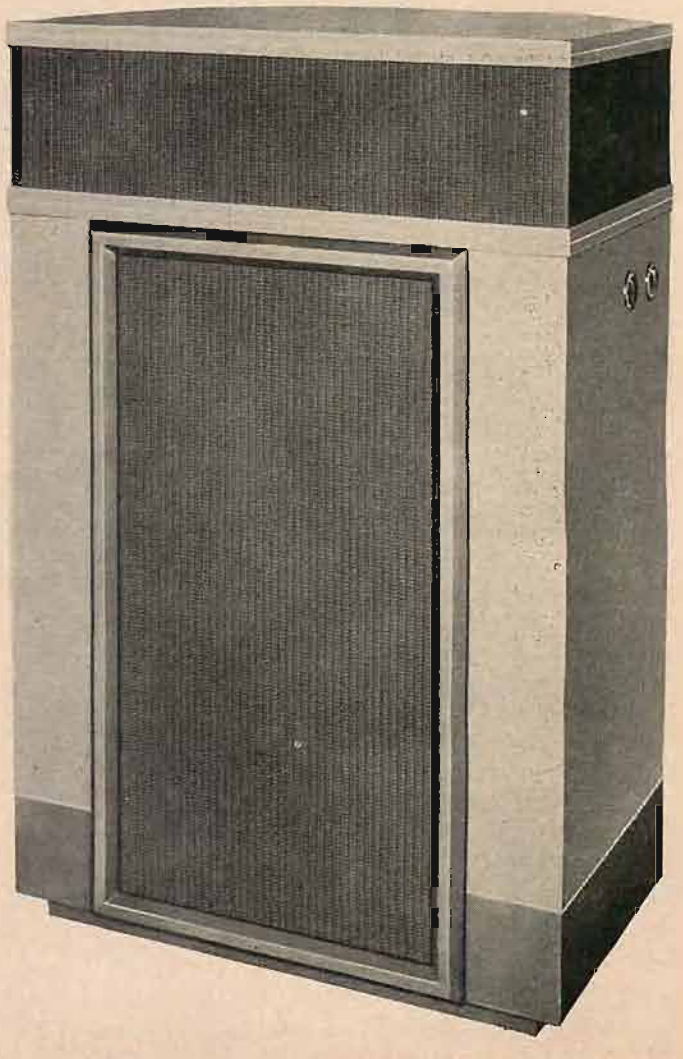

Fig. 1. The Jensen Laboratory Standard Loudspeaker, Model RS-100.

*Senior Physicist; **Chief Engineer, Jensen Manufacturing Company, 6601 So. Laramie Ave., Chicago 38, Ill.

With a flat high-frequency response, experience has shown that high-end boost is rarely necessary, if ever. This can be attributed to the Fletcher-Munson effect, in that the ear is less sensitive to change in response with respect to level variations as compared to effect of such change at low frequencies.

With many speaker systems, liberal use is generally made of the bass boost controls, especially when: listening level is disproportionately low, woofer is inefficient, improperly matched, or not housed so as to get the most from its capabilities, or program material is deficient in bass, due to poor pickup or recording.

A common misconception about speakers is that a big efficient speaker in an infinite baffle, driven by an amplifer with high damping factor is the ideal combination. Severe over-damping of the speaker can give as much as 10 to 12 db loss at the speaker resonant frequency. There is no advantage in exceeding critical damping by using too low an amplifier internal impedance. To the contrary, there is some preference for slight under-damping in the interest of better attack time. Under high damping conditions, a bass-reflex enclosure gives considerable improvement over a total enclosure even when the latter is large enough to be considered infinite in size for all practical purposes. Properly designed horn loading, of course, gives the best low end output and performance.[1]

Boosting bass in the amplifier to compensate for insufficient speaker output has several drawbacks. The woofer cone has to move further, and may reach a condition of overloading. Harmonic and intermodulation distortion to a serious degree may be found when 10 to 12 db of bass boost is used. Under conditions of high bass boost, an amplifier is severely limited in average power output before it becomes overloaded—and the overload is maximum at the low frequencies where amplifier performance is necessarily the poorest. When the happy combination of reducing both the power output of the amplifier and woofer cone movement can be achieved, important gains in sound quality are found. The closest approach to the ideal condition at this stage of the art comes with use of a well-designed woofer-horn system in which these elements are optimally matched together to take advantage of complementation of physical and acoustical factors.

Highly damped speakers in closed boxes or infinite baffles do not emit bass sound equivalent to that of the original pickup unless some amplifier bass boost is used. There are already too many losses in the recording-playback system to allow much additional loss in the speaker. The pickup microphone may have a drooping low end, especially where tailored to favor speech. Records have definite groove limitations, although equalization is intended to compensate by a boost in the preamplifier. Pickup cartridges usually have some loss at extreme low frequencies. If these other transducers are not perfect—as they are not at this stage of the art—it is doubly important to gain low end efficiency where it is still possible—in the loudspeaker system.

[1] D. J. Plach and P. B. Williams, "Horn loaded loudspeakers." *Radio and Television News*, May, 1952.

The New Model

In this unit, the utmost planning, designing and auditioning of various combinations and designs have given a reproducing system which comes close to the ultimate goal of speaker designers—to reproduce sound exactly equivalent in proportion and timing to the original sound-produced electrical energy. Final testing has been done over a considerable period of time both in the laboratory listening and measuring rooms and in living rooms of well known audio experts before large and varied audiences. This extensive auditioning with microgroove records, tape recordings, FM and AM programs, has shown that bass boost has been called for only on rare occasions—no more, actually, than the instances in which some bass drop would be acceptable, or even desirable for optimum balance as judged by the ear. The new Laboratory Reference Standard loudspeaker, RS-100, is an integrated system based upon the solid foundation of optimized and intermatched elements and components selected, and modified where necessary, to deliver as close to flat total sound output as the state of the art permits. Painstaking attention to sound character and cleanness of quality has resulted in a unit which can be listened to for long periods of time without aural fatigue or consciousness of distracting self-generated sounds. This loudspeaker is pictured in *Fig.* 1.

This superb performance has been achieved with an articulated triple-channel system completely horn loaded. Choices of the midchannel, and to a lesser extent the high-channel units, were dependent upon the highest frequency at which the woofer could operate without noticeable breakup or intermodulation.

Actually, for the best arrangement, this top frequency is not high, varying from 400 to 800 cps for a 15-in. woofer, dependent upon its construction and the lowest frequency of operation needed. Any woofer has a limited range of frequencies over which its cone operates as a piston, moving as a unit without the segment vibration sometimes used in speakers to raise the normal high-frequency cutoff. When something can be done to extend one end of the woofer range without affecting operation at the other end, the job of the midchannel unit can be made easier, and sound quality of the system thereby improved.

What can be done to stretch out the woofer passband and still keep it clean? The high end can be extended by lightening the cone, making it stiffer, or lightening the voice coil. But all of these things tend to degrade the low-end performance. But something can be done with the low end—a trick which is entirely practical and gains extra lows. Based on sound design principles,[2] "reactance annulling" is used to mutually cancel out limiting factors in the speaker and in its loading horn by designing these elements to complement each other.

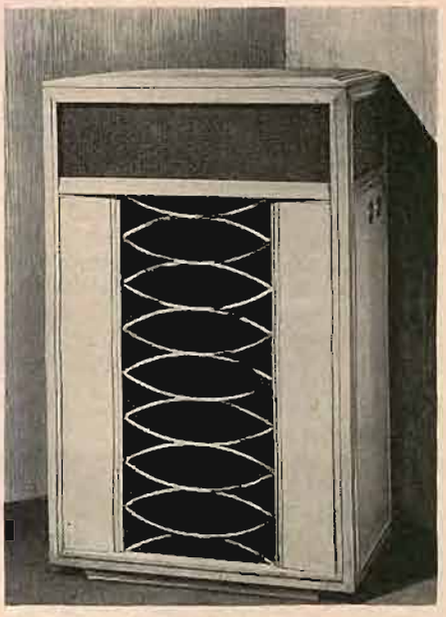

Fig. 2. The Laboratory Standard speaker in *furniture-type* styling suitable for the home.

Below its resonant frequency as operated in free space, or in a box, a speaker is stiffness-controlled, meaning that the suspension primarily determines the cone velocity. Under this type of operation, acoustic output drops off, while distortion rises rapidly. In this range the speaker appears capacitive in nature as viewed from the driving point on the mechanical side.

A horn presents to a loudspeaker a complex load consisting of a useful resistive component accounting for acoustical radiation, and a quadrature component which is mass-like or inductive in nature. In the hypothetical infinite horn, the throat resistance is theoretically zero at the cutoff frequency and the mass reactance generally has its maximum value at this point for most useful horns. For the practically usable finite horn, the throat resistance at cutoff is not zero. It has a small but finite value at this point, and approaches zero below horn cutoff.

Reactance Annulling

To obtain maximum possible efficiency in the vicinity of cutoff, it is imperative to cancel the positive mass reactance of the horn by counteracting it with the stiffness of the speaker suspension. Since the speaker is stiffness-controlled below resonance, proper choice of system parameters can achieve this required reactance annulling at horn flare cutoff. This condition requires that the speaker resonant frequency be placed *higher* than horn flare cutoff. The resonant frequency, however, cannot be chosen arbi-

[2] D. J. Plach, "Design factors in horn-type speakers." *J. Aud. Eng. Soc.*, October, 1953.

trarily. It must be related to the type of horn, the cutoff frequency and to throat size. This annulling also effectively cancels out the speaker stiffness effect, so that it operates normally *below* its free space resonant frequency and to frequencies somewhat below horn cutoff.

The choice of horn flare is important. The Jensen hyperbolic-exponential flare family[3] has characteristics markedly better than the well known exponential type. The throat resistance characteristics can be made more constant closer to cutoff by proper flare choice. In fact almost any desired reactance or resistance characteristic near cutoff frequency can be obtained by appropriate choice of the flare parameter T.

The RS-100 employs the principle of reactance annulling in the woofer and midchannels. The effect is most striking in the woofer channel, where solid, clean bass is available as low as 32 to 35 cps, and at relatively high power.

In general, distortion in a woofer rises as the frequency is lowered, because of the greater cone movement as frequency decreases. *Figure* 3 shows an unretouched photograph of an oscilloscope tracing of the output of the "furniture" model of the speaker, PR-100 (shown in *Fig.* 2), at low frequencies at high power levels. These powers are considerably more than to be expected in ordinary use. The close conformance to the original sine wave pattern shows negligible distortion at frequencies and powers commonly expected to give considerable harmonics instead of pure tones. In a typical medium or large listening room, 50 milliwatts (1/20 watt) average power as indicated by a VU meter gives sufficient power to this speaker system to provide louder than normal listening level. At this average power, assuming 20 db increase for peaks to be expected in orchestra music, 5 watt peaks will drive the speaker system. This means that speaker distortion will be so small as to be negligible and probably not even detectable. Extensive listening tests have not shown up any instances of recognizable distortion at these low frequencies.

The enclosure consists essentially of low frequency horn, with the necessary trimmings, mountings, hardware, controls, and space for smaller reproducers and networks. The T of the flare is 0.70, with theoretical 40-cps cutoff. The trilateral-mouth area of 576 square inches has an effective area of 4000 square inches in a corner. The woofer is mounted at the bottom of the front panel, radiating backward and upward. In a manner of speaking, it is a restricted-range two-channel system by itself. The special 15-in. cone type driver is designed with a heavy, high-inductance, low-resistance voice coil and heavy-body cone. Speaker loading, a sign of efficiency, is quite heavy, so that cone movement is relatively small even at the bottom frequencies.

As a direct result of extending the operation of the woofer below its otherwise normal cutoff frequency, a 600-cps top frequency is attainable. At this point, horn loading a compression driver is perfectly practical, and in fact desirable. It is not generally realized, but the musically important region from 300 to 600 cps is difficult to reproduce in a completely horn-loaded speaker system of reasonable dimensions. Even a properly designed 2-in. compression driver diaphragm when properly loaded must move an excessive amount at 380 cps, where power peaks in orchestral music are at a maximum. With a system rated at 35 watts input, as is the RS-100, twenty-two thousandths of an inch movement would occur occasionally for typical peaks in orchestral program material. While this movement is not great for a cone speaker, it puts a severe strain on compression drivers intended for the most linear sound output. At a frequency of, say, 600 cps, this movement for the 2-in. voice-coil compression diaphragm is reduced to about six thousandths of an inch, well within its capability.

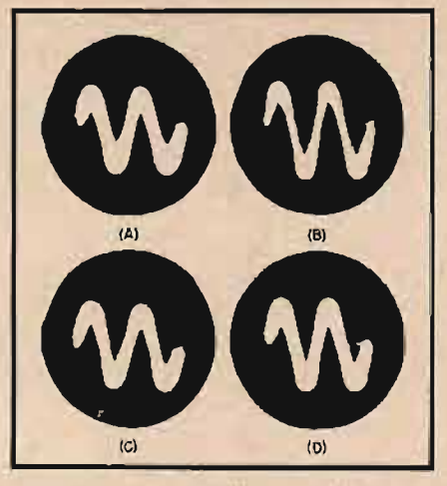

Fig. 3. Unretouched oscillograph photos showing sine-wave response at various outputs and frequencies: (A) 35 cps at 16 watts; (B) 40 cps at 16 watts; (C) 40 cps at 30 watts; (D) 60 cps at 30 watts.

The back-radiation from a woofer cone cannot be depended upon to produce much output above about 300 cps, because of the many reversals of direction of the air path and absorption in surfaces and irregularities of structural members of the enclosure. While a separate woofer can be used to fill in this response region, the extra space required is rather large if complete horn loading is an objective for a system.

The simplest method is to use the front of the woofer cone for direct radiation to the outside. This operation does not detract from back loading performance, and indeed simplifies it in some ways, So in effect, the 15-in. unit is operating in a modified two-channel arrangement of its own, with an acoustic crossover at about 300 cps.

The range from 600 to 4000 cps is reproduced by a type RP-201 midchannel speaker. While this unit operates quite well to 7000 cps, an advantage in spatial distribution is effected by utilizing a smaller unit above 4000 cycles. The RP-201 uses a 2-in., voice-coil, reentrant, fabric-filled, phenolic diaphragm and a cast hyperbolic-exponential horn with flare of $T = 0.7$. A multiple take-off passage eliminates sound-chamber interference effects in the passband of this driver. An intra-range equalizer is installed in this channel to give the complete system response balance considered by listeners as most nearly ideal.

Any desired reduction in output from these channels is provided by continuously variable pads at the side of the enclosure. These adjustments are independent of each other, for maximum flexibility and accommodation to different program material. This considerable latitude of adjustment in balance of the whole system will adapt the RS-100 for use in rooms of any size and degree of liveness. In a large room with many drapes and other absorbing material, the two pads should be adjusted for high output to compensate for frequency selection absorption. A small living room position usually calls for about 2 db padding in the midchannel and 6 db in the tweeter. These attenuations occur with both control knobs vertical. This vertical position is considered the "normal" position for flat response.

From 4000 cycles up, the ultra-high-frequency RP-302 Super-Tweeter reproduces all the tinkles, swishes, and "musical instrument separation" possible at this stage of the art. This tiny unit, self-contained with its own horn of $T = 0.7$, is mounted "piggy-back" on the midchannel horn to minimize baffle-type reflections.

The lightweight, phenolic-resin-impregnated tweeter diaphragm has an inherent "damping factor" as a physical characteristic. Unlike metallic radiating surfaces, this phenolic material can be moved by its motor system without the excessive breakups and resulting harsh noises and intermodulation frequently apparent in metal diaphragms. This damping feature is especially important in the presence of interfering scratches, pops and other noises which always occur to some degree in record surfaces. At best, any sudden impulse such as record groove imperfections may create has an annoyance factor of its own, and the annoyance is multiplied many times if the speaker unit moving system is free to oscillate as one piece or in segments, following a burst of noise.

At very high frequencies, where the voice coil has an increasing tendency to become decoupled from the diaphragm, internal damping is extremely important, as internal dissipation in the diaphragm is the controlling factor in transient performance.

For this reason, the phenolic diaphragm, with its high internal damping, is preferred to the aluminum or magnesium type diaphragms, with their inherently high-Q characteristic. Phenolic plastic material is preferred from the standpoint of transient performance in high-quality reproducing systems.

(*Continued on page 84*)

[3] U. S. Patent 2,338,262.

The Employer's Rights In Employees' Inventions

ALBERT WOODRUFF GRAY*

Is your invention yours or your employer's?

A PATENT ON A LOOP ANTENNA granted to an employee of a New York radio manufacturer was the subject of a recent action by the employer in the Federal Court, in which it was maintained that this employee had no right of any kind in this patent.

The filing of the patent application, the company contended, had been a violation of trust and confidence imposed by the employer in this employee and the employer asked the court for a decree that the employee be compelled to assign the patent to the employer, for an injunction against any charges of infringement that might otherwise be made by this employee, and for an accounting of profits.

In his defense the employee contended that this former employer had infringed his patent and had unjustly enriched itself by the use and sale of the products manufactured under the patent.

When this patentee had entered the manufacturer's employment he had represented himself to be an experienced mechanical engineer and was assigned with others to the development and improvement of this antenna, then being assembled for the United States Signal Corps. Later the employee had secured a patent on the antenna and as a consequence of threats made by him to the Signal Corps of an infringement action, the government demanded that the manufacturer indemnify it against litigation of this character.

A few months ago the Federal Court decided in this action that the employee had no right of any nature either in the invention or in the patent and granted an injunction against the making of any infringement claims by the employee or by any others in privity with him.

The principle of law governing the rights of an employer and employee in the inventions made by the employee has been set out by Justice Jackson of the United States Supreme Court in a recent decision.

"Though the mental concept is embodied or realized in a mechanism or a physical or chemical aggregate, the embodiment is not the invention and is not the subject of a patent. This distinction between the idea and its application in practice is the basis of the rule that employment merely to design or to construct or to devise methods of manufacture, is not the same as employment to invent.

"Recognition of the nature of the act of invention also defines the limits of the so-called 'shop right' which, shortly stated is that where a servant, during his hours of employment, working with his master's materials and appliances, conceives and perfects an invention for which he obtains a patent, he must accord his master a non-exclusive right to practice the invention.

"This is an application of equitable principles. Since the servant uses the master's time, facilities and materials to attain a concrete result the latter is in equity entitled to use that which embodies his own property and to duplicate it as often as he may find occasion to employ similar appliances in his business.

"But the employer in such a case has no right to demand a conveyance of the invention which is the original conception of the employee alone in which the employer had no part. This remains the property of him who conceived it together with the right conferred by the patent to exclude all others than the employer from the accruing benefits."

A few years before the incident involving this loop antenna patent a similar action was brought by the United States against an employee of the Army Engineering Laboratories, asking for the assignment of a patent issued to that employee. The employee had been hired under a so-called "Patent Memorandum" of the government that,

"You are hereby assigned to develop improvements in arts of value to the Chief Signal Officer. It is expected that this work may result in the discovery of patentable features and your assignment to this work is for the particular purpose of vesting in the United States all right, title and interest in any invention that you may make while engaged in the work assigned if in the opinion of the Chief Signal Officer the public interest demands that the invention be owned and controlled by the War Department."

Within a month or two after undertaking this assignment the employee conceived the idea of an alternating current generator that would maintain within limits the voltage output notwithstanding the load. After the patent had been issued on this invention the government asked the employee that he execute a general license to the government for the use of the patent or an assignment with a license to the employee permitting him to use the patent in any commercial arrangement he might make. The employee refused to accept either suggestion and suit was brought by the government for an assignment of the patent itself.

In its decision in favor of the government in this action in which this employment memorandum was a determining factor, the Federal Appellate Court said of the rights of employers in employee inventions,

"In the absence of agreements fixing the rights of the parties, the rights of an employee in an invention which he has made are subject to different rules depending upon the facts. If he has made an invention on his own initiative and on his own time and resources the invention belongs to him and the employer has no rights in it.

"If while engaged in a certain line of work for his employer he has devised or improved a method or instrumentality for doing the work, using the property of the employer and the services of other employees to develop his invention and has assented to the use of the same by the employer, the invention is his property subject to an irrevocable license or shop right in the employer.

"If he makes an invention while employed to make investigations and conduct experiments for the purpose of making it, the invention is the property of the employer, who is entitled to the fruits of the labor for which he has contracted."

In another case involving circumstances of this character a Federal Court, asserting that the employee had merely performed the services for which he was paid, said in directing an assignment of the patent to the employer,

"An employee performing all the duties assigned to him in his department of service may exercise his inventive faculties in any direction he chooses with the assurance that any invention he may thus conceive and perfect is his individual property.

"But this general rule is subject to these limitations. If one who is employed to devise or perfect an instrument or a means of accomplishing a prescribed result, he cannot after accomplishing the

(*Continued on page 90*)

* *35–36 76th Street, Jackson Heights, N. Y.*

A Transistor Phonograph Preamplifier for Magnetic Pickups

BASIL T. BARBER*

Complete instructions on building a transistor preamplifier with miniscule power requirements, with an analysis of its performance and data on transistor circuits in general for audio use.

RECENT AVAILABILITY of improved types of transistors and their present successful application in the field of communications, computers and guided missiles, indicate that the transistor has at last ceased to be looked upon as a laboratory curiosity and is rivaling in performance many functions that the vacuum tube has monopolized for the past thirty years.

In the audio field, with the exception of a few "transistorized" hearing aids and AM tuners, progress has been slow, at least in comparison with other fields. This was due mainly to the inherent technical limitations of the new item and its scarcity and high cost, rather than the audio engineer's or high-fidelity addict's lack of pioneering spirit. Now that most of the original limitations of the transistor have been either eliminated or greatly reduced, the way should be open for an increased number of transistor applications in audio reproduction.

Following is a brief classification of the three basic types of transistor circuits with their duals in the more familiar vacuum-tube circuit. A word of caution is warranted. Do not begin replacing grids with bases, plates with collectors, and cathodes with emitters! A basic understanding of transistor operation is essential to avoid frustration and disappointment in designing circuits around them. Adequate literature is already available, and although the theory of semiconductors is not likely to be found easy to digest, one does not have to wade through Shockley's "Electrons and Holes in Semiconductors" in order to design simple transistor circuits for audio applications.

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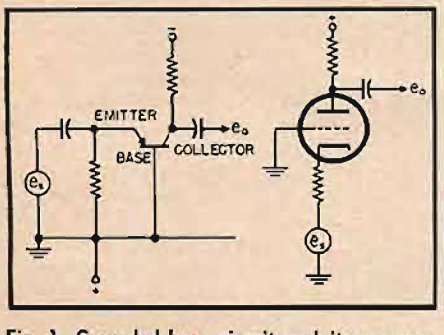


Fig. 1. Grounded-base circuit and its vacuum-tube equivalent.

Transistor circuitry can be, very broadly, put into three classes, depending on which element is grounded. Functionally, each class performs differently and its selection for a particular application will depend to a large extent on the specific requirements of the application as to gain, input and output impedance, noise level, power output, frequency response, etc.

Grounded-Base. Figure 1 presents the first class. Electronically it is similar to a grounded-grid vacuum-tube amplifier. Input impedances of as high as 1,000 ohms and output impedances of as high as 20,000 ohms are possible. These are comparatively low; it is necessary to use high-value input capacitors and matching transformers if transistors are employed in cascade. Gains per stage as high as 37 db are possible, with matched impedances. There is no 180-deg. phase reversal as in a tube, and two batteries are required, or a tapped one. The principal problem with grounded-base circuits is one of stability, especially if transistors with α, the current amplification factor, greater than 1 are employed. Junction transistors are superior to the point-contact type in this respect.

Grounded-Collector. In *Fig.* 2 we have the grounded-collector circuit, which resembles the vacuum-tube cathode-follower. The voltage gain is less than 1, but can be made as high as 0.95, a loss of less than 1 db. *Power* gains as high as 20 db have been recorded. There is no polarity reversal and external stabilization with bleeders may be necessary. The most interesting feature of the grounded-collector circuit is the relatively high input impedance which, although it can be as high as 1 megohm, depends on the load resistor R_L. Low values of R_L will bring the input impedance down. The output impedance can be made as low as 100 ohms. The techniques of self-bias can be employed as successfully as in vacuum-tube circuits. *Figure* 3 shows a common method of self-biasing. E is the bias obtained from voltage divider R_1–R_2.

Grounded Emitter. Figure 4 shows a popular type of transistor circuit for attaining good voltage amplification. Gains as high as 46 db are possible, and the circuit exhibits a 180-deg. phase reversal at its output, making possible the application of negative feedback around it without resorting to transformers. The input and output impedances are higher than the ones of the grounded-base class, but the problem of stability still exists, although it can be corrected with bleeders as before. In *Fig.* 5, self-bias is again employed, eliminating one battery.

Transistors and Audio

With the above brief resumé in mind, an evaluation of transistors can be made in terms of functions and characteristics directly applicable to the audio field. This evaluation is based on the latest information available and is by no means complete or conclusive as, judging from the present rate of improvement, only a short period of time may be required to modify any of the main transistor characterstics completely.

From a designer's point of view the following may well be the most important criteria on which a transistor may be judged for its applicability in audio work.

Impedance. In non-linear elements such as magnetic amplifiers, transistors, crystals, and semiconductors in general, the input as well as the output impedance is low in most cases, resulting in a serious problem of impedance matching, especially if these elements are to be employed in cascade. In telephony and general transmission work with coaxial or 600-ohm lines this becomes a desirable characteristic, but in audio it is likely to be a serious problem, although shielding headaches are minimized. Impedance-matching transformers can be used, but their expense and their introduction of phase shift, distortion, and limited bandwidth make their usefulness questionable. The input impedance of the transistor, usually less than 1,000 ohms, makes necessary coupling capacitors of high value, though

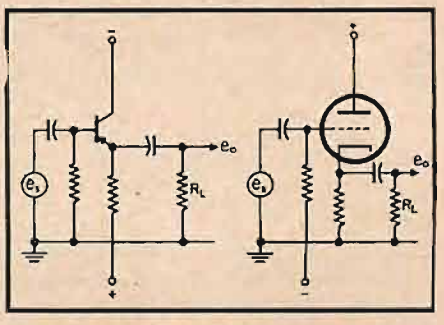


Fig. 2. The grounded-collector transistor circuit.

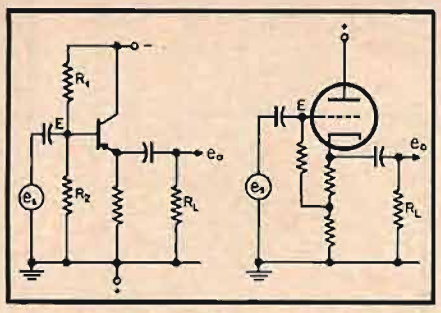


Fig. 3. Grounded-collector circuit can be self-biased in somewhat the same manner as a cathode-follower tube.

they can have low voltage breakdown ratings.

Assume that we have a transistor circuit with an input of 500 ohms. The input coupling capacitor should have a value of not more than 50 ohms at 20 cps for 1 db (10 per cent) attenuation at that frequency, or about 160 μf!

This is a rather impressive value for a coupling capacitor.

Recently available minature tantalum capacitors are ideal for this application, although their present cost reminds one of the black market days of the last war.

Gain. The actual gain will depend on the degree of impedance matching and, depending on circuitry, can be from 17 to more than 40 db per stage, which comes close to the capabilities of most high-gain triodes and pentodes.

Noise. Noise may be the limiting factor of a transistor in audio. Remarkable improvements have been made during the last few months in this respect and the noise level has been reduced from 60 db (at 1 kc) to below 10 db in some types, which compares favorably with a vacuum tube. Junction types have lower noise level than the point-contact types. The noise level is, to some extent, a function of the collector voltage and a lower-power supply voltage will give less noise, but less gain also. Another serious disadvantage of the noise present is that its magnitude is inversely proportional to the frequency, rising at about 3 db per octave. In addition, the input impedance seems to play a role in the amount of noise present and a matched load does not necessarily give the best signal-to-noise ratio.

Frequency Response. Transistor circuits have been designed flat to as high as 10 mc, more than adequate even for that super-ultra-fidelity unit we have in the back of our minds. The average circuit will give a practically uniform frequency response to beyond the audio range. The low-frequency cutoff point will be determined by the value of the input capacitor. Point-contact transistors have better frequency response, but their high distortion and problematical stability exclude them at present from any audio applications.

Distortion. With junction transistors distortion can be kept down to about 2 per cent and with negative feedback values well below 1 per cent are possible.

Dynamic Range. Outputs as high as 3 volts, enough for preamplifiers and equalizers, are easily available. With a unit of low noise level, a dynamic range of 60 db or more can be attained with excellent linearity.

Power. Power requirements should, in all fairness, be considered in terms of the power level of the signals to be handled.

Present transistors can give as much as 0.1 watt maximum power output and this level can be increased to about 1 watt in a push-pull-parallel configuration. In designing preamplifiers and equalizers, however, the question of power should present no problem since only a few milliwatts is necessary. A point of interest is a comparison of efficiency between a transistor and a tube employed as preamplifiers. A transistor requires about 30 milliwatts, while a tube would need about 5 watts,[1] or almost 200 times as much power. At present, 80 per cent of the power used in a transistor amplifier is wasted in dropping resistors required to provide a constant-current supply from a constant-voltage source and for stabilization purposes. As transistors and batteries improve, even the present small power drain will be considerably reduced.

Hum. As the transistor needs no heater supply, complete elmination of hum, a stumbling block that has felled many an audio enthusiast attempting to build his own equipment—is a reality. In addition, there is no time delay for warmup after the power switch is turned on.

Microphonics. A transistor can withstand a forced vibration from 5 cps to 5 kc with 100 g acceleration and shock in excess of 20,000 g, with no ill effects on its operation. Although it is hoped that such conditions are not likely to occur too often in a home audio system, these characteristics are desirable if for instance a transistor preamplifier is to be mounted directly under the motorboard of a record player.

Stability. Units having current gain α, greater than 1 invariably present a serious problem of stability. With latest models of junction transistors and with the use of external stabilization, this problem has been almost eliminated.

Temperature. Temperature effects are likely to cause some trouble, especially in extreme climatic conditions. In normal surroundings temperature becomes no problem. As the temperature increases above normal, the transistor becomes more noisy and loses some of its gain, but it can be improved with negative feedback. A word of caution when working with transistors: The leads should not be subjected to prolonged contact with a soldering iron, as excessive heat will result in permanent destruction of the unit. The same general precautions should be taken as when working with germanium crystals.

[1] Filament approximately 2 watts and plate about 3 watts.

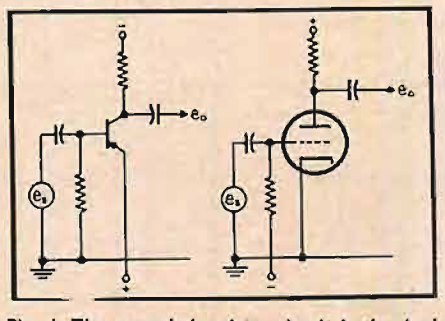


Fig. 4. The grounded-emitter circuit is the dual of the grounded-cathode amplifier.

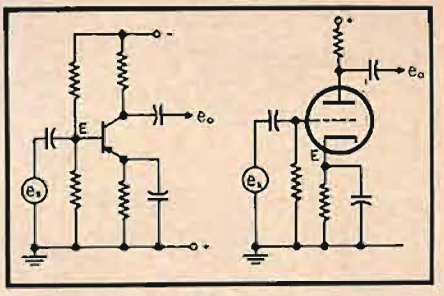


Fig. 5. The self-biased grounded-emitter circuit and the cathode-biased tube are not quite true duals.

Life. Half-life, determined on a statistical basis, is about 70,000 hours or close to 10 years of continuous operation. Since the only permanent part of the average high-fidelity system is its chronic susceptibility to modifications (and improvements), the transistor is likely to outlive, if not the owner himself, at least a dozen or so circuits built around it.

Reliability. With the proper power supply, present units seem to exceed the vacuum tube in reliability. Uniformity in production has been a serious problem, but late units are manufactured within ±2 db uniformity in their characteristics, which is even better than the tube tolerances (±3 db).

Space. A transistor is about the size of a coffee bean.

Cost. Transistor cost is high at present, ranging from $5 to $15, but prices will doubtless decrease as demand increases and methods of production are improved. Availability ranges from stock to a few weeks delivery on most types.

The Transistor Phonograph Preamplifier

Taking the foregoing into consideration, it should be therefore possible to design a phonograph preamplifier which will compare favorably with its electronic counterpart. From *Figs.* 3 and 5 it is seen that a combination of a grounded collector and a grounded emitter in a direct-coupled circuit is possible, provided that the appropriate bias levels are supplied. Direct coupling eliminates the need for a large interstage coupling capacitor, and also provides a relatively high input impedance. Peter Sulzer was first to apply this.[2] Although this type of circuitry needs two transistors, one of which supplies no gain, the definite advantages seem to outnumber the cost of the extra transistor, especially with the elimination of a large-value capacitor and the likelihood of employing an input transformer.

[2] Sulzer, Peter, "Junction transistor circuit applications," *Electronics*, Aug. 1953, p. 170.

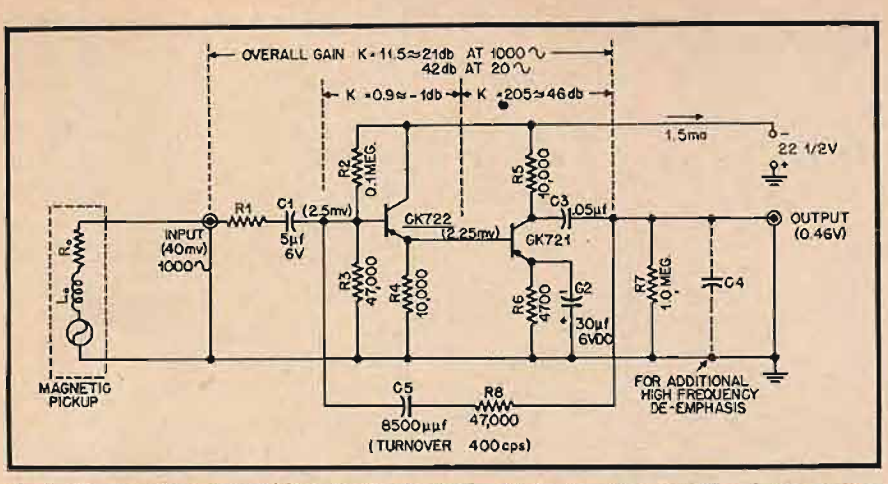


Fig. 6. The transistor preamplifier circuitry is simple and its response—including bass equalization—is excellent. The 22.5 volts may be furnished by the power amplifier bias supply, a small power supply, or a battery.

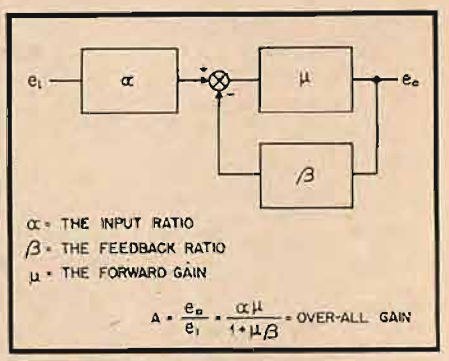


Fig. 8. This block diagram and the formulas show that grain of the transistor preamplifier is calculated in the same way as tube circuits.

Figure 6 shows the final circuit selected. A CK721 is employed as a voltage amplifier, instead of a CK722 giving about 40 per cent higher gain at about the same percentage increase in price. The input impedance, being about 20,000 ohms, makes it necessary to employ a large input capacitor to get down to 20 cps. It should have an impedance, at 20 cps, of not more than 1/10 of the input impedance of the circuit or 2,000 ohms, which means a 4-μf minimum value.

Figure 7 shows the frequency response of the schematic in *Fig.* 6. Noise level, about −39 db, is rather high for our application. A gain of 42 db compares very favorably with most electronic tubes, taking into consideration that the first transistor is actually employed as a cathode follower. Since the complete circuit has a 180-deg. phase reversal, frequency-selective feedback can be applied around it, modifying the frequency response to provide the low-frequency pre-emphasis necessary for any magnetic pickup. In addition, the feedback will increase the input impedance at the high frequencies, decrease the noise present, and improve the linearity and harmonic distortion.

With a total gain of 42 db, the best compromise may be to use half of it for the middle-frequency band beyond the low-frequency turnover, and the other half for the necessary low-frequency preemphasis. The AES curve is employed for developmental work.

From *Figs.* 6 and 8 we have,

$$\mu = K_1K_2 = (0.9)\ (205) = 184 \approx 42\ db$$

and therefore

$$A\,(@1Kc) = \frac{42}{2} = 21\ db \approx 12.5 = \frac{\alpha\mu}{1+\mu\beta}$$

from which

$$(\alpha - 12.5\beta) = \frac{12.5}{\mu} \approx 0.07$$

One pair of α and β giving an approximate solution is $\alpha = 0.88$ and $\beta = 3/50$, giving $R_o + R_f = 2700$ ohms and $R_s = 47{,}000$, assuming that C_f and C_s present negligible impedance (at 1000 cps) as compared to $R_o + R_f$ and R_s.

Since the AES curve's low-frequency turnover is 400 cps we have,

$$C_s = \frac{1}{2\pi R_s f_o} = \frac{1}{2\pi(47{,}000)\ (400)} \approx 8500\ \mu\mu f.$$

The pickup inductance L_o assumes considerable importance, since the inductive reactance of the pickup approaches the value of the input impedance at high frequencies. In calculating the high-frequency de-emphasis, therefore, the value of L_o has to be taken into consideration, and this, unfortunately, will limit the preamplifier to a specific cartridge. In addition, the value of L_o will effect the linearity of the ratios α and β. As α decreases with frequency, β increases, but their product does not remain constant, and therefore Equation

$$A = \frac{\alpha\mu}{1+\mu\beta}$$ holds only approximately.

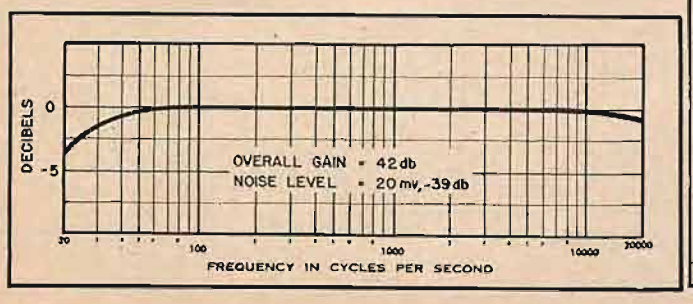
Note that these variations of α and β for a certain fixed frequency are not fixed, but depend on the value of L_o. If the impedance of L_o is small compared to the value of the resistance R_o, the gain variation will be less than 1 db, which may be considered acceptable.

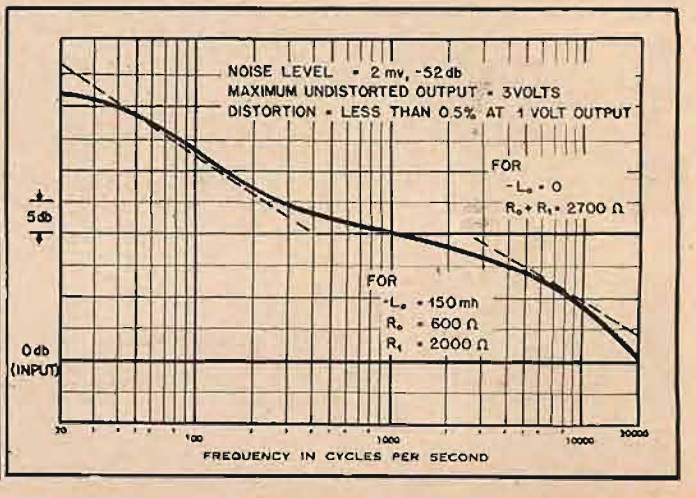
Figure 9 shows the closed-loop frequency response of *Fig.* 6. With $L_o = 0$ and $R_o + R_f = 2{,}700$ ohms, the unit is flat to beyond 100 kc, while with a simulated Pickering cartridge ($R_o = 600$, $L_o = 0.15$ H and $R_f = 2{,}000$) the frequency response follows the AES standard curve closely. In actual practice R_f may be even lower, depending on the manufacturing tolerances of the pickup. With the application of negative feedback, the noise level has been reduced to 2 millivolts or about −52 db, which compares favorably with the average tube preamplifier.

The normal gain of 21 db is obviously inadequate for a low-output cartridge

(*Continued on page 99*)

Fig. 7. Frequency response of the preamplifier without its negative feedback loop.
Fig. 9. With the feedback loop added the preamplifier response comes very close to the AES curve, which is indicated by the dashed line.





Testing with White Sound

A thorough discussion of the value of instantaneous tests made with signal sources of sawtooth or square waves. The author compares the two, shows typical 'scope pictures portraying differing amplifier conditons, and tells how to construct sawtooth and square-wave generators for source signals.

RICHARD C. HITCHCOCK*

MUCH USEFUL INFORMATION about an audio amplifier can be gained by examining a carefully selected picture. One oscilloscope picture can show whether or not the amplifier has flat response, boost or cut for high or low tones, and if it is stable to transient waves. The eye likes to see an over-all picture (a picture is worth ten thousand words, remember). The fact that measurements are not needed, except for overload tests, is an additional feature.

Nine tests are usually made in testing audio amplifiers, see Table I. The final authority, No. 1, is the listening test. It is always a problem to show off the good features of an amplifier to a non-technical listener. He doesn't know about, and says he isn't interested in intermodulation distortion[1] and transients. So you, the demonstrator, must be prepared to play records to prove how good an amplifier-speaker system you have made.

Conceding that the playing of the outfit is the final authority, it is also true that this can take a lot of time. And though you have your own series of records which you prize highly, and each of them appears to sound fine on the new outfit—you may play a favorite record for your friend, and discover that some special sound effect has an awful result. Perhaps your amplifier "rings" on the change in pace in the tympani passage.

Our interest is in the selection of a single simple test which will show just about all the characteristics of an audio amplifier. With a sawtooth oscillator and a cathode ray oscilloscope (which you already have, or will find this test a good excuse to get) you can show the effects of tests of Nos. 2, 3, and 4 in Table I.

The general term *White Sound*[2] includes, in one repeating wave, all the sounds the human ear can hear. This is taken by analogy from the term used in physics, white light, which includes all the colors the eye can see. A similar term *White Noise* is also in regular use[3, 4] and with more equipment, this is also a useful test to make. But white noise has a quite different make-up. White *noise* includes random audio frequencies. These are inconvenient to use for measuring purposes, because they don't repeat.

White sound, as used here, is a wave in which the higher frequencies are less intense, somewhat following the Fletcher-Munson curve,[5] plus a steep wave front giving transients. In brief, white sound is a sawtooth wave.

References showing wave shapes[6, 7] show that a sawtooth contains all the harmonics. That is, a 100-cps sawtooth contains (1) the fundamental 100-cps wave; (2) 200-cps waves with half the amplitude of the first; (3) 300-cps waves with one third the amplitude of the fundamental, and so on. Somewhat similar are square waves, the major difference being that they include only odd harmonics.

The outstanding feature for both sawtooth and square waves, for testing, is that both are made up of straight lines. An unpractised eye can readily detect

* *Consulting Engineer, Syntron Company, Homer City, Pa.*

[1] R. C. Hitchcock, "Intermodulation distortion," AUDIO ENGINEERING, Oct. 1952, p. 21.

[2] White Sound Corp. is the name of a manufacturer of high quality audio equipment, 5614 North Clark St., Chicago 26, Ill. Their kind permission to allow use of their name in the title of this paper is hereby acknowledged.

[3] Emory Cook, "White noise testing methods", AUDIO ENGINEERING, Mar. 1950, p. 13.

[4] H. Fletcher, *"Speech and Hearing in Communication."* D. Van Nostrand, 1953, p. 98.

[5] Fletcher and Munson, *J. Acous. Soc. Am.*, Oct. 1933.

[6] *"Reference Data for Radio Engineers."* Federal Tel. & Radio Corp., 3rd Ed., 1951, p. 299.

[7] C. E. Smith, *"Applied Math. for Communic. Engrs."* McGraw-Hill, 1945, pp. 311–316.

TABLE I
AUDIO AMPLIFIER TESTS

Test No.	Name	Input Device	Input Measurement*	Output Device	Output Measurement
1.	Listening	Microphone Radio Tape Phonograph	(VTVM)	Speaker	Rectifier voltmeter**
2.	Frequency range	Single sine, Variable freq.	(VTVM) (CRO)	Speaker*** Resistor	Rectifier voltmeter** CRO
3.	Compensation Boost or cut	Single sine, Variable freq.	(VTVM) (CRO)	Speaker*** Resistor	Rectifier voltmeter** (CRO)
4.	Stability, Transients, Ringing	Square wave Sawtooth wave	. . . .	Speaker*** Resistor CRO	. . . .
5.	Voltage gain	Single sine, Variable freq.	VTVM	Speaker*** Resistor	Rectifier voltmeter** (CRO)
6.	Power output	Single sine, Variable freq. Sawtooth wave	(VTVM)	Speaker*** Resistor	Rectifier voltmeter**
7.	Hum	None Microphone Radio Tape Phonograph	. . . .	Speaker*** Resistor	VTVM
8.	Harmonic distortion	Single sine, Variable freq.	VTVM	Bridge, Resistor, Speaker	VTVM
9.	Intermodulation distortion	2-tone sine fixed	VTVM (CRO)	Speaker Resistor Filter	VTVM (CRO)

* Optional accessory shown by parentheses.
** In all cases rectifier voltmeter can be replaced by VTVM or thermcouple.
*** Speaker can be replaced by load-absorbing resistor for a quiet test, but before amplifier is completely tested, a loudspeaker and test No. 1 should be used.

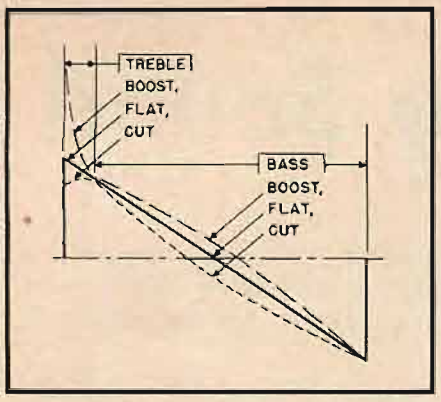


Fig. 1. Sawtooth wave and what it shows. Treble response is in the left 10 per cent; boost shows as a spire, flat as a sharp corner, cut as a rounded corner. Bass is the right 90 per cent; boost is a bulge upward, flat is a straight line, cut is concave upward.

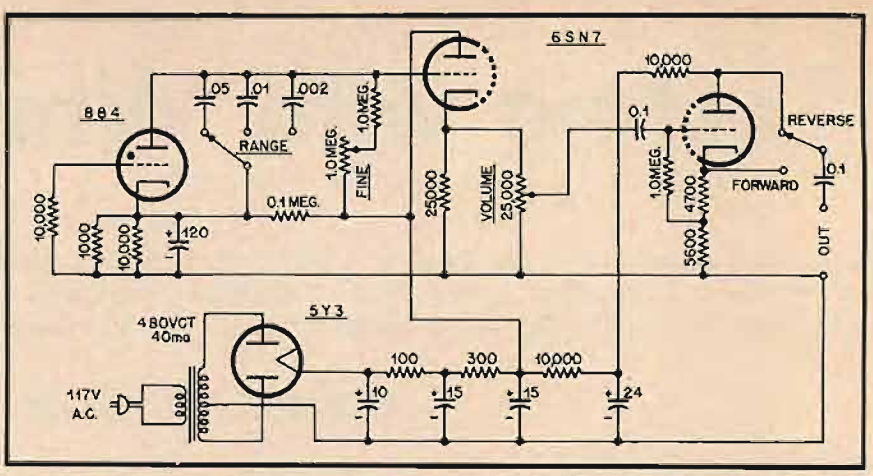


Fig. 3. Sawtooth generator. Note reverse and forward switch at output, extreme right. Volume control is in cathode circuit of ½ 6SN7. Main range control is sp3t switch in plate of 884; fine control is potentiometer across capacitors. Ranges 100, 1,000, and 10,000 cps.

deviation from a straight line. Incidentally, an experienced eye can detect deviation from a sine wave curve and tell some of the harmonics that are present. A better way, of course, is to use special equipment.[8]

Sawtooth Wave and What it can Show

Figure 1 has a linear time scale (horizontal); the perfect sawtooth is the heavy line rising positively at the start at the left, sliding down a straight line to the most negative point, and then abruptly rising at the end of the cycle. When an audio amplifier faithfully reproduces such a wave, it indicates flat response over a wide range of frequencies. *Figure 2* shows the connections.

Also indicated on *Fig.* 1 are the deviations by which we can tell amplifier performance: the first section of the positive peak, about 10 per cent, tells treble response. A spire (dashed) shows treble boost, and the rounded corner (dotted) shows treble cut. If the sawtooth has a frequency of 1000 cps, the 10 per cent shows response to 10,000 cps. On the remaining 90 per cent of the sawtooth, bass boost shows as a convex line, (dashed), and bass cut by a concave line (dotted). The sawtooth oscillator circuit is shown in *Fig.* 3, and described in Appendix 1.

[8] G. E. Jones, Jr., "Theory and construction of a harmonic distortion meter", Audio Engineering, Nov. 1952, p. 22.

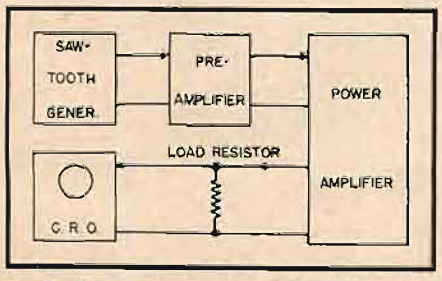


Fig. 2. Test connections used for making pictures of Figs. 4 and 7. For Fig. 6 the resistor was omitted. Pictures were approximately 10 in. wide and 7 in. high on a 20-in. picture tube, DuMont Type 233 oscilloscope, 3 feet from camera. ½ second exposure at f/3.8 on XX120 film. Sawtooth frequency as noted on each figure.

Incidentally, if the sawtooth is inverted, the wave goes negative at the start instead of positive as shown on *Fig.* 1. The 10 per cent first portion shows the treble spire (if any) downward. The remaining 90 per cent bass response indication is shown on the rest of the picture.

On some single-ended amplifier output stages, the response is quite different when the sawtooth is inverted. A brief listening test (exchanging the load resistor *R* of *Fig.* 2 for a loudspeaker) while watching the oscilloscope picture, will tell which polarity to use. A spdt output switch permits either reverse or forward sawtooth waves.

Following the boost and cut ideas of *Fig.* 1, oscilloscope pictures are given in the lower row of *Fig.* 4, using 1,000-cps sawtooth waves. At (F) the bass cut is 6 db at 100 cps; (G) shows a bass boost of 14 db at 100 cps; in (H) the treble cut is 12 db at 5,000 cps; (I) shows a treble boost of 8 db at 5,000 cps; and (J) shows the results of a bass boost of 14 db at 100 cps, plus a treble boost of 8 db at 5,000 cps. Note particularly that the actual waves used are 1,000 cps, yet they show boost and cut at 100 and 5,000 cps—a concentrated single picture.[9] For comparison, (A) to (E) show the amplifier response to a square wave under the same conditions.

[9] H. E. Bryan, "Square-wave testing simplified", Audio Engineering, Feb. 1953, p. 28.

Flat Response

Quite often the controls for boost and cut are potentiometers. Exact center positions are hard to find, especially for logarithmic-taper controls. Yet the setting for flat response should be known, if only for reference. A perfect sawtooth with neither bulges nor spires is the setting for flat response, as in (D), (E) and (F) in *Fig.* 5. Actually, these photographs were made with the oscilloscope connected directly to the generator. A

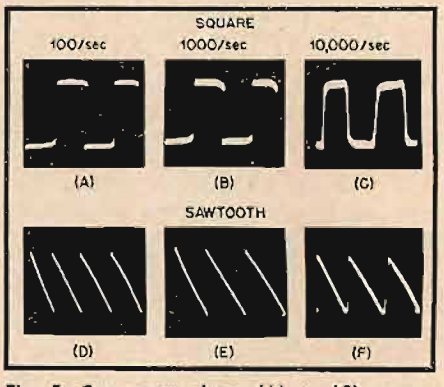


Fig. 5. Generators alone. (A) to (C), square waves; (D) to (F), sawtooth waves bottom row, taken from terminals of circuits of Figs. 3 and 9.

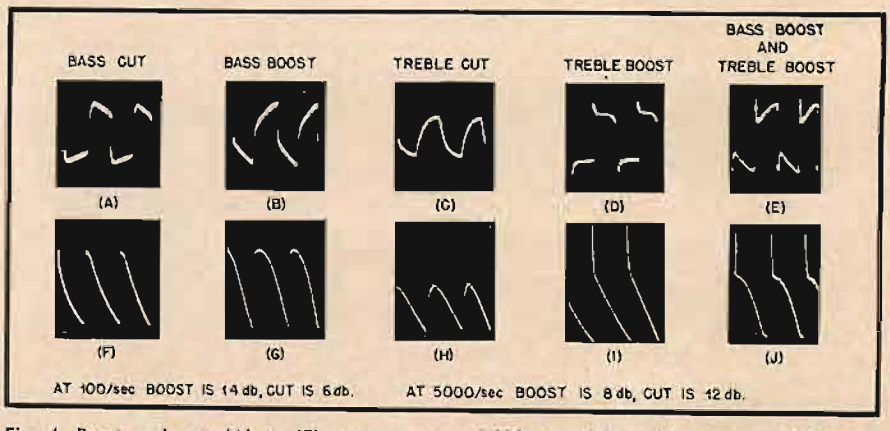


Fig. 4. Boost and cut. (A) to (E), square waves, 1,000 cps; (F) to (J), sawtooth 1,000 cps. Compensation arranged as noted between rows (boost or cut). Though the test waves are 1,000 cps, they show effects at 100 cps where the boost is 14 db, or cut 6 db, and at 5,000 cps where the boost is 8 db or cut 12 db.

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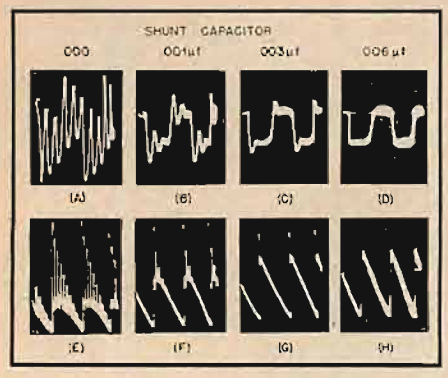

Fig. 6. Ringing, with 10,000-cps. square waves in (A) to (D); sawtooth waves, same frequency, in (E) to (H). Capacitor values are in parallel with 600-ohm feedback resistor from 8-ohm output tap to 10-ohm resistor to ground, part of cathode circuit of input pentode which precedes split-load phase inverter.

perfect amplifier would reproduce them without change. A perfect square wave also shows flat response, (A), (B), and (C) in *Fig.* 5.

Treble Boost or Cut

Many listeners object to boost and cut, not because of the controls, but because such circuits[10] often add distortion to the amplifier output. Testing with a suitable signal will show this type of distortion and indicate remedies.

Treble boost makes a spire at the start of the wave, as in (I) of *Fig.* 4, but—and this is important—it must not start the amplifier to ringing as in *Fig.* 6, to be described presently. To reduce a treble spire, one remedy is to add a resistor in series with the capacitor which gives the boost. This is a trial and error process, but quite easy to do. The position of the boost or cut circuit is known, and any small capacitor is likely to be the culprit.

For example, a 100-μμf capacitor may have a resistor of 47,000 ohms added in series, and the resulting sawtooth picture watched. If nothing different happens, look for another capacitor. If the offending capacitor has been selected, and the resistor is too large, the spire (boost) will change to a rounded edge (cut). If the resistor is too small, the spire will be reduced, but not enough. The correct resistor value causes the spire to disappear into a sharp corner, —and provides flat response.

Treble cut, (H) in *Fig.* 4, shows a rounded edge at the start of each wave. Treble cut never causes ringing. As mentioned previously, the maximum treble compensation illustrated in *Fig.* 4, at 5,000 cps is a boost of 8 db, or a cut of 12 db.

Bass Boost or Cut

All pictures of *Fig.* 4 were made with 1,000-cps input signals. The preamplifier could be set for maximum bass boost of 14 db at 100 cps or a bass cut of 6 db at the same frequency. Thus these pictures give information as far away as one tenth the test frequency, as noted in an earlier reference.[9] It is possible, and perhaps advisable in some cases, to check bass response with a lower sawtooth frequency, such as 100 cps, which would indicate response down to 10 cps.

To obtain flat bass response, another experimental method is followed. Bass frequencies below 100 cps are largely affected by the output transformer inductance, and also the interstage coupling capacitors and grid resistors. It is convenient to find values of coupling and bypass capacitors, as well as resistors, from a manual.[11] However, if low bass tones are required, larger capacitor values are recommended. The charts are based, at 100 cps, on a response of 70 per cent for heater-type pentodes, 80 per cent for heater-type triodes, and 90 per cent for phase inverters. It is not desirable to increase resistor values, usually.

It is possible that better quality in the output transformer is indicated, for low bass tones. As before, the goal has been reached when the sawtooth shows a straight line response at the loaded output terminals, for flat response.

A caution should be sounded here: some years ago bass-boost circuits included an iron-core inductor. These are undesirable from a high-fidelity standpoint mainly because of their non-linearity. All pictures in this paper dealing with boost and cut were taken of resistor-capacitor boost and cut circuits.

Square Waves for Transients Display

Traditionally, transient response has been tested with square waves, because each wave starts with a burst of energy, a steep wave front. This front includes high-frequency components, higher than can be heard with a human ear. A fast rise time is a transient, present in both square and sawtooth waves. Some authorities[12, 13] say that the attack and decay times of sounds largely determine their tonal quality, rather than their harmonic content.

Tests for frequency response described above can be performed almost as well with square as with sawtooth waves. The blind spot in a square wave is its failure to show overloading. It is well known that an overloaded push-pull amplifier makes square waves out of input sine waves. For this reason a good-looking square wave may be obtained when the amplifier is overdriven.[14]

Figure 7 shows pictures of voltages across the output resistor, using the same amplifier, first for square- and then for sawtooth-wave inputs, each at 1,000 cps. This amplifier, which will be described further with regard to *Fig.* 6, "rings" when there is a capacitor of less than .006 μf across the feedback resistor. For the square wave, the amplifier is overdriven in (A) and (B) of *Fig.* 7, but no difference is shown in the picture. The amplifier just cannot ring, cannot go any further positive or negative. Contrast these with (C) and (D) where the normal output of the amplifier is being supplied to the load. In (C) the sharp peaks show ringing. These peaks are completely eliminated when .006 μf is used, with the result shown in (D).

Overloading and Power Measurement

Overloading shows as a flattening of the top and bottom of the sawtooth in both (E) and (F) of *Fig.* 7. As in the square wave, both these figures are alike, the ringing cannot occur because the amplifier is delivering its peak output. The major difference between the results of square and sawtooth is that overload is shown only by the sawtooth. This is an important difference, its information is useful.

For instance, measurement of maximum power output is simple with a saw-

[10] W. B. Bernard, "Distortion in voltage amplifiers," AUDIO ENGINEERING, Feb. 1953, p. 28.

[11] *"Receiving Tube Manual,"* RC-17, 1954, pp. 258–267; Radio Corp. of America.

[12] F. Langford-Smith (ed.) *"Radiotron Designer's Handbook"*, 4th Ed., (1953) p. 619. Radio Corp. of America.

[13] T. Powell, "Phase band width", (letter), AUDIO ENGINEERING, June 1949, p. 6.

[14] The word *overloaded,* is often used when *overdriven* would be a better choice. For example, as the input voltage is gradually increased the output voltage increases proportionally, until maximum "clean" output is reached. Then if the input voltage is further increased, it usually overdrives the output stage. This means that only part of the wave is reproduced, the rest is clipped. This is one way to tell what part of an amplifier is overdriven—the single-ended early stages normally show clipping of only one peak, while push-pull stages (including driver stages) show clipping of both top and bottom peaks.

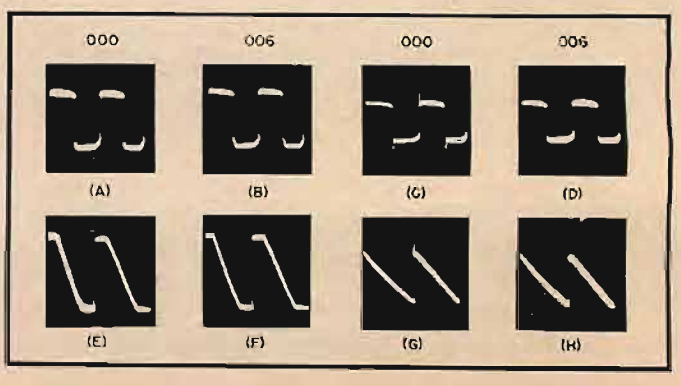

Fig. 7. Overload and rated load. (A) to (D), square waves; (E) to (H), sawtooth, each 1,000 cps. Spires show only at rated load or less.

tooth wave. In addition to the equipment shown in *Fig.* 2, an a.c. voltmeter is connected across the load resistor. Any of several kinds of audio-frequency voltmeters is suitable, but its kind must be known, as the readings vary with different types. The importance of knowing the type is illustrated in *Fig.* 8. Practically all a.c. voltmeters are calibrated so that they read the same with a sine-wave signal. This is not true for most other wave shapes.

On *Fig.* 8 the left scale represents the meter indication in volts for sawtooth

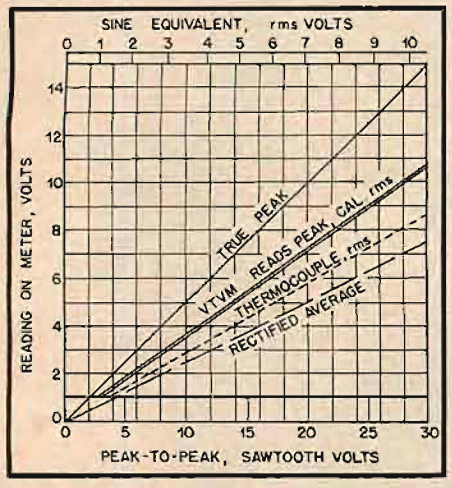

Fig. 8. Meter indications for sawtooth waves. Three common types of meters indicate differently because of their characteristics and calibration. Example: line up 20-volt peak-to-peak sawtooth (bottom scale) with 7.07-volt sine equivalent (top scale); a rectified-average meter (dashed line) would show 5.0 volts (left scale), a thermocouple meter 5.8 volts (dotted line), and the VTVM 7.07 volts (double line).

waves. Straight line graphs show values for different types of meters: solid line for true peak meter, double line for the usual VTVM which indicates peak volts but is calibrated in rms sine-wave equivalent, dotted line for thermocouple rms meter, and dashed line for rectifier meter. The bottom scale is marked peak-to-peak sawtooth volts, the top scale rms sine-wave volts. Before describing measurements these check points might be noted: a peak-to-peak sawtooth voltage of 20 has the same maximum and minimum as a sine wave having an rms value of 7.07 volts. Connecting these two values we find that the reading of the rectifier meter will be 5.0 volts, the thermocouple 5.8, and the VTVM 7.07. The peak meter would read 10.0 volts, half the peak-to-peak of 20 volts.

The procedure for determining the overload point, using a sawtooth, is:

1. Increase the gain of sawtooth input to amplifier, until CRO shows clipping of top and bottom, as in (E) or (F) of *Fig.* 7.
2. Reduce the gain until the wave just begins to show a sharp corner, such as (E) in *Fig.* 5.
3. Read voltmeter across load resistor; for example, 5.0 volts.
4. Convert to equivalent sine volts, using *Fig.* 8. If a rectifier meter, the 5.0-volt reading shows that the sawtooth voltage is 20 peak-to-peak, and as noted earlier, which has the same maximum and minimum as a sine wave of 7.07 volts rms. With other meters use appropriate graph and resulting values.
5. Assume now that this voltage is across an 8-ohm resistor load, *Fig.* 2. The amplifier overloads, or is overdriven, if more than the rms equivalent of 7.07 v sine wave is impressed. Thus the maximum clean output is $E^2/R = 7.07^2/8 = 6.3$ equivalent sine wave watts. This is the item of interest.

Sawtooth Waves also Contain Transients

Sawtooth waves have a fast rise time, once per cycle, compared with the double transient of a square wave with the same frequency. An amplifier which shows up well with sine waves over a wide range of frequencies, even those above audibility, sometimes "rings" when tested with waves having fast rise times.

Figure 6 shows a series of ringing tests. For this series the amplifier output terminals have no load, just the negligible high impedance of the oscilloscope. The input signal was 10,000 cps for all pictures in *Fig.* 6. The amplifier is conventional: 6SJ7 pentode-connected voltage amplifier, 6J5 split-load phase inverter, push-pull 6L6 pentode-connected power output tubes, and a good output transformer. The feedback is 600 ohms from the 8-ohm output tap to a series resistor of 10 ohms to ground, as part of the 6SJ7 cathode bias resistor. The improvement due to adding capacitance across the feedback resistor is shown progressively, until with .006 μf the waves are sharp and normal. This capacitor parallels the 600-ohm feedback resistor with a capacitive reactance of 295 ohms at the ring frequency of 90,000 cps.

Perhaps the no-load testing just mentioned should be justified. This amplifier, after careful construction and testing with phono records, was heard to have "too sharp" an attack when a full orchestra was playing loudly. Oscilloscope pictures taken across the loudspeaker terminals indicated an extra fast rise time. Using the sawtooth as input, the output looked like (G) in *Fig.* 6, although at that time no capacitor was used. When the loudspeaker was disconnected, the ringing effect filled the cycle, as shown in (E). One of the goals of amplifier design is stability, and when the .006-μf capacitor was applied as noted, this amplifier was stable even with no load. With the loudspeaker reconnected, it sounded fine on all types of musical passages.

Using a resistor for output load is standard, and quiet, but a loudspeaker should certainly be tried before the amplifier can be said to be satisfactory. A severe test is to remove all load, as mentioned for the pictures of *Fig.* 6. Many amplifiers will then ring. If a multi-speaker system is planned, by all means use all dividing networks and speakers, and put the sawtooth waves through the complete set-up, watching the oscilloscope pictures of the voltage across the amplifier output terminals. It is not necessary to use full power, though a full volume sawtooth of 100 cps is the "best darned stringed instrument you ever heard" (maybe).

It is informative to watch oscilloscope pictures of the voltages across the woofer, and then across the tweeter, either with or without boost or cut, using sawtooth waves as input. The result, as you would expect, is that even when the amplifier is set for flat response, the woofer voltages indicate bass boost, (G) in *Fig.* 4, and the tweeter voltages show treble boost, (I).

Do not use an all-capacitor output load. This is a super-ringing combination which may wreck your output transformer, power tubes, and other components.

Appendix 1. Sawtooth Oscillator Circuit

Figure 3 is the sawtooth oscillator circuit[15]. The 884 tube generates sawtooth waves at a frequency determined mainly by two resistors and one capacitor. The poten-

(*Continued on page 89*)

[15] "*Radio Amateur's Handbook*", 25th Ed., (1948), Fig. 16-26, p. 489.

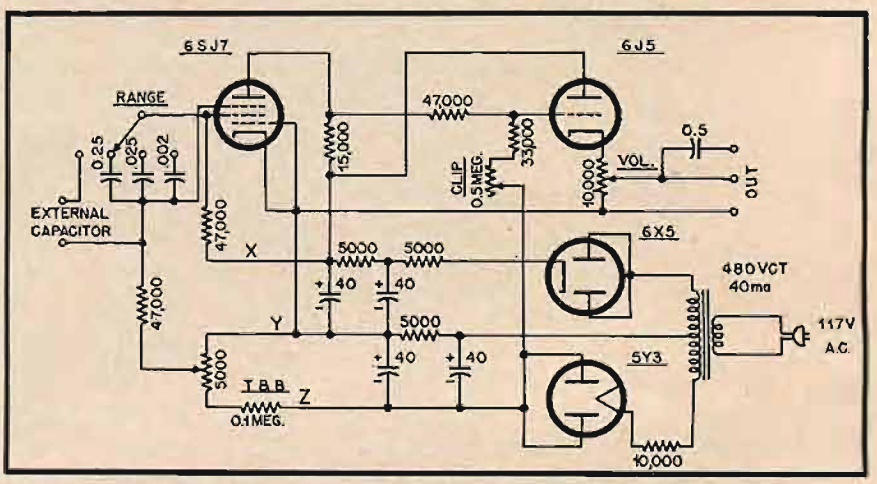

Fig. 9. Square wave generator. Note double d.c. power supply X to Z, center-tapped at Y, using separate rectifier tubes. Values shown for 100, 1,000, and 10,000 cps.

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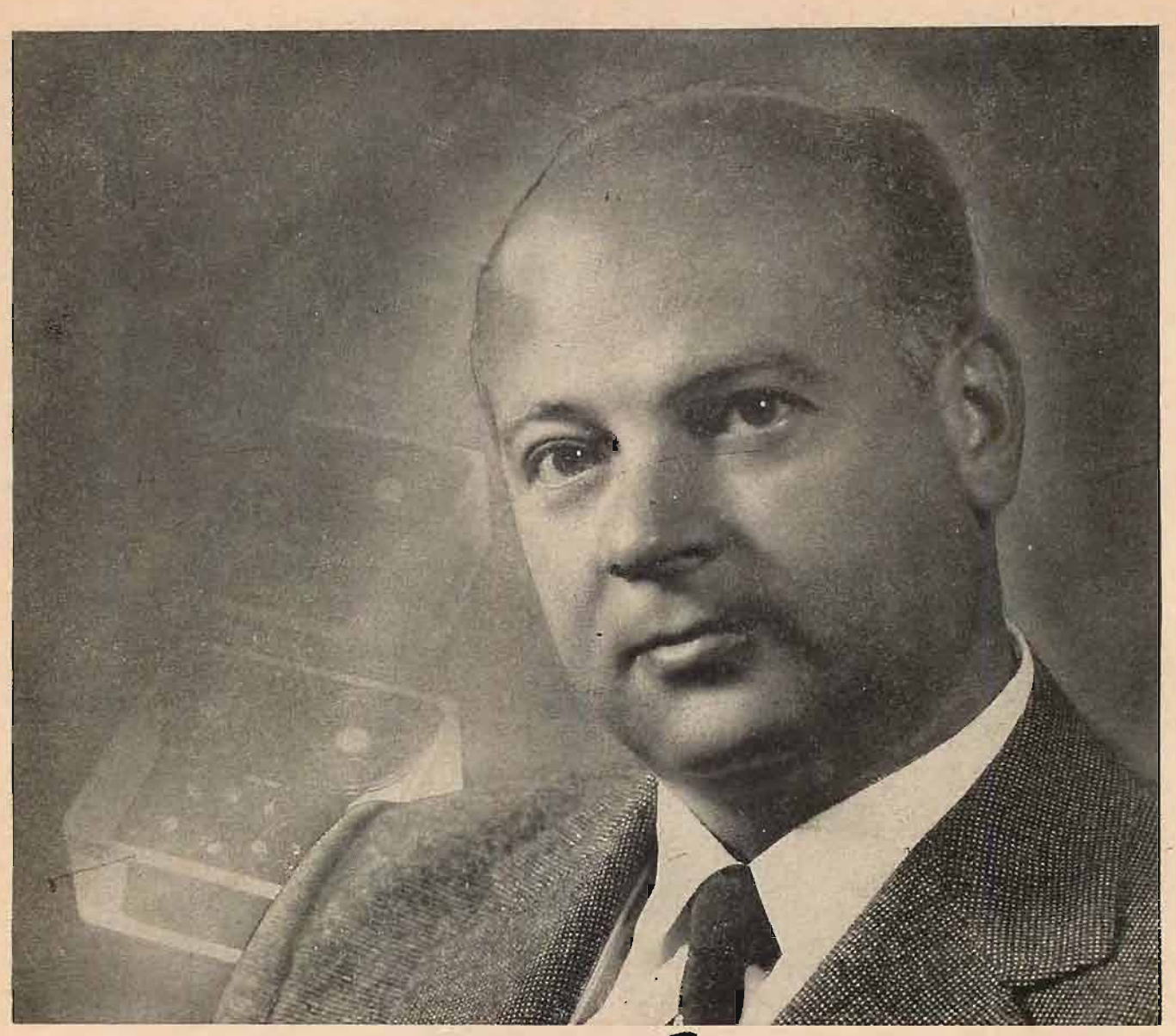


Irving Rossman

President — The Pentron Corporation
Largest Exclusive Manufacturer of Tape Recorders

REASONS WHY MR. IRVING ROSSMAN USES

STERLING PERFORMANCE!
Encore is the newest of all recording tapes...scientifically developed for brilliant, artistic sound reproduction.

LABORATORY QUALITY!
Every inch of Encore Tape is precision-tested and laboratory bonded for uniformity, freedom from noise and distortion, and unvarying output from reel to reel.

EXCLUSIVE SCIENTIFIC MANUFACTURING PROCESSES!
These insure optimum sensitivity, without loss of quality, adherence of oxide coating, maximum tensile strength, longest shelf-life and splice-ability.

BUILT-IN CONVENIENCE AND EXTRA VALUE!
Without extra cost, Encore Tape provides the "extras" needed to preserve superior audio performance. Every reel is packed in a polyphane bag, with spliced color-coded leader for extra cue time, and 5 full inches of Encore splicing tape—a complete recording package!

Encore
RECORDING TAPE *

Developed and manufactured by the Electro-Magnetic Products Division, TECHNICAL TAPE CORP., Morris Heights, New York 53, N. Y.
Distributed in Canada by Canadian Technical Tape, Ltd., 5541 Papineau Ave., Montreal

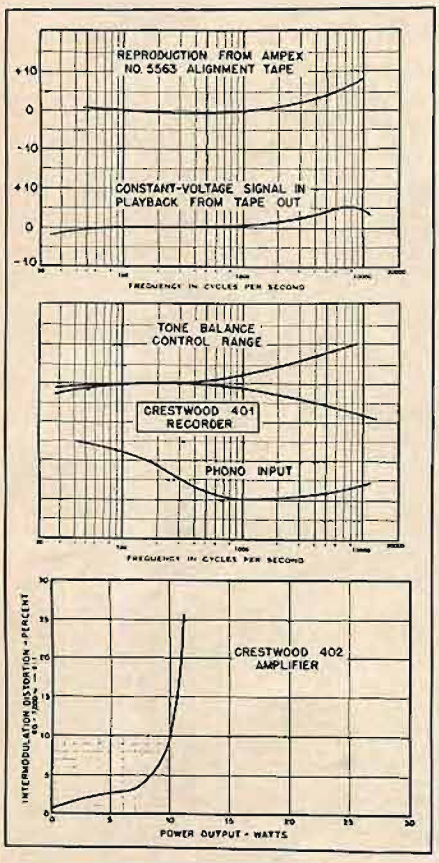
ANOTHER TECHNICAL BRAND

Encore means more in recorded results— Just try it!

* IMPORTANT! Encore is *not* a pre-recorded tape. Treasure Tapes are not for sale, except as a demonstration of the recording quality *you* can obtain using your own tape recorder.

Equipment Report

Crestwood 401 Tape Recorder and 402 Power Amplifier and Speaker combination—Fairchild 280 Transcription Arm—Laboratory of Electronic Engineering "Catenoid" Loudspeaker—Pilotone AF-860 AM-FM Tuner



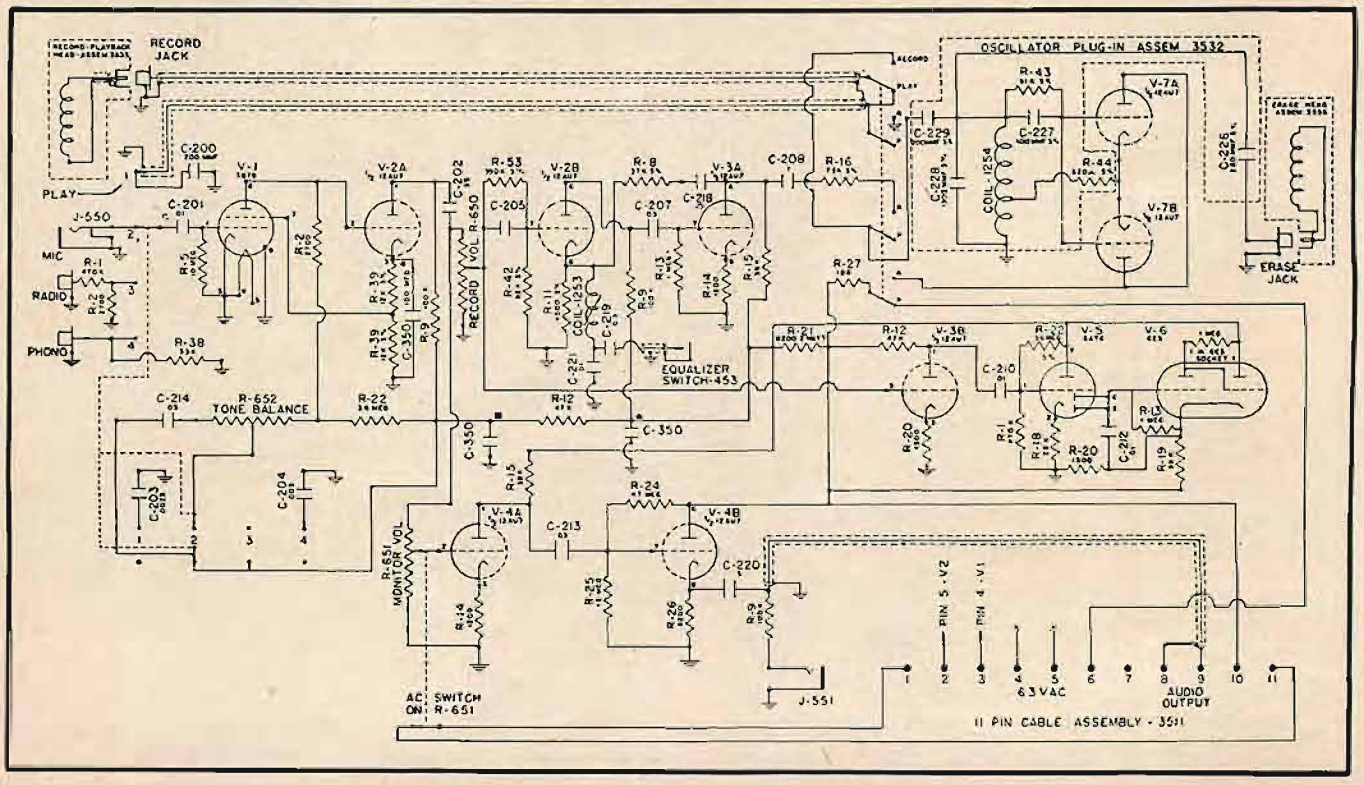
SALES OF TAPE RECORDERS have been reported to be in the vicinity of 250,000 units so far this year, with a total of 375,000 units expected before the year is over. And while we have not overlooked the importance of this branch of the audio industry, we have felt that the average non-professional machine was not capable of providing the quality of sound reproduction that would be demanded by the serious hi-fi hobbyist.

Any good tape recorder that can stay on the market for a length of time is capable of giving a great amount of entertainment to the average user, and for many applications of recorders, they are perfectly adequate. But with the quality obtainable from LP records as high as it is, it is doubtful if the music lover would continue to be satisfied with the average machine if his principal use was for the recording of *music*.

Chief among the objections is the inability of many of the non-professional machines to reproduce a high-quality tape with a frequency response that is in keeping with the original recording. Conversely, of course, the man with a professional machine cannot exchange tapes comfortably with his less fortunate friend who must be content with something less than the best. We are happy to say that this condition is rapidly being alleviated, and that more and more machines are being introduced with equalization that more closely matches the professional machine. (We still have to cope with the problem presented by the lack of standardization among the professional machines, but the differences are not beyond solution with fairly simple equalizer circuits).

The Crestwood 401 recorder which was recently tested appears to be capable of matching standard professional curves well enough for all but the most rigid professional requirements. Using a standard Ampex Alignment Tape, No. 5563, measurement of the output was made, with the result shown in the top section of *Fig.* 1. The TONE BALANCE control was set at the center of its rotation, which is not exactly correct for the Ampex tape, but it is the setting that the user would consider normal until he became thoroughly conversant with its action. The high-frequency tip-up would be an advantage in many cases, however, but for accurate reproduction, it would be desirable to adjust the TONE BALANCE control. The second curve in the top section of *Fig.* 1 shows the effect of feeding a constant voltage signal into the RADIO jack, recording on the tape, and playing back to the OUTPUT jack. Here again it is seen that the high-frequency equalization is somewhat more than normal, but with suitable setting on the TONE BALANCE control, the playback can be made within ±1 db from

Fig. 1 (left). Performance curves for the Crestwood 401 recorder and 402 amplifier and speaker. Fig. 2 (below). Schematic of the recorder amplifier. Its power supply is on a separate chassis, and furnishes d.c. to the heaters of V_1 and V_2, as well as a.c. for the other heaters and plate power to the entire amplifier.



2 NEW Capps MICROPHONES

Dynamic

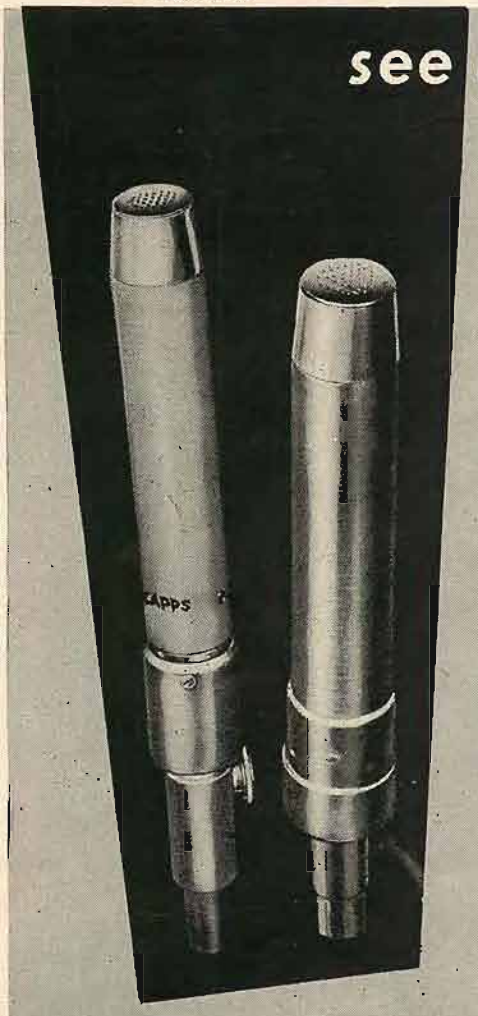
DM 2050

Frank L. Capps & Co., pioneers in AUDIO, bring you two new quality dynamic microphones which, like the CAPPS CONDENSER MICROPHONES and CAPPS RECORDING STYLI, set standards of performance which few can match.

Model DM 2050 OMNIDIRECTIONAL DYNAMIC STUDIO MICROPHONE.
This instrument is especially suited for reproducing with a high degree of fidelity and brilliance large sound bodies — orchestras, choirs, organs, etc. Frequency response 50-15,000 c.p.s., 50 Ohms impedance.

Model DM 1060 DYNAMIC NONDIRECTIONAL MICROPHONE.
A less expensive version of the DM 1050 STUDIO microphone suited for small orchestra use, high fidelity enthusiasts, etc. Frequency response 50-10,000. c.p.s. — 60 Ohms impedance.

see us at the AUDIO SHOW room 516



Frank L. Capps & Co., the world's leading manufacturer of disc recording styli since 1929, continues to maintain the tradition of its founder in developing and producing products embodying the highest standards of engineering and workmanship.

CAPPS stretched diaphragm CONDENSER MICROPHONES are the product of many years of engineering and development. They are acoustically faithful, distortion free, omnidirectional, blast proof, and have a smooth frequency response from 30 to 15,000 c.p.s. The excellent transient response in addition to the above mentioned characteristics make them ideal for those who must have the ultimate in acoustical transmissions.
Studio models CM 2030C (30 Ohms) and CM 2250 (250 Ohms) also "Professional" model CM 2001 — High Impedance.

FRANK L. CAPPS & CO., Inc. 20 Addison Place Valley Stream, N. Y.

the input. The TONE BALANCE control is not a tone control in the usual sense, as can be seen in the center section of *Fig.* 1. It will provide adequate boost or cut to the high frequencies only—which is where they are needed in most cases—to enable the user to obtain a satisfactory tape. Feeding a constant voltage signal into the PHONO jack resulted in the lower curve in the center section of *Fig.* 1. This will permit the user to dub phonograph records onto tape without using any additional equipment, if he wishes, with the assurance that the equalization is a reasonable compromise with current LP recording curves.

All these measurements were made at 7½ ips, since it is not felt that lower speeds are ever satisfactory for high-quality music reproduction. In spite of that, however, measurements at the 3¾-ips speed indicate that the recorder would provide satisfactory response to at least 6000 cps at this speed, suitable for those applications where the original signal was of itself not of true "high-fidelity" quality.

The recorder itself—shown in schematic form (without its power supply) in *Fig.* 2, and pictorially in *Fig.* 3—is easy to handle. A function switch selects the source of the signal being recorded—radio, microphone, or phono pickup—or, in another position, playback. At all of these settings, the monitor signal is fed to the phones, permitting the user to start or stop the recorder at will so as to eliminate undesired announcements or other material. An indicator tube shows the recording level, and an interlock button precludes switching to RECORD accidentally. Even the speed control requires the use of a coin, which discourages inadvertent operation of the control unless it was actually desired. Separate controls vary record and playback gain so that once correct settings for these are found, they may be left in place during subsequent playback or recording operations.

A low-microphonic 5879 is used in the first stage, and d.c. is furnished to the heaters of both first and second stages. An input signal of 1.0 volts is sufficient for full modulation from the RADIO input, and a signal of only .003 volts is required at the phono jack for full modulation. Line power requirement is 170 watts.

Using the 250-cps signal on the Ampex tape for standard operating level, the output signal is 1.38 volts at maximum setting of the playback control.

Mechanical Features

The tape transport mechanism appears to be sturdy, and flutter is below the audibility level on average material. Fast-forward time for a 1200-ft. roll of tape was clocked at 1 minute and 33 seconds, with only 1:27 being required for rewind. All inputs except the microphone jack are on a panel at the back of the case; microphone and monitor jacks are on the top of the panel. The output jack, power-line receptacle, and line fuse are also at the back, but on another panel, providing good isolation between input circuits and output and power connections. The unit is housed in a portable case 9½ in. high, 13½ in. deep, and 16 in. long. The chassis and the associated power supply can be remounted in a furniture cabinet quite simply.

Fig. 3. The Crestwood 401 and 402.

Amplifier and Speaker

Housed in a companion case and designed for use with the recorder is a 10-watt amplifier and an 8-in. loudspeaker, model 402. The two units together provide a complete system with somewhat better sound quality than is possible when the speaker is housed in the same case with the recorder. The bottom section of *Fig.* 1 shows the IM distortion curve of the amplifier—frequency response is not shown since it is flat within ±0.5 db from 20 to 20,000 cps. Listening tests show that the lowest usable output occurs at around 80 cps, with some cabinet vibration below 50 cps. Peaks can be heard at 105, 155, and 190 cps, in addition to one at 80 cps, and the highest usable frequency is 12,500 cps—which is considered good throughout for the size of the case. The amplifier, shown schematically in *Fig.* 4, is provided with an OUTPUT jack which cuts off the internal speaker when an external speaker is plugged in. For 1-watt output, an input signal of 0.75 volts is required. The two instruments are shown together in *Fig.* 3.

Among the advantages of this combination is the possibility of using the amplifier and speaker, along with the recorder unit, as a PA system, recording simultaneously if desired. Many users would require only the recorder unit, however, preferring to use the power amplifier and speaker of their present hi-fi system for home use, and thus eliminating the need for duplication of power amplifier and speaker in the recorder. The flexibility of the entire system would undoubtedly be considered an advantage by many, and like the usual home music system, one need only buy those parts which are required to have whatever kind of service he wants.

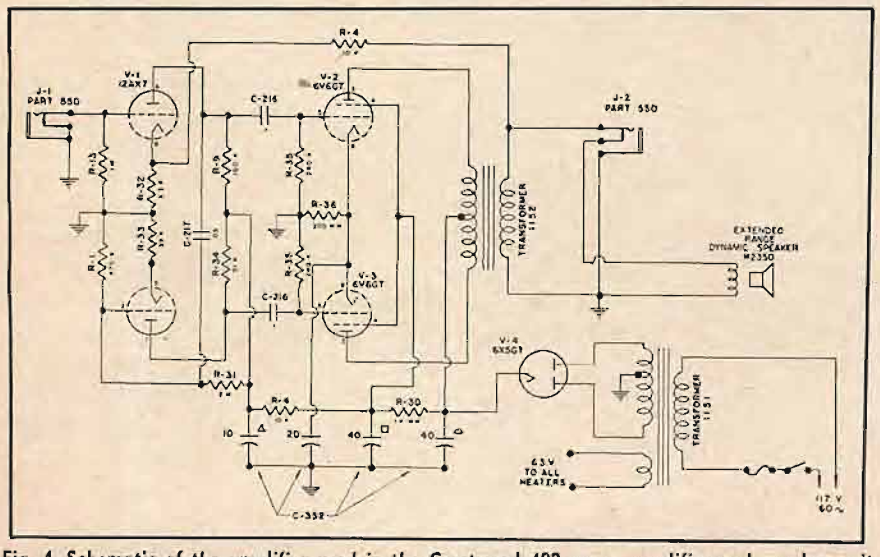


Fig. 4. Schematic of the amplifier used in the Crestwood 402 power amplifier and speaker unit.

FAIRCHILD PHONO EQUIPMENT

SINCE ITS INTRODUCTION to the hi-fi field a relatively short time ago, the Fairchild 215 and 216 cartridges have achieved good acceptance by users. With the further introduction of the 280 Series transcription arms and the Model 826A plug-in transformer, more users are likely to become acquainted with the line.

One of the problems in the use of the 215 pickups has been that the output impedance of the cartridge is low, with a consequent low output voltage, usually of the order of .003 volts. While this does not *demand* the use of a transformer, most preamps do not have sufficient gain to provide adequate output for home use without unduly high settings of the volume control and the accompanying high hum and noise level. Transformers have been available heretofore, but they required some fitting into the chassis, and were relatively cumbersome to use for this reason. The new 826A transformer eliminates this problem.

It has long been recognized that the pickup arm has an important effect upon

(*Continued on page 54*)

Audio Fair Exhibitors

HARVEY RADIO COMPANY, INC. 631

103 W. 43rd St., New York 36, N. Y.
Products: Complete hi-fidelity home music systems and components; tape recorders; radio parts and broadcast supplies.

IN ATTENDANCE

Harvey E. Sampson — Abe Kobrin
Roy Neusch — James Carroll

HAYDN SOCIETY, INC. 539

30 Huntington Ave., Boston, Mass.
Products: Fine hi-fidelity phonograph records. The most complete history of music on records, **Anthologie Sonore.**

IN ATTENDANCE

Thomas R. Crowder — William Lerner
Bernard G. Schwartz — Louise Goodman
Douglas H. Duer — Judith Smith

HIGH FIDELITY MAGAZINE 549-50

The Publishing House, Great Barrington, Mass.
Products: The Magazine for Music Listeners, audiophiles, hi-fidelity enthusiasts —for all, in short, who listen to music in their homes.

IN ATTENDANCE

Charles Fowler — Roy H. Hcopes
John M. Conly — Roy F. Allison
Warren B. Syer — Fred C. Michalove
M. E. Pickett — James Hinton, Jr.

INTERELECTRONICS CORPORATION 620

2432 Grand Concourse, New York 58, N. Y.
Products: New "Coronation" 40-watt amplifier; New "Coronation" preamplifier with power supply for FM phono pickup and 16-mm sound projector photocell; "Coronation" Supra-Linear amplifier; "Coronation" consolette preamp-equalizer; "Staticloth" record cleaning cloth.

IN ATTENDANCE

M. H. Pintell — Walter Brullet
R. H. Pintell — Aldo Caporetti
Leonard Zlowe

INTERNATIONAL ELECTRONICS CORPORATION 533

147 Parkhouse St., Dallas, Texas
Products: F-M wide-range loudspeakers for home music systems, electronic organs, and theaters.

IN ATTENDANCE

J. A. Frazier — Marty Bettan
Edmond A. May

INTERNATIONAL SCIENTIFIC INDUSTRIES CORP. 739

3101 42nd St., Minneapolis 6, Minn.
Products: Tape Recorder.

IN ATTENDANCE

John O. Fundingsland — John D. Goodell

JENSEN MANUFACTURING CO. 518-19

6601 S. Laramie Ave., Chicago 38, Ill.
Products: Imperial Reproducer, Tri-plex, Triaxial speakers; coaxial speakers; Duettes, cabinets, etc.

IN ATTENDANCE

Louis W. Selsor — Horace L. White
Karl Kramer

KARLSON ASSOCIATES, INC. 720

1483 Coney Island Ave., Brooklyn 30, N. Y.
Products: Ultra-Fidelity enclosures.

IN ATTENDANCE

John E. Karlson — Jim Pickett
Anne G. Karlson — George Brown
Wayne Green — Sage Mackay
Jordan Polly — Ellie Littlefield
Irma Cohen

KLIPSCH & ASSOCIATES 534

P. O. Box 64, Hope, Arkansas
Products: Klipschorn, a corner-horn loudspeaker; Shorthorn.

IN ATTENDANCE

Paul W. Klipsch — Mrs. Eva Belle Klipsch

KRAL PRODUCTS 743

1704 Walnut St., Philadelphia 3, Pa.
Products: Rek O Kleen Record Brush.

IN ATTENDANCE

Rubin Levin — Harold Weinberg
Alex Karlan

LABORATORY OF ELECTRONIC ENGINEERING 548

413 L Street, N.W., Washington 1, D. C.
Products: L.E.E. Catenoid Loudspeakers, L.E.E. Fantasia Speakers; Medical Electronics; Instrumentation.

IN ATTENDANCE

H. Peter Meisinger — John Safer

LANGEVIN MANUFACTURING CORP. 734

37 W. 65th St., New York 23, N. Y.
Products: Amplifiers; power supplies; transformers; reactors.

IN ATTENDANCE

Donald S. Morgan — Leroy Bremmer
Robert Edwards — Robert Scott
George D. Schatz — Nathan Paulson
F. K. Hankinson — Albert Schneider
F. J. Neidig — John Meehan
Donald E. Barth

JAMES B. LANSING SOUND, INC. 731

2439 Fletcher Dr., Los Angeles 39, Calif.
Products: Loudspeakers.

GENERAL ELECTRIC COMPANY 531

RTVD #5—Electronics Park, Syracuse, N. Y.
Products: Full line of hi-fidelity equipment.

IN ATTENDANCE

T. J. Nicholson — F. Beguin
M. E. Woodworth — C. H. Donnelly
N. R. Bibko

G & H WOOD PRODUCTS CO. (CABINART) 719

75 N. 11th St., Brooklyn 11, N. Y.
Products: Klipsch Rebel V—Also loudspeaker enclosures and equipment cabinets for hi-fidelity installations.

IN ATTENDANCE

Sidney Herbstman — Harold Blumenstein
George Getzels — Paul Klipsch
Oscar Kraut — Jay Carver

GOODMANS INDUSTRIES LIMITED 637

215 E. 37th St., New York 16, N. Y.
Products: Loudspeakers: Axiom 22 Mark II; Axiom 150 Mark II; Axiom 80; Axiette 101.

IN ATTENDANCE

Ed Straw — A. W. Pleasanton
Sydney Wimpie — R. Pfeffer
Mort Wimpie — Wm. Habig

GRAY RESEARCH & DEVELOPMENT CO., INC. 503

658 Hilliard St., Manchester, Conn.
Products: The finest audio equipment for home and broadcast use including the Gray transcription tone arms and equalizers.

IN ATTENDANCE

Newland F. Smith — Chester A. Snow
Chester B. Hayes

GROMMES DIV. OF PRECISION ELECTRONICS, INC. 520

9101 King Ave., Franklin Park, Ill.
Products: Complete line of hi-fidelity amplifiers.

IN ATTENDANCE

William S. Grommes — Albert A. Hart

ADOLPH L. GROSS ASSOCIATES, INC. 732

23 Park Place, New York 7, N. Y.
Products: Miracord XA 100 record changer, Miraphon XM 110 record player.

IN ATTENDANCE

Milton D. Thalberg — Adolph L. Gross
Gershan T. Thalberg — Lew Abeles
Tjard Schmidt — S. Sass

HACK SWAIN PRODUCTIONS 505

AAA-Carey Bldg. Box 2384, Sarasota, Fla.
Products: MUSIKON Tape.

IN ATTENDANCE

Hack Swain — Mrs. Marie Swain

HARMAN-KARDON, INC. 708

52 W. Houston St., New York 12, N. Y.
Products: AM-FM tuners; amplifiers; "Festival" combined AM-FM tuner-preamplifier-power amplifier.

IN ATTENDANCE

Sidney Harman — Robert Furst
Sidney Hecht — Martin Averbach

HARRISON HIGH-FIDELITY RECORD CATALOG & RECORD (and Sound) RETAILING. 609

274 Madison Ave., New York 10, N. Y.
Products: The Harrison High Fidelity Record Catalog; Record (and Sound) Retailing.

IN ATTENDANCE

Neil F. Harrison — Harry Shepard
Ralph Freas — Ben Lebow

Audio Fair Exhibitors

FEDERAL MANUFACTURING & ENGINEERING CORP. 510

211 Steuben St., Brooklyn 5, N. Y.
Products: FME tape recorders and accessories.

IN ATTENDANCE

Robert S. Schlanger
Herbert Pels
Bert Carlson
Frank Pesca

FEDERATED ELECTRONICS SALES, INC. 832

66 Dey St., New York 7, N. Y.
Products: Franchised distributors for all nationally known hi-fi and audio equipment.

IN ATTENDANCE

Jack Greenspan
William Kornhauser
Daniel Seymour
Ed Hanson
Robert Becker
Harry Mintzer
Basil Guerra
Joseph U. DiBella
Stephen Urevith
Stanley Eagle
Peter N. Markantes

FENTON COMPANY 502

15 Moore St., New York 4, N. Y.
Products: Tape recorder, record changers, Adaphone (remote control hearing aid for TV) Adaphone pillow speaker, convenience speaker, miniature earsets, C-1 UHF converter, B-1 VHF booster.

IN ATTENDANCE

Charles F. Fenton
Mrs. Ann Fenton
Abe Kanig
Miss Anne M. Fenton
Charles A. Fenton
Doris Frank
Lucia A. O'Loughlin

FERRANTI ELECTRIC, INC. 837

30 Rockefeller Plaza, New York 20, N. Y.
Products: Pickup.

IN ATTENDANCE

R. H. Davies
M. J. Pope
M. Dellerson
H. Weller

FISHER RADIO CORP. 529-30

21-21 44th Dr., Long Island City 1, N. Y.
Products: The Fisher Model 50-A Lab. Standard Amplifier; Series 50-C Master Audio Control; Model 50-F Hi-Lo Filter; Model 50-H Horn; Model 50-LP Phono Cartridge; Model 50-ST Phono Cartridge; Model 50-PR Preamp. Equalizer; Model 50-R AM-FM Tuner; Model 70-A Audio Amplifier; Model 70-RT AM-FM Tuner with controls; Model PR-5 Pre-Amplifier.

IN ATTENDANCE

Avery R. Fisher
Ben L. Arons
George P. Maerkle
James J. Parks
Walter O'Donnell
Sid Weiss
Paul Braun
Ray Pfeffer
Leonard Feldman
George Meyer
Lee Seiler
Kay T. Wyman
Tess Small

FREED ELECTRONICS & CONTROLS CORP. 542

200 Hudson St., New York 13, N. Y.
Products: Tuners, amplifiers, receivers.

IN ATTENDANCE

Arthur Freed
Walter Jablon
Robert Reiss

GATES RADIO COMPANY 610

123 Hampshire St., Quincy, Ill.
Products: Broadcast audio equipment including new Yard control console especially designed for TV, broadcasting, and recording; new 1955 Dynamote compact 3-channel remote amplifier; new 3-speed turntable with fully automatic speed change for 33 1/3, 45, and 78 rpm.

IN ATTENDANCE

Jack Colvin
John Haerle
E. J. Wilder
L. J. Cervone

COWAN PUBLISHING CORP. 617

67 W. 44th St., New York 36, N. Y.
Products: Radio-TV Service Dealers; CQ, The Radio Amateur Journal; (Magazines). Video Speed Servicing Systems; Radio Amateurs Mobile Handbook; Single Sideband Techniques. (Handbooks)

IN ATTENDANCE

Sanford R. Cowan
Oliver P. Ferrell
Samuel L. Marshall
Sanford L. Cahn
H. N. Reizes
L. J. Steiner
Harold Weisner

DAYSTROM ELECTRIC CORPORATION CRESTWOOD RECORDER DIVISION 703

753 Main St., Poughkeepsie, N. Y.
Products: Magnetic tape recorders.

IN ATTENDANCE

James F. Brehm
H. H. Hanlon
Charles R. Frost
Frank Randall
Ed Straw
Syd Wimpie
Donald Hankins
Morris F. Taylor
Gus Nelson
Frank Van Dusen
Robert Dillinger
T. C. Smith
Dr. E. A. Keller

deMARS ENGINEERING & MFG. CO. 535

360 Merrimack St., Lawrence, Mass.
Products: Hi-fidelity loudspeaker systems.

IN ATTENDANCE

Paul A. deMars
Karl W. Miles

DICTOGRAPH PRODUCTS, INC.— HI-FIDELITY MUSIC DIVISION 834

95-25 149th St., Jamaica 35, L. I., N. Y.
Products: Dictograph custom-engineered, packaged Hi-fidelity home music systems.

IN ATTENDANCE

S. Osserman
J. Merritt
P. Lehr
S. Cuker
A. Fritsche

ELECTRO-SONIC LABORATORIES 728

35-54 36th St., Long Island City 6, N. Y.
Products: Phonograph pickups, matching transformers, preamplifiers.

IN ATTENDANCE

John H. McConnell
Samuel J. Spector
Bernard L. Cahn
Benjamin Pinz
Adolph Friedman
Robert Smith
George Antonion
David Friedman

ELECTRO-VOICE, INC. 626

Cecil and Carroll Sts., Buchanan, Mich.
Products: Standard Ultra-Linear hi-fidelity ceramic cartridges; crystal and ceramic phono-pickups and cartridges; broadcast, public address, recording, communication, amateur and special purpose microphones; hi-fidelity, full-range loudspeakers; low-, mid-, high- and super-high-frequency drivers, cellular and diffraction horns, crossover networks; speaker enclosures; broadband FM and television boosters; public-address loudspeakers; equipment consoles; Compound Diffraction Projectors and accessories; hi-fidelity amplifiers and preamplifiers.

IN ATTENDANCE

Albert Kahn
Lawrence LeKashman
A. M. Wiggins
Howard Durbin
Howard Souther
Everett Leedom
Eugene Carduner
S. Fleischman
S. Holt

ESPEY MFG. CO., INC. 634-35

528 E. 72nd St., New York 21, N. Y.
Products: Hi-fidelity AM-FM tuners, receivers, and amplifiers; hi-fidelity phonos and sound reproducers; hi-fidelity tape playback equipment; binaural reproducers; binaural tuners.

IN ATTENDANCE

Edward P. Robinson
David Levine
Earl Oppe
S. L. Sack
Nathan Pinsley
Sol Pinsley
Robert McKean

FAIRCHILD RECORDING EQUIPMENT COMPANY 526

Whitestone 57, N. Y.
Products: Moving coil cartridges and accessories; plug-in transcription arm; turret-head transcription arm; preamplifier-equalizer.

IN ATTENDANCE

Jay H. Quinn
Robert G. Bach
Leonard Zlowe
Robert J. Marshall
Lewis G. Whittier

Audio Fair Exhibitors

BROCINER ELECTRONICS LABORATORY 523

344 E. 32nd St., New York 16, N. Y.
Products: Mark 12 amplifier; audio control center Model A100-CA2; Ultra-Linear power amplifier, Model UL-1; preamplifier-equalizers, Series A100; Model 4 corner horn; Transcendent 3-way corner horn. Mark 30 power amplifier and audio control center.

IN ATTENDANCE

Victor Brociner — Benjamin Pinz
A. Stewart Hegeman

BROWNING LABORATORIES, INC. 742

750 Main St., Winchester, Mass.
Products: FM, FM/AM, and Binaural tuners.

IN ATTENDANCE

G. G. Green — R. E. Lonnberg

CAPEHART-FARNSWORTH COMPANY 846

3700 E. Pontiac, Fort Wayne 1, Ind.
Products: Radio-phonograph combinations.

IN ATTENDANCE

S. A. Morrow

CAPITOL RECORDS, INC. 850

1730 Broadway, New York 19, N. Y.
Products: Hi-fidelity phonograph records in all categories of Music, with special emphasis on Full Dimensional Sound process.

IN ATTENDANCE

William Fowler — Dick Linke
Hal Cook — Anthony Rubino
John Coveney — Don Ovens
James Chapin

FRANK L. CAPPS & CO., INC. 516

20 Addison Place, Valley Stream, N. Y.
Products: Capps condenser microphones; disc recording styli.

IN ATTENDANCE

Richard Marcucci — Sal Gualtieri
Harriet Williams — Lewis S. Goodfriend
Ron Marcucci — Gilbert Owyang

COLLARO 641

215 E. 37th St., New York 16, N. Y.
Products: Collaro record changers, players, crystals, transcription turntable, automatic record combination, and accessories.

IN ATTENDANCE

Sydney Wimpie — Ray Pfeffer
Edward Straw — Mort Wimpie
W. E. Habig — W. McAteer
A. W. Pleasanton

COLUMBIA RECORDS, INC. 835-36

799 Seventh Ave., New York 19, N. Y.
Products: Records; phonographs.

IN ATTENDANCE

James Conkling — Bill O'Boyle
Paul Wexler — H. Dittenhoefer
Jim Sparling — Forrest Price

CONRAC, INC. 721

19217 E. Foothill Blvd., Glendora, Calif.
Products: Fleetwood custom television chassis with complete remote control.

IN ATTENDANCE

W. J. Moreland — J. G. Jones
R. M. Alston — L. L. Adelman

COOK LABORATORIES, INC. 648-649

114 Manhattan St., Stamford, Conn.
Products: Cook BN/MN preamplifier; Cook BN/MN clip conversion; test records; Sounds of our Times LP records; binaural records.

IN ATTENDANCE

Emory Cook — Bob Bollard
Michael Adrian

AUDIO & VIDEO PRODUCTS CORPORATION 511-512

730 Fifth Ave., New York 19, N. Y.
Products: 511: A-V Tape Libraries—Complete line of A-V Recorded Tapes (popular & classical music, educational, literary & religious material recorded on magnetic tape). Custom Music Division: world's largest Tape Library of Background Music (music on long-playing tapes suitable for stores, restaurants, offices, factories, etc.).
512:
Tape recorders and accessory equipment. Hi-fidelity equipment.

IN ATTENDANCE

Charles E. Rynd
Thomas Merson
Richard Rynd
Gene Gold
Robert Winston
Philip Erhorn
Jerome K. Levy
Ray Rand
John Beaumont
James Gerrity

BEAM INSTRUMENTS CORP. 752-53

350 Fifth Ave., New York 1, N. Y.
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Ed Altshuler
Jerry Forkosh
Jerry McDonald
Dick Hoskin
Rita Cole
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Warren Stanton
Paul Letl
Trux Evans
Sid Weiss

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IN ATTENDANCE

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M. Sumberg
David Pear
N. Polamer
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Morton Lee
Harold Leak
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THE AUDIO FAIR—1954

Directory of Exhibitors

AUDIORAMA—1954 will undoubtedly go down in history as the greatest year for the entire high-fidelity industry to date. But it is sure that that will be the fact only if the history is written early in 1955, for it is just as probable that 1955 will be even better. One thing is certain—the market potentialities of hi-fi have only been scratched so far, and while there may someday be a limit to the number of people that are able to pass through the exhibit rooms of a given audio show during the two, three, or four days of the exhibition, that limit has not yet been reached, for still they keep coming.

The principal reason is that people almost universally have a love for music—and especially for its true re-creation at times when it suits their mood. Music in "live" form is usually restricted to every other Thursday night, or the second and fourth Saturday afternoons—even in the metropolitan centers. Yet the audio industry has given people music—with quality which is reasonably close to the original—at any hour of the day or night they choose to hear it. Few other "public services" give people so much of what they want *when they want it.*

The growth of the entire audio industry is living proof of this. Every year—in increasing numbers—people have flocked to see *and hear* what they could have seen and heard in the distributor's showroom throughout the year. Yet they still come in droves to the various audio shows every place they are held.

Credit for this goes to the manufacturers and distributors who have made it possible for people—all kinds of people, big or little, rich or poor, young or old—to have something they consider important. With high-pressure tactics it is possible to sell almost any kind of merchandise, regardless of whether or not the buyer wants it. But people come voluntarily to see and hear good audio equipment *because they want it* and because it fills a need. So long as every year's Fair is bigger than the previous one, we have no fears about the importance and security of the audio industry.

Come and see, if you want proof. It's free to anyone; you'll be welcome and you'll have a good time. Here are the pertinent data:

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IN ATTENDANCE

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IN ATTENDANCE

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IN ATTENDANCE

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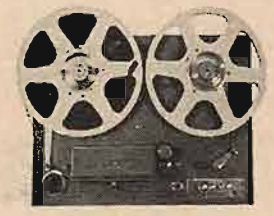

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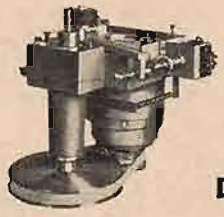

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ABOUT MUSIC

HAROLD LAWRENCE*

The Proof of the Pudding

Ralph Vaughan Williams, one of Britain's finest contemporary composers

THIS MONTH the greatest living figure in English music, Ralph Vaughan Williams, celebrates his eighty-second birthday with a trip to the United States. His itinerary is uncomplicated. He will go directly to Cornell University for a series of lectures and then will visit friends in Arizona before returning home in December.

Although his music is infrequently performed in concert in the United States, Vaughan Williams is no stranger to the American discophile. He has had the good fortune of being recognized by the recording companies. Along with his most popular compositions—*Fantasia on Greensleeves, English Folk Song Suite, Fantasia on a Theme by Tallis*—a healthy segment of his orchestral music is now on discs. In the case of London ffrr's edition of all seven symphonies (recorded in Kingsway Hall), the composer himself supervised each session and even had the rare opportunity of making last minute revisions in the score and then hearing them put into effect on the spot by Sir Adrian Boult and the London Philharmonic Orchestra. (If more composers were given this privilege, perhaps many minor—as well as major—miscalculations in instrumentation could be caught in time.) The listing in the Schwann catalogue still omits quantities of Vaughan Williams' important works, notably three operas: *Hugh the Drover, Sir John in Love* and *The Pilgrim's Progress*. But let's not be ungrateful. With 25 works on LP (not to mention several duplications), Vaughan Williams outdistances any other contemporary English composer; Walton and Britten are runners-up with a combined total of 25.

Vaughan Williams began his career late—that is, late for a composer—at the ripe old age of 29. His first orchestral work was written at the age of 32. Since then, like Saint-Saëns, he has been producing music as an apple tree produces apples. In 1908 Vaughan Williams then 36 made the inevitable Channel crossing. He had come to the conclusion that "I was lumpy and stodgy, had come to a dead-end, and that a little French polish would be of use to me." He went to Paris, studied with Ravel (chiefly orchestration) and, after three months, returned to England with a "bad attack of French fever." The effects, however, were shortlived. Ravel complimented Vaughan Williams by saying that he was the only pupil he ever had who did not imitate him. But to imitate Ravel would have been as difficult for Vaughan Williams as having him dress up in a powdered wig, brocaded vest and *lorgnon*, and dance a Lully minuet.

Like Ravel, Vaughan Williams composes at the piano. But that is where the similarity ceases. Ravel's sensitive musical palette constantly thirsted for "nouvelles harmonies." Vaughan Williams' approach is less sensuous: "I hope I am not like the fox without the tail, but I usually feel content to provide good plain cooking, and hope that the proof of the pudding will be in the eating"—a revealing statement, as well as a fine candidate for the "Block That Metaphor!" column in the *New Yorker*.

Also revealing is a comparison of the two composers' physical appearance. Ravel was short, wore neat tight-fitting suits, donned showy cravats and seemed to have stepped out of a bandbox. Vaughan Williams, on the other hand, was described on a recent occasion as "wearing his mackintosh crumpled up over one shoulder, hanging unevenly on his back, his shabby hat thrown precariously on his thick mop of white hair. He looked untidy enough to

* *26 W. Ninth St., New York 11, N. Y.*

(Continued on page 93)

Manfred (and other works, the Second Piano Concerto, for example) covers a vast dramatic range, but the thinking is less obvious, more involved, very possibly on a more subtle and higher level. The moods are black and white—plus a vast range of grays. The themes, consistently, are more elaborate, less memorable, their treatment not as easy to follow. Sometimes, alas, Tchaikowsky seems just to churn around and around—but mostly, the music is good of its kind; it merely lacks directness.

If you are tolerantly inclined, you'll find some superb themes, moods, ideas here. But not a la "Romeo and Juliet." You really must sit down to this one and study it.

The Russian recording, via an authorized Leeds tape, is moderately hi-fi, nicely miked and lovely of sound in the softer parts. Loud sections are not good—and it sounds like limiter action to me, that thuddy breaking-up of percussion (remember the old Toscaninis?) that comes when a limiter circuit gets there too late. Limiter or no, the loud parts are less than hi-fi, in case you like them best. I don't, and the rest is fine.

Sibelius: Tapiola. Symphony #4. Philharmonia Orch., Von Karajan. Angel 35082

Not exactly Big Noise—though there are plenty of noisy moments. The Angel recording is all you can ask for, but those who still are genuine followers of Sibelius (he's pretty far out-of-style for our younger generation) will find the Von Karajan rendition strangely disturbing in a thousand details, very much as in the case of his recording of Debussy and Ravel reviewed in the September issue. Nothing remotely approaching a careless, incompetent or insensitive playing; this is another of those interesting examples of a wholehearted, carefully worked out and thoroughly expert interpretation that is in the most subtle way imaginable rather violently alien to the music, as we've known it in dozens of earlier hearings. A fine record for a good musical argument—and the sound is lovely, like it or not.

Tchaikowsky: Romeo and Juliet; "1812" Overture; Marche Slave; Capriccio Italien. Vienna State Philharmonia, Perlea. **Vox PL 8700**

Well—the first move in reviewing this incredible collection was obvious enough: I played the last grooves on each side, the loud endings of "Romeo" and the "Capriccio Italien"! Verdict: Excellent. Considering the loudness and the quantity of music on this single disc, the final grooves are very passable, if not more. 'Nuff said!

Better still, a gorgeous over-all hi-fi sound of the sort that Vox has lately developed (See AUDIO, August). The close-up sharp-edged technique, in a huge liveness, is somewhat like that in the Nixa records of Westminster but the close-up aspect is less pronounced, the big, over-all majesty of sound more apparent. A fine sense of vast space and orchestral presence, and a lively, musical performance, too. I don't know how long this record can be expected to last, with a normal 6-gram stylus pressure—but you get so much music for your money that you'll be able to afford a replacement when it wears out!

Deems Taylor: Through the Looking Glass. Eastman-Rochester Symphony, Hanson. **Mercury MG 40008**

Played immediately after the above Tchaikowsky, this Mercury single-mike sound is startlingly close and dead. You'll very quickly get used to it and so the comparison isn't necessarily unfavorable; but those who like big, resonant, large-space recording won't find it here. The larger liveness is sacrificed to a great clarity of instrumental detail, instructive but not aurally inspiring. Aside from the acoustical effect (which is of first importance to most of us) the recording is superbly well processed for top technical hi-fi. And if you like Alice (there's lots of color and effect and nothing disturbingly modern) you'll enjoy the music. I just tend to get absent-minded; for all its orchestral complexity, it doesn't really have much to say.

"into your living room", decidedly full-size, and you'll find them as compelling as any symphony orchestra. Just as loud, too. The recording here seems more alive, better balanced that some earlier Columbia Budapests on LP.

Schubert Lieder Recital. Eliz. Schwarzkopf; Edwin Fischer, piano. **Angel 35022**

If you ever were able to enjoy Lotte Lehmann's Schubert, then Schwarzkopf is her successor for you, and her singing, in the same grand *lied* tradition, is easier to follow than Lehmann's, more accurate, more pure. (Not any greater; just more accurate.) She sings with that inescapable panting, breathless excitement, that tremendously strong speaking of the words, that acting, which is a part of these songs, and is usually lost on American or English singers. To the uninitiated, I admit, it tends to sound like shrieking and yelling—until the musical sense gets through. Then it's another story, and worth waiting for. Edwin Fischer's piano is a superb accompaniment.

Mozart: Symphony #40. Schubert: Symphony #8 ("Unfinished"). Vienna State Opera Orch. Prohaska. **Vanguard VRS 445**

Vanguard says somebody has described Prohaska as "a young Bruno Walter". This recording bears it out. A deeply thoughtout version of each of the great symphonies here, without stunts—thank the Lord—and without stodginess, an excellent playing of each for those who are tired of conductors' histrionics, however inspired, and would prefer to hear a maximum of straight Schubert and Mozart. Try it. Tempi a bit slow, in the current Austrian style; recording acoustics and technique excellent, a lovely balance and warmth.

Mozart Symphony #40. Haydn: Symphony #94 ("Surprise"). NBC Symphony, Toscanini. **RCA Victor LM 1789**

Well—here we go again. Inspired, yes. These Toscanini "New Orthophonic" recordings undoubtedly glow with intensity, and there are plenty of extremely eloquent and moving passages; the level of musical excitement is well above that of the Prohaska in the sense of drama. But that ends it. For one thing, the Toscanini tempi in the "Surprise" of Haydn vary from a hurried, nervous rush in the first movement to a speed in the minuet movement that, as far as my best musical sense is concerned is just plain preposterous. The music is played double-time, at full scherzo tempo, as fast as some versions of the Beethoven third movements. Yes, I suppose we have no black-and-white *proof* that the "Surprise" minuet is supposed to go roughly at minuet tempo (which allows plenty of leeway). But for the life of me I can't see how any reasonable examination of the plain internal evidence of this score could conceive of any such extreme speed as this! It doesn't make any audible sense.

. . . And then there is the cannon-blast explosion of the last movement, (à la Rossini and "William Tell")—music which to many quite reasonable ears has no such fiery violence implied in it at all. And, in the G minor Mozart, #40 there is the superbly realized intensity—at the expense of countless lost phrasings, unfinished musical lines, blurrings, hurryings, of detail-work that should be as beautiful as it looks on paper.

Yes, we must have over-all conceptions, and too many stodgy conductors play the details and forget the whole. But this is an equal if opposite sin! The whole is the sum of the parts. Frankly, and with the best honesty I have, I can't help a sigh of relief and pleasure at the straightforward Prohaska reading, after this tussle with Toscanini. It's musically bruising.

Mozart: Symphonies #40; #35 ("Haffner"). London Mozart Players, Leo Blech. **Bluebird LBC 1069**

While we're on Mozart's Number 40, here's RCA's lower-priced offering, a new recording, not a reissue oldie. Oddly, this one has the sound of an abnormally large ensemble, a "full orchestra" though I'm inclined to guess that the effect is one of mike technique. Whatever the actual number of players, this is the "symphony orchestra" sound, the older type of orchestral sound that is still familiar in "live" form in our symphony concerts and which was more or less universally expected for Mozart and Haydn before the present use of smaller, more intimate groups of players became so common. To those who have collected LP records during the last few years, the difference will be immediately striking; yet people who regularly attend "live" concerts by symphony orchestras and who are not so familiar with records will find this the "normal" Mozart sound. An interesting trend—not only the smaller size of the Mozart "orchestra" itself, but reaching much farther, into the microphone techniques now commonly used to give a close-up, sharply-etched almost chamber-music sound to this kind of music.

You'll note that even the Toscanini version, above, has the newer sound, close, tight, brilliant and clear, as in a small auditorium.

The Blech performance is highly musical if a trace "old fashioned;" the strings are warm, soft, a bit over-expressive, the wood winds particularly nice. Nothing grim and tense about this gracious Mozart!

BIG NOISE

Rimsky-Korsakoff: The Great Russian Easter; "Antar" Symphonic Suite. London Symphony, Scherchen. **Westminster WL 5280**

A Westminster Nixa recording—which is enough description for anybody who has heard earlier hi-fi discs in this series, made in Britain. The Nixa technique represents possibly the most advanced use of the new "close-up-and-distant" method, whereby every instrument is a solo, sharp and loud a couple of feet away, and yet the ensemble (as well as every solo) simultaneously sounds at a vast distance in a huge hall. It can be a very striking effect.

Rimsky's colorful orchestration, as may be imagined, is blown up to hair-raising clarity of detail; triangles like telephones, huge cymbals, drums, harps that twang, bells like fire alarms—a most exciting body of hi-fi sound, notably in the famous Russian Easter music. (Scherchen with his accustomed conductor's freedom takes it about twice as fast as you've heard it before—and for my money the music is vastly improved!)

For those who value the subtlety of orchestral coloration in many Rimsky pages of score, the Nixa treatment may seem to smack of crudity. There is surely very little of veiled impressionism here! Matter of taste—and Westminster's processing brings you every last trace of the Nixa product with gorgeously low distortion.

Tchaikowsky: Manfred. Bolshoi Symphony Orch., Alexander Gauk. **Concert Hall CHS 1308**

Here is an oddity—a long symphonic poem by Tchaikowsky, in four movements, that has been called one of his greatest works, yet is very seldom heard. It is on the largest scale, with all the familiar Tchaikowsky tricks, and those who really enjoy Tchaikowsky for himself (not merely for his high fidelity) will find it a long, but absorbing experience musically. To others it may seem unbearably heavy-handed, long-winded, turgid . . . but then, Tchaikowsky lived in a long-winded period and Manfred is surely not abnormal for the time.

Nor is there, I think, a lack of good construction and musical coherence—for this is no blatant "1812" overture! The answer to Manfred's unpopularity, aside from the plain fact of its length, is in the tunes.

The works of Tchaikowsky that remain popular are those which have big, showy themes—easy to sing, easy to remember. It's is invariably these works which have, also, a big, simple, "stagey" dramatic force that wastes no emotional strength on complexities of structure and of mood. The structure is usually superb—as in the "Pathétique" or "Romeo and Juliet"—but the drama never for a moment hesitates; all is as clear as black and white—or the big, clear themes themselves that we all remember.

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backed viol family; but, oddly enough, the results here are quite musical and most entertaining, with soprano-tenor close-up duets from the well-known Marais and Miranda, to the very sweet contrapuntal accompaniments of the viol group in arrangements by Marais himself. Not folk music, not any musical fish nor fowl, but nice listening and wonderfully recorded.

Martha Schlamme Sings Songs of Many Lands. **Vanguard VRS-7012.**

Perhaps this Austrian lady has received audience acclaim on extended world-wide concert tours, but she's no folk singer for my money. A pleasant, open delivery, not the slightest vestige of a sense of differing styles, an accurate voice that sings everything in an unintended parody, from Negro spirituals to Yiddish wisecracks, all to an innocuously wishy-washy sort of piano accompaniment, no doubt complete with gestures—she is the perfect example of the well-meaning singer-turned-folk-artist, who hasn't the faintest idea what a folk song (any nation, any race) is all about.

Kentucky Mountain Songs: Jean Ritchie. Elektra EKL-25

—And here is the ultimate opposite, a true folk singer, a consummate musician whose songs and singing style come straight from a long family tradition in the Southern mountains. Jean Ritchie is the kind of folk singer who is so good that even people who can't stand folk songs are spellbound by her musicianship and the incredible subtlety of her style of delivery. This is a second volume from Elektra, including some dulcimer solos, as well as a brace of unforgettable old English ballads done in the strange, quavering, highly ornamented style of the old music—a style that defies notation altogether and is only passed on by intimate and long-time listening. Dulcimer, guitar accompaniments; unaccompanied songs.

A Folk Music Sampler. Elektra FMS-1 (Available from Elektra Records, 361 Bleecker St. N.Y. 14.)

An advertising disc, but worth noting as a legitimate use of the new convenience of tape editing. Twelve songs by a number of singers, sampling the regular Elektra catalogue. No fadings-out—each item is complete. (You'll find other samplers available, including, I think, an RCA Victor Jazz Sampler.)

Korean Children's Choir. Sponsored by the American-Korean Foundation. **Urania URLP 7125**

An off-shoot of one of those well-publicized U.S. tours, this was taken on the fly as the Korean kids whirled, singing, through our fair country. My copy (not yours) has a plug by John Daley, radio-style, explaining that you can send a Korean Orphan to school for one year if you buy the disc. ($5.95, Record, Am.-Korean Foundation, New York City, N. Y.)

The record is both funny and pathetic. The kids shriek enthusiastically in piercing treble everything from Jeannie with the Light Brown Hair and Danny Boy to assorted Korean tunes—all of them dished out with a grade-school-style piano accompaniment indisputably made in U.S.A. Not exactly a musical *tour de force.*

Beethoven, Schubert, Mozart

Badura Skoda plays Beethoven. ("Moonlight," Pathétique," "Appassionata" Sonatas.) **Westminster WL 5184**

Here Badura Skoda is put to work cleaning up the Beethoven war-horses of the piano repertory—and I, for one, find the job unexpectedly vital and refreshingly absorbing. Skoda has always been for my ear an ideal Mozart and Schubert pianist, but a year or so ago his big Beethoven, the "Emperor" concerto, didn't come off well at all, not enough of the old trouper, the big-time showman, for that showily demanding masterpiece.

But nothing is wrong with the Skoda potency here. Not only is the interpretive thinking of the very highest order, and indeed a fascination from measure to measure, without a loose end, a meaningless phrase or a blurred bit of detail—but the powerhouse quality of the big Beethoven movements comes through to please anybody. Top recommendation for all who would learn more of what is inside these much-played works.

Beethoven: Piano Sonatas in E, Opus 109, A flat, Opus 110. Myra Hess. **HMV LHMV-1068**

Dame Myra is still about the finest woman pianist of her type—and a vanishing type it is, the full-blown big romanticist whose central musical existence is with the German classics of Beethoven, Schumann—nobody can surpass her Schumann—Mozart, Bach.

These are masterly performances of the two difficult late-Beethoven sonatas, pure musical expression far above mere pianistic finger-wigglings, though there are plenty of passages in these that sound thick and hopelessly complicated under lesser fingers and littler minds. The Hess versions are inevitably to be compared to the imperishable Schnabel: they are of the same order, but less stern, more lyric (and feminine), milder, often slower, but not a bit less profound. Again, there is much to be learned here and enormous enjoyment to be had from such utterly easy, understanding playing. Top-quality recording, too.

A Sonata Recital by David Oistrakh. (Beethoven: "Kreutzer" Sonata; Le Clair: Son. in D; Ysaye: Solo Sonata op. 27, #3.) Vanguard VRS 6024

Oistrakh recordings have been piling up in my backlog for some time—to tell the truth, I've been somewhat intimidated by the high-powered notices he's been getting. Sensation stuff. But now I eat crow. This is an excellent "Kreutzer" (the piano as well as the violin—he is Lev Oborin), masculine, full-bodied, strong and solid but never hysterical or overtaut as so often is the case in this work. Remarkably lucid display of the essential musical stuff. (Le Clair is a nice 18th c. trifle, the Ysaye is a dreadful solo violinist's nightmare.) The same goes for:

Oistrakh Plays Beethoven and Glazounov. (Beethoven Violin Concerto, Glazounov op. 82.) With the "State Orchestra" under Gauk, Kondrashin. **Period SPL 598**

(Quotes above are mine. "State" Orchestra—what State? Does anybody think it's the State Orchestra of North Dakota or something? It might—horrors—even be the Moscow State Orchestra for all I know.) (Why can't they stop putting OISTRAKH in huge letters on all his albums? It takes up so much space here to list the music he plays, after the title!)

The Beethoven Concerto is not unlike the "Kreutzer," beautifully played if a bit stolid in the orchestral part, heavier even than Beethoven himself. For all his present fame, Oistrakh is not given to flamboyance nor to any sort of dramatic showmanship. His tone is the warm, luscious one of the world-famous violinist virtuoso but his antics are non-existent. No reason, then, to be afraid of his notoriety, and every reason to enjoy his obvious understanding of Beethoven.

I haven't tried the Glazounov. Didn't want to, after Beethoven. Oisters and chocolate sauce! *You* try it. (I *did* touch a few measures; technical quality is below the Beethoven, sounds like a disc job.) The Beethoven is well recorded something less than tops, the sound a bit dense and the acoustics rather unresonant. Unimportant drawbacks.

Schubert: String Quartets #13, #14, #15. Budapest String Quartet. **Columbia SL-194 (3)**

I've been playing the contents of this album again and again since March and have never stopped long enough to mention it. Here are the three big quartets (including "Death and the Maiden") played with astonishing intensity and fire—for this is the kind of work the Budapest now does most superbly.

This is a Schubert everyone should know, far from the sweet lyrics of the familiar music, related to those familiar ominous sections of the "Unfinished Symphony" but going much farther towards the bizzarre, the macabre; in these deadly serious and almost morbidly exciting moments (interspersed, of course, with the most wonderfully relaxed lyricism) Schubert was an extraordinary pioneer in Romantic expression, well ahead of Beethoven, matched only by Weber at the time.

To quartet-distrusters: don't ever be scared of this sort of hi-fi quartet music! The high-fidelity phono system brings these four vigorous players

3

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The Hi-Fi Highway

"New Orthophonic" High Fidelity. Various bands, artists; hi-fi tonal range demonstration, etc. With Booklet.

RCA Victor LM 1802

Look fellers, I'm a musician. When somebody plays music at me—I hear music. It may be good, bad or indifferent, intriguing or boring, well-reproduced or poorly in a thousand and one ways; but if it's music I hear music. This record has music on it.

High Fidelity, as far as I'm concerned, is a six-lane super-highway with a green strip in the middle and a lot of trees. It's a highway *to* somewhere. I like nice highways, but I wouldn't think of just driving on them, to look at the lovely concrete and the green grass in between. Not for long, anyhow. If that highway doesn't take me somewhere I want to go (and take me better than some other road to the same place) then to heck with it. I want a Destination.

Same thing with hi-fi reproduction: if it brings me sound that I like, fine. If not, then the hi-er the fi the more my displeasure or boredom, or what-have-you. Hi-fi is strictly a means, for me.

So I listened to this record straight—before tackling the "booklet", a volume roughly twice the size of the record itself and dozens of pages long. My reaction was something like this:

. . . What's this?—oops, a foam-rubber turntable mat! Fell out of the album. Just an extra hi-fi bonus that, somewhat irrelevantly, comes with the package.

Side 1. "Adventure in High Fidelity", by Robert Russell Bennett. Aha—the first piece of music ever composed expressly for hi-fi. (That is, the first Destination ever created so that a six-lane highway might have somewhere to go. . .). Wow! All the bells in Christendom and everything else too. Take out the bells and where have I heard that sound before? Ah yes, old Stravinsky did it the year I was born, at the beginning of *his* adventure in hi-fi; "Petrouchka." No bells, though. And now come a herd of hippopotami in brass, no doubt intended to overload my amplifier while it was busy with them thar bells . . . they wallow in a sort of D minor; but in come a couple of screetching parrots (piccolo) and some fine hi-fi gazelles (oboe), plus a solo violin a couple of centimeters from the end of my nose. This must be the Apotheosis of the African Veld. Wood blocks, Chinese something-or-others right out of Ferde Grofé's Grand Canyon . . . yep, I knew it, here comes the native dance, with percussion.

Funny, I'm getting confused; did I hear a bit of Broadway mixed with Jungle Jim's percussion over there? And what about that "tick, tick", out of Latin America? Where the heck *are* we? . . . Might have guessed it—Bali. Or is it Bangkok? Anyhow, there's that gamelin stuff, with a few cowbells thrown in . . . and now? *Of course!* I shoulda' guessed: South Pacific. The traveling road company, strings, saxes, and all. Only, the castanet man from Spain bungled into the middle. And now—"Petrouchka" again: the music box sound. (Remember, the man with the walking bear?).

Around the world in hi-fi. For now we're in neo Tchaikowsky, right out of Aurora's Wedding—whoops, altered-thirteenths in the saxes; that bodes no good. Ominous muted trumpet. "Porgy and Bess"? Or is it Virgil Thomson's "Louisiana Story"—that's where I last heard *that* kind of sound. Alligator music or something. That was the slow movement . . . but here we go, right onto the stage of the Paramount.

Batteries of brass rise up with purple spotlights on them and—WHAT? Yep, Haydn in jazz, variations on Haydn's variations on Haydn's "Surprise"—sinking ominously downwards until that good old Chinese gong sends Papa H. back where he belongs, and "Porgy and Bess" takes over once more.

Grand Finale—with bells and hippopotami again. Form, by golly: the First Idea returns at the very end, the Full Frequency Fountain of Farewell. (That's the title.) I quote from the booklet, *in re* this Fountain:

"Again the incredibly rich musical fabric of the opening movement, heavily accented by full-brass chords emerging from madly swirling woodwind and string arabesques and a fountain spray of glittering percussion notes . . . all rising with seemingly inexhaustible dramatic power to a preroration that may well represent the ultimate incandescence to which musical sound may be fired. It leaves the listener overwhelmed by a sonic experience unlike any he can have ever known before, a dream of High Fidelity. . . ."

Tut-tut. It still sounds like hippopotami to me.

Phew! That was only band 1, side 1. To be sure, the rest of this record has some very instructive stuff on it. Next comes a piece called "The Orchestra in a Nutcracker Shell" which is no more than a very nice batch of solo passages for the principal instruments, each one recorded at arm's length for your greater instruction. You can hear the keys clank and the breaths wheeze. Tunes from the "Nutcracker", and very nicely played.

Side 2 begins with a Restricted Range Demonstration. An unexpected yawp. It's only an electronic tone generator zooming from Low to High—and we're off in those bells and hippopatami again. Sudden stop; Somebody flipped the pot closed right in the middle of the Veld. Another yawp, not quite so persuasive, and—re-take. The scene starts all over, bells, hippopotami and all. I've had almost enough of them by now.

Fade-out. Yawp #3. Once more, like some zany comedy show, we start all over with bells and hippopotami! This time, the bloom is off the peach. . . . I mean the shine is off the hippo. The 5000-cps. cut-off only makes 'em sound fatter. . . .

Now don't get this wrong. I'm retailing a *musician's* reaction to these goings-on. If you wish to ignore the music and listen to the fi, you've got a very nice demonstration here of full-range, slightly-restricted (100–8000 cps), and decidedly-restricted (200 to 5000 cps) reproduction. Couldn't be better. But I just hear the same piece of music again, a second, third, and fourth time—when, frankly, I wish I hadn't heard it the first time. Please yourself!

That's not all. Suddenly (side 2, band 4) the hippos vanish in an instant—and we're in a recital hall. Nice! A really lovely rendition of Richard Strauss' highly-colored song, "Amor". What a pleasure! Here we are, at last, back in music—normal, sensible, music-for-music's-sake. This is true Hi-Fi—a highway to real musical pleasure. Same with Victoria de los Angeles' charming 18th-century-style "Gold Finch", with harpsichord accompaniment, and Jussi Bjoerling's fine singing of a splendidly typical Grieg song, "A dream". (Original text in booklet, minus translation.) Leonard Warren's baritone contribution in Italian, "The Last Song," is relatively a trifle, innocuously musical and perfectly delivered.

These four songs, for four voice-types, make a splendid lesson—not in high fidelity, (which is, of course, tops here), but in the art of singing. Worth the entire disc, for musical people. You won't find a better and truer illustration of what Hi-Fi is all about than this little vocal concert—for here, top-quality recording technique is put to work to project excellent musical values. That's real hi-fi.

One band left to play—and here she goes. WOW! Here comes the Pops Parade, with (lemme look quick)—Bahama Buggyride and Hugo Winterhalter And His Orch. leading off.

Now my field isn't pops. I just listen to the noise it makes. And man, THIS IS HI-FI. Never mind the music, I say (since I don't know a rebop from a bebop), just LISTEN TO THAT SOUND! RCA has really done it. "Moonlight and Roses" on guitar, accordion and Hammond; "My Impossible Love", real big-time dance band stuff, and—finally—"Eddie and the Witch Doctor." Music? Pops? Well, anyhow here we have *"the ultimate resources of wide-range, transient-true recording and reproduction . . . in the dramatic exploitation of percussion instruments."* Ultimate, yes! But not very original. Methinks I've heard this New Sound before, too; it was composed first around 1926 by a gent named Edgard Varèse and if you think that was popular music, you're nuts. It was VERY serious.

This price, however, ends with a New Note that didn't occur to Edgard Varèse. Just before the final whirlwind blast, the entire ensemble, percussion, brass and for all I know the sound engineers and the maintenance crew as well, toss their instruments and their hats in the air and let loose a blood-curdling yell. HURRAH for good old High Fidelity! There really wasn't anything else left to do.

R. D. Darrell, incidentally, does a manful job with the mammoth hi-fi booklet which (along with the rubber turntable mat) fills out this High Fidelity package. It was, shall we say, a parious assignment, that I wouldn't have dared touch with a ten-db pole, and he has done it proud. An excellent discussion, between superlatives, of the functions of hi-fi in sound reproduction. And, all kidding aside, the recording is a credit to RCA's sound engineers and processors, if not to their musical staff. Don't miss it.

FOLKISH

Ballads of Long Ago. Marais and Miranda, Pardo Ancient Instrument Ensemble.

Columbia ML 4894

Well, any folklore-ist would have the shivers at the mere thought of this weird *compôte* of traditional balladry and ancient instruments—viola d'amore, tenor viol, gamba, the mediaeval flat-

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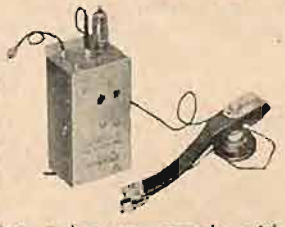

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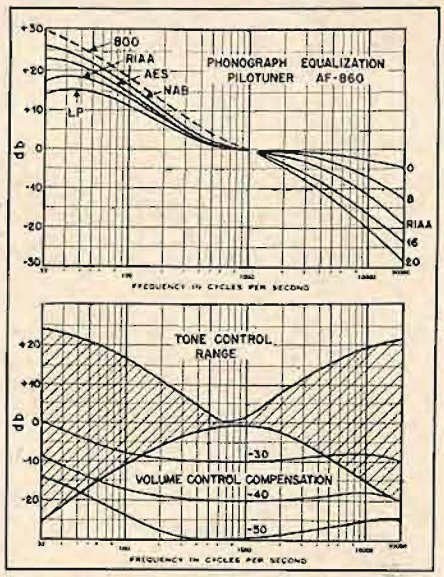
Fig. 8 (left). Front view of AF-860 Pilotuner. Fig. 9 (right). Performance curves for the AF-860.



commonly used electron-ray tube. On FM the station is tuned to a center indication on the meter, with satisfactorily close tuning being shown by a ⅛-in. wide band at the center of the meter scale. On AM, the meter indicates with a maximum swing to the right when the station is properly tuned in. One of the desirable features of this tuning meter is that it is mounted at the bottom of the dial escutcheon so that the user does not have to bend down to see an indicator located (usually) at the top of the dial opening.

A second valuable feature of the tuner is the variable AFC control. Instead of a simple switch with either "in" or "out" positions, the AFC may be used either fully out or fully in, or in any desired amount. This is an advantage in fringe areas where fading often permits a stronger station to take over when full AFC is used, but a slight amount of control would be desirable.

Figure 8 shows the appearance of the tuner from the front, *Fig.* 10 from the rear. From left to right the knobs are: volume control with on-off switch; phono equalizer, the outer knob for turnover, inner knob for rolloff; AFC control; selector; tone controls, outer knob for bass, inner knob for treble; tuning control. On the rear apron is the high or low-level pickup switch (in the photo, the switch is labeled PREAMPLIFIER IN—OUT) a pickup load control, input and output jacks, a hum balance control, and two convenience outlets.

Tuner Section

An iron-cored loopstick serves as antenna for the AM section, with a connection available for an external antenna when one is required. On FM, a small capacitor connects to the a.c. line cord, the power transformer being isolated by r.f. chokes. For fringe areas, an external antenna may be connected to the terminal strip.

One r.f. stage and two i.f. stages are used for both AM and FM, with two additional stages on FM as limiters, followed by a Foster-Seeley discriminator. The AM detector circuit is essentially a diode, since it uses the grid circuit of the first limiter as a "diode plate." The signal is developed acros a resistor in combination with a 10-kc filter which is extremely sharp, being provided with a frequency control as well as a resistance null control which increases sharpness so that at 9 and 11 kc the response is less than 3 db down, while rejection at 10 kc is of the order of 60 db. The audio section consists of two sections of a 12AX7 as the phono preamp, with the turnover and rolloff controls between the two sections of the tube, followed by two sections of a 12AT7 in cascade with the tone controls between them, and followed still further by ½ of a 12AU7 as a cathode follower output tube. The tuner has its own power supply, and indicator lights show when the selector switch is set on PHONO, TAPE, or AUX, and when set on AM or FM, only the working section of the dial scale is illuminated. Broadbanding of the AM circuit is accomplished by switching in an overcoupled coils in the first two i.f. transformers.

Performance

Figure 9 shows the performance curves for the tuner. Any one of the five low-frequency characteristics may be used with any one of the high-frequency characteristics. The solid lines represent actual measured values; the dotted "800" curve is factory specification, since the tuner tested did not give the characteristic expected when it was measured. The two concentric knobs are intelligently arranged—providing clear lettering on the panel and a maximum of ease in use. The two knobs have settings that coincide for the RIAA curve; the large low-frequency knob rotates counterclockwise from the RIAA position through LP, AES, NAB, and 800, while the small high-frequency knob rotates clockwise from the RIAA position through 20, 16, 8, and 0, the figures representing the number of db down at 10,000 cps.

Tone control range is shown at the lower section of *Fig.* 9. as is also the compensation of the volume control. The figures – 30, – 40, and – 50 represent db below maximum response at 1000 cps, with the associated curves showing the response throughout the audio spectrum.

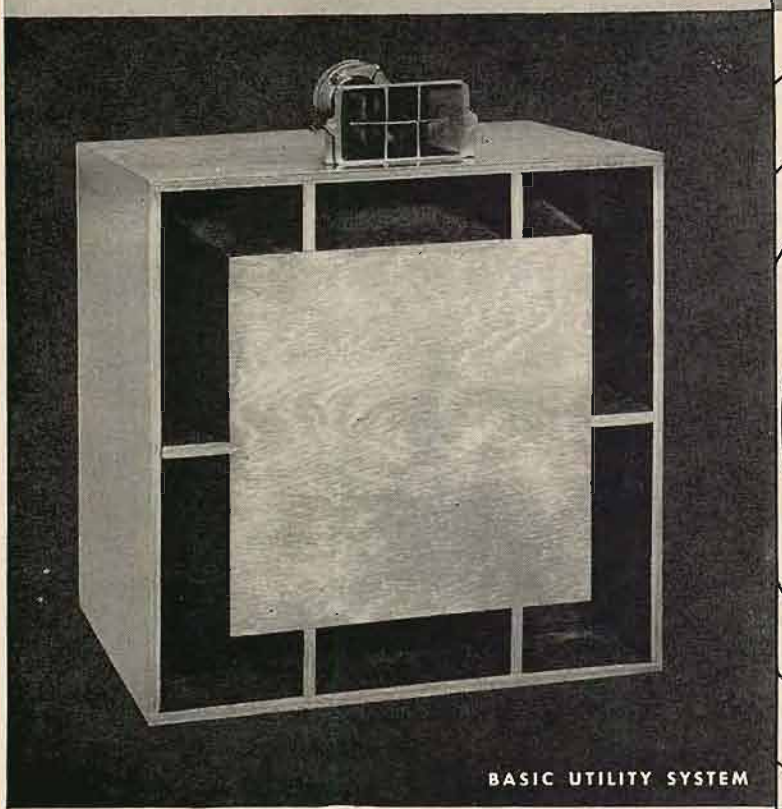
The hum balancing control is effective, giving a range of about 15 db in minimum hum output. Pilot has long used a variable control to provide the correct load on any type of magnetic pickup, and this gives a range from 6800 ohms to 106,800 ohms. This feature is retained on the AF-860, and is considered desirable. The HI-LO switch gives a voltage ratio of approximately 5 to 1 to accomodate pickups with differing output voltages.

Power consumption for the tuner is only 55 watts, which seems low for a tuner with the additional audio and preamp stages. For a 1-volt output at the AUDIO OUT jack, a signal of 0.118 volts is required at the TAPE and AUX input jacks. The DETECTOR OUT jack is fed from a second cathode follower which derives its signal ahead of the tone-control stages. Consequently there is less gain in this channel, and for a 1-volt output at this point, an input signal of 1.14 volts is required at the TAPE and AUX inputs. For the LO phono input, an input of .0115 volts is required to produce a 1-volt output; for the HI input, the required input signal is .054 volts. IM distortion measurements through the amplifier section, with controls on flat position, show that the distortion is less than 1 per cent at 2 volts output, and less than 2 per cent at 5 volts output. Hum level is satisfactorily low, being approximately 45 db below 1-volt output at the maximum setting of the volume control on PHONO, and about 65 db below 1-volt on the TAPE and AUX inputs.

Sensitivity appears to be better than 3 microvolts on FM; factory specifications call for 2 microvolts on AM. With two i.f. stages used on AM, the selectivity is excellent, and the 10-kc filter effectively eliminates any interstation signal, whether on BROAD or SHARP.

Fig. 10. View of AF-860 to show input jacks and rear apron controls.

now! *at prices you can afford... a true* *exponential speaker system*



BASIC UTILITY SYSTEM

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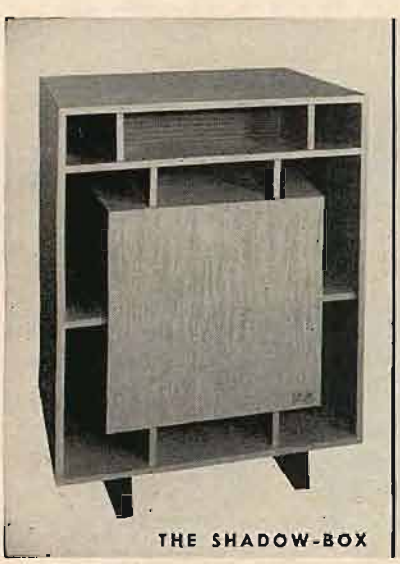
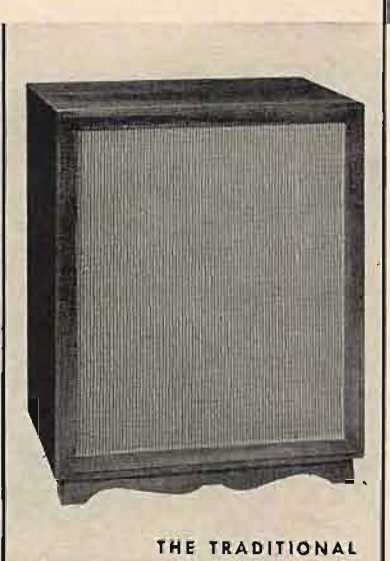
Frazier-May

horn

a new dimension in sound reproduction *... at amazingly small cost*



THE SHADOW-BOX



THE TRADITIONAL

1. *Revolutionary New Damping principle* . . . practically eliminates hangover and intermodulation distortion.
2. *Compactness* of unique design gives performance equal to enclosures three times the size.
3. *High Dispersion Factor* . . . eliminates the "point source" of sound.
4. *Low Distortion* . . . lower than many amplifiers.
5. *High Definition* . . . each instrument is reproduced with authentic brilliance and clarity.

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bench-crafted cabinetry

See the variety of beautiful F-M horn models in authentic bench crafted cabinets on display at the *Sight & Sound Exposition* at Chicago's Palmer House, Room 815, and at the New York *Audio Fair*, Hotel New Yorker, Room 533.

International Electronics Corp.

159 HOWELL STREET
DALLAS, TEXAS

Equipment Report

(*from page 52*)

reproduction quality, and most manufacturers—wishing to ensure optimum results with their equipment—have made sure that they offered an arm which was designed to work with their own cartridge. In many instances, these arms have achieved favor among users to the extent that they were being used with the cartridges of other manufacturers. Wishing to ensure the availability of an arm especially designed to work with the 215–216 series of pickups, Fairchild now offers two transcription arms—Model 280 for 12-in. turntables, and Model 281 for 16-in. turntables. The 12-in. model is shown in *Fig.* 5, and the appearance of the 16-in. model is similar except for the length.

Desirable features of this arm are: freedom from low-frequency resonances and its adjustability for stylus force, height of arm, drop limit, and leveling. The adjustments are readily made, using thumb screws for stylus force control and drop limit. The former tightens or loosens, as required, the main supporting spring; the drop limit controls the lowest point to which the stylus can drop so the stylus need never touch the turntable when no record is on it.

The height adjustment is controlled by a set screw in the base which bears against the supporting post. Levelling is accomplished by tightening or loosening the three screws holding the base to the motor board —rubber bushings between base and board take up the slack. When properly installed, the arm rests at a point 7 in. from the center of the turntable, and the curvature of the arm is practically concentric with the record. At the rest position, the arm is held in place by a built in spring clip which eliminates the need for a separate holding device.

The arm itself is of square cross section, with the rear portion free to revolve about the vertical axis, the front of the arm being pivoted about a horizontal axis. The design

Fig. 5. Fairchild Model 280 Transcription Arm.

ensures equal stylus force over a vertical position of at least ¾ in. so records can be stacked up if required, as on a record changer.

The pickup is mounted on a slide which clips into the front end of the arm, permitting the user to have a number of pickups mounted for different applications with ready interchangeability. Contact to the pins on the back of the pickup is made by two springs which short together and prevent an open circuit when the pickup slide is removed. A snap-out button is provided on the top of the arm to accomodate cartridges with turn-around styli.

The Model 826A transformer, *Fig.* 6, is designed to match the 80-ohm impedance of the 215 series of cartridges, and the secondary should be terminated by an input resistor of approximately 50,000 ohms. Thus the usual input resistor in the preamp —47,000 ohms—is a satisfactory match. The principal advantage of the transformer is its mounting. The primary connections are made through a standard phono jack, and the secondary output is through a 30-in. shielded cable terminated with a pin plug. Thus the normal lead from the pickup arm is removed from the preamp and plugged into the transformer input, and the output cable is plugged into the preamp jack. The transformer is mounted by means of a clamp which attaches to the cabinet with a single wood screw. Thus it is possible to locate it at a point where the hum pickup is at a minimum, with movement about the mounting screw and axial rotation permitting an adjustment for an absolute minimum of hum. This feature of adjustment is clever, and deserving of considerable commendation.

L.E.E. "CATENOID" FOLDED HORN

THE FOLDED HORN enclosure offered by the Laboratory of Electronic Engineering is of unusual design, yet manages to radiate an excellent-quality signal from a relatively small box. The woofer section of this enclosure—its principal feature since the mid-range speaker and the tweeter both radiate directly toward the listener—consists of a low-frequency speaker in an infinite-baffle enclosure and radiating downward. The "horn" begins at the speaker, expands along the bottom of the cabinet, up

Fig. 6. Fairchild Model 826A step-up transformer to match the 215 Series of moving-coil phonograph pickups.

the front, back to the wall corner, and out at the sides. The expansion curve of the horn is termed "Catenoid," which is more adaptable to straight-sided passages than is the exponential. Crossover from the woofer to the mid-range speaker is at 300 cps; from mid-range to tweeter is at 6500 cps; well out of the fundamental range of music.

In direct comparison to what we consider our "standard" loudspeaker, we find that the LEE enclosure offers smooth response over the range from 30 to 15,000 cps, but no absolute measurements were made on the complete speaker. It was felt, however, that performance was remarkably close to the "standard" over all but the very lowest ranges, which is to be expected since the "standard" is a large 8¼ cu. ft. horn-loaded corner cabinet employing a heavy-duty woofer, multicellular mid-range horn and driver, and a popular super-tweeter unit.

The LEE Catenoid system is compact—measuring only 36 in. high and 28 in. along the two walls from the corner—and its attractively finished. Its relatively small size should make it very popular with those for whom space is a commodity that is not too abundant. As usual, the decor of a room could absorb this corner speaker without any apparent reduction of room area. Side radiation of the very low frequencies gives the very desirable effect of a large source—completely devoid of the "hole in the wall" feeling common to certain types of speakers. Under measurement, however, this feeling of "hole-in-the-wallness" can usually be attributed to minor resonance peaks which serve as formants, giving one or more humps in the response curve and coloring the reproduction accordingly. The Catenoid seems to be completely free from any such resonances, the reproduction being smooth over the entire audio spectrum.

Fig. 7. Laboratory of Electronic Engineering's three-way Catenoid loudspeaker.

AF-860 PILOTUNER

There are two schools of thought as to how a tuner should be built—one believes that the tuner should be stripped of all controls except the tuning knob and a selector switch to choose between AM and FM, while the other believes that all controls should be incorporated in the tuner, which thus becomes the operating center for the system. There is much to be said for both sides, but there is no gainsaying the advantage of economy when the second school is followed, for only two separate units are required—tuner and power amplifier—and installation is considerably simplified. Greater flexibility is the principal advantage of the first method, and as recently as two years ago this was important because none of the tuners then available were fitted with suitable tone and phono-equalization controls. Now, however, most tuners have excellent control flexibility, and the economy of the two-unit system becomes important.

The new AF-860 Pilotuner belongs to the second school of thought. It provides—in addition to a sensitive AM-FM tuner—a phono preamp with both turnover and rolloff separately adjustable, separate bass and treble controls, and a selector switch for choosing the desired signal source, be it radio, phono, tape recorder, or some other "auxiliary" input. In addition, this switch chooses two degrees of selectivity for the AM section of the tuner, and switches the indicator lights and the tuning meter. There is also an AFC control.

The tuning meter itself is one of the interesting innovations of this tuner. Heretofore available on only the most expensive tuners, the meter gives a more reliable indication than is possible with the more

Sixth Annual Convention Program

AUDIO engineering society

Hotel New Yorker, New York City. October 14-15-16, 1954

Technical Papers

All sessions to be held in the North Ballroom

Thursday, October 14th

9:30 a.m.

Annual Business Meeting of the AUDIO ENGINEERING SOCIETY

10:00-12:00 a.m.

MICROPHONES

Chairman: B. B. Bauer
Shure Brothers, Inc.

CATHODE FOLLOWER CIRCUITS APPLIED TO A MICROPHONE

JOHN K. HILLIARD, JAMES J. NOBLE, *Altec Lansing Corporation, Beverly Hills, California*

The cathode follower vacuum tube is used as an impedance translator between the miniature condenser microphone and the output circuit. It is evaluated for both the triode and pentode connection, and it is shown that the pentode connection is the most favorable in terms of input admittance.

A means for minimizing noise arising from thermal agitation and leakage current is presented with data relating the noise threshold to the real component of the microphone circuit impedance.

MICROPHONES FOR INFORMAL USE

L. M. WIGINGTON, R. M. CARRELL, *RCA Electronic Products Division, Camden, New Jersey*

Television programing often requires that microphones be used informally, off the axis of the speaker's mouth. An integrating audiospectrometer is used to determine the approximate response curve for proper balance when the microphone is worn on the chest or lapel. A new miniature microphone having suitable frequency response and directional characteristics for informal use is described.

UNIAXIAL MICROPHONES

HARRY F. OLSON, JOHN PRESTON, AND J. C. BLEAZEY, *RCA Laboratories, Princeton, N. J.*

Uniaxial microphones are unidirectional microphones in which the maximum response occurs on the principal cylindrical axis. Ribbon transducers are used in these microphones because of the outstanding and desirable characteristics of these systems as demonstrated in more than two decades of use. Distributed and lumped acoustical resistance terminations and phase shifting networks have been developed for uniaxial microphones. Uniaxial microphones of both first and second order have been developed.

A STABLE LABORATORY STANDARD CONDENSER MICROPHONE

JOSEPH F. HOUDEK, JR., *Kellogg Switchboard and Supply Co., Chicago, Ill.*

This microphone is designed to provide calibration stability in the audio frequency range in laboratory, studio and testing applications. Featured are rugged construction and spring loading which maintain constant diaphragm tension. Modifications of the acoustic controls provide a pressure or free field type. Each has uniform characteristics and meets ASA performance requirements in its own application.

A METHOD FOR QUANTITATIVE MEASUREMENT OF WIND NOISE SENSITIVITY IN MICROPHONES

R. M. CARRELL, *RCA Electronic Products Division, Camden, N. J.*

A long, spring suspended pendulum is presented as a simple means of making quantitative measurements of the wind noise sensitivity of microphones. Measurements of the velocity-displacement characteristics of a typical pendulum are presented.

2:00-4:30 p.m.

MISCELLANEOUS & TAPE MACHINES

Chairman: Sherman M. Fairchild
Fairchild Recording Equipment Corp.

A MOVING-COIL FEEDBACK DISK RECORDER

C. C. DAVIS, *Westrex Corporation, Hollywood, Calif.*

The distinctive feature of this recorder is the application of corrective feedback originating in the actual stylus driving mechanism. Thus, the motion of the stylus is accurately controlled, irrespective of recording conditions over a wide range of amplitudes and frequencies. The latest improvements are described and include a simple method of applying heat to the stylus and the use of tapered shank styli to facilitate their replacement.

AN EXTERNAL AUTOMATIC SWEEP GENERATOR FOR USE WITH CATHODE RAY OSCILLOSCOPES

ALAN BLOCH, *Audio Instrument Company, Inc., New York City*

The instrument, which has no manual controls, accepts a repetitive signal with a frequency between 20 and 50,000 cps, and with any reasonable amplitude. It delivers a constant-amplitude linear sawtooth at one-half the input frequency, which serves as a time-base (two cycles long) for the associated oscilloscope.

Use of the instrument eliminates much of the adjustment normally associated with oscilloscopic use, and makes it easy to carry out continuous observation of waveforms while the frequency is varied, since the time base is automatically locked to the signal over the entire frequency range.

AN EXPERIMENTAL STUDY OF DISTORTION

C. L. LEBEL, *Audio Instrument Co., Inc., New York City*

The measurement of non-linear distortion by various methods is studied. Measurement results secured by various methods are compared and the limitations of theoretical interrelations discussed. It is emphasized that a method whose results do not correlate with the opinion of the ear has little practical utility in audio.

TRANSISTORIZED MAGNETIC TAPE RECORDER

A. I. ARONSON, *RCA Engineering Products Division, Camden, N. J.*

An experimental transistorized record-playback tape recorder with performance characteristics equal to or better than conventional recorders is described. Direct coupling to the loudspeaker and utilization of the tape drive motor for a power transformer eliminates the need for costly and bulky iron cored components. The amplifier stages are stabilized for both temperature change and transistor variation.

DEVELOPMENT OF A SUB-MINIATURE TAPE RECORDER

ALBERT C. TRAVIS, JR., *President, Broadcast Equipment Specialties Corp.*

Subject matter covers the problems and solutions involved in scaling down the transport and amplifier to pocket size without undue sacrifices of functions, recording time, and quality while simultaneously utilizing a maximum of readily available components. The result, the Tapette, which is as small as the Minifon wire recorder is described.

1. Ref: Journal of AES, Vol. 1, Number 1, January, 1953.

DEFINITE STEREOPHONIC SOUND

COLONEL R. H. RANGER
Rangertone, Inc.

Friday, October 15th

10:00 a.m.

TAPE MEDIA

Chairman: Col. Richard H. Ranger
Rangertone, Inc.

FREQUENCY MODULATION NOISE IN MAGNETIC RECORDING

R. A. VON BEHREN AND R. J. YOUNGQUIST, *Minnesota Mining & Manufacturing Co., St. Paul, Minnesota*

Certain noise effects associated with high frequency recorded signals are attributable to rapid fluctuations in the speed of the magnetic tape as it passes over the recording heads. The mechanical sources of these speed variations are investigated and their frequency modulation effects upon the signal are quantitatively evaluated.

MAGNETIC RECORDING MEASUREMENTS

WALTER H. ERICKSON, *RCA Victor Division, Camden, N. J.*

The current need for measurement standardization in magnetic recording is discussed. Problems associated with measurement of frequency response, non-linear distortion, recorded level, noise, modulation noise, layer to layer print-through crosstalk, erase efficiency, and tape speed are evaluated with respect to systems standardization on measurements on a particular recording.

DEFECTS IN MAGNETIC RECORDING TAPE, THEIR CAUSES AND CURES

FRANK RADOCY, *Audio Devices, Inc., New York City*

Imperfections in the surface of magnetic tapes has been a problem to the special data and home recording fields. Squeal, sticking and the level variations have been caused by deposits on the head due to the shearing of imperfections.

Through improved binder formulation and coat-

(Continued on page 96)

IN ATTENDANCE

William H. Thomas — William Hartsfield
George F. Halkides

LEONARD RADIO, INC. 536 & 537

69 Cortlandt St., New York 7, N. Y.
Products: Hi-fidelity sound equipment, record players, tuners, amplifiers, speakers, cabinets, tapes, records, etc.

IN ATTENDANCE

Leonard Levy — Sidney Schugar
Lawrence J. Silverman — Norman Sanders
J. Davis — Ellis Rosen
Beatrice Silverman — Sam Lewis
Bernard Bernstein — Sylvia Levy

LERU LABORATORIES, INC. 707

Black Oak Ridge Rd., Wayne, N. J.
Products: Siemens Final Fidelity Radios and Phonographs imported from Western Germany. Also AM-FM-short-wave tuners and audio amplifiers with speakers in one package.

IN ATTENDANCE

Henry Goldsmith — Hy Bloom
R. K. Hansen

LONDON RECORDS, INC. 831

539 W. 25th St., New York, N. Y.
Products: London FFRR Records.

IN ATTENDANCE

Harry C. Kruse — Herbert Goldfarb
Leon C. Hartstone — Henry Principe
Pierre Bourdain — Herbert Helman
Remy Van Wyck Farkas

THE MAGNAVOX COMPANY 722-23

Fort Wayne 4, Indiana
Products: The Magnavox hi-fidelity phonographs; hi-fidelity radio-phonographs; hi-fidelity radios; television; television-radio-phono combinations.

IN ATTENDANCE

E. L. Redden — B. O'Hara
R. Welber — D. Price
G. Wilkens

MAGNECORD, INC. 604-5

225 W. Ohio St., Chicago 10, Ill.
Products: Tape recording systems for professional and home use.

IN ATTENDANCE

James R. Butler — D. K. Hornbogen
John Wm. Hines — George E. Gynn
W. S. Hartford

THE MAICO CO., INC. 507

21 N. Third St., Minneapolis 1, Minn.
Products: Audio-frequency curve tracer; hearing aids; audiometers; psychometer; chromalyzer; auditory training systems. Hearing tests available to all hi-fi fans.

IN ATTENDANCE

Clifford A. Nygard

MAJESTIC INTERNATIONAL CORPORATION

Subsidiary of The Wilcox-Gay Corporation 701

79 Washington St., Brooklyn 1, N. Y.
Products: GRUNDIG-MAJESTIC INTERNATIONAL: Mini-Boy Pocket Radio; Table Model AM-FM Short Wave Radios; Transworld Portable AM-FM Short Wave Radio; Ultra-High-Fidelity AM-FM Radio-Phonograph Combinations; Ultra-High Fidelity AM-FM Radio-Phonograph-Tape Recorder Combinations.
WILCOX-GAY: Tape Recordios: Portable, Hi-Fi portable, Hi-Fi De Luxe, Tape Recordiogrand, Hi-Fi De Luxe Console.
MAJESTIC RADIO & TELEVISION: Music Mate Battery-Electric Phonograph-Radio.

IN ATTENDANCE

Leonard Ashbach — Harry Goodman
Louis Silver — Victor Monner
L. M. Sandwick — Louis Belmont
Joseph G. DeVico — Arnold Bromberger

Audio Fair Exhibitors

S. B. MARANTZ 704

25 W. 43rd St., New York 36, N. Y.
Products: The Marantz Audio Consolette (control preamplifier-equalizer) featuring high-quality construction plus low distortion and noise.

IN ATTENDANCE

S. B. Marantz — Sidney S. Smith

MARINE VIEW ELECTRONICS INC. 547

744 E. 138th St., New York 54, N. Y.
Products: Hi Fi tuners, amplifiers, preamplifiers.

IN ATTENDANCE

Peter N. Tsokris — Edward Wineblatt
Henry Moro-Lin

JEFF MARKELL ASSOCIATES 608

764 Sixth Ave., New York 10, N. Y.
Products: Equipment cabinets and loudspeaker enclosures for home hi-fidelity systems.

IN ATTENDANCE

Jeff Markell — Wyn Kramarsky
Mary Leighton — Leonard Zlowe

McINTOSH LABORATORY, INC. 607

320 Water St., Binghamton, N. Y.
Products: Hi-fidelity amplifiers.

IN ATTENDANCE

Gordon J. Gow

MERCURY RECORD CORP. 628

35 E. Wacker Dr., Chicago 1, Ill.
(New York Office—1733 Broadway)
Products: Phonograph Records (Featuring "LIVING PRESENCE" Ultra Hi-Fi).

IN ATTENDANCE

Wilma Cozart — David Hall
Ronald Wise

MINNESOTA MINING AND MANUFACTURING COMPANY 508

900 Fauquier Ave., St. Paul 6, Minn.
Products: "SCOTCH" brand magnetic tapes and accessory items.

IN ATTENDANCE

Paul W. Jansen — James J. McDonald
Daniel E. Denham — William F. Enright
Jack A. Watson — Peter B. Van Deventer

MOONEY-ROWAN PUBLICATIONS 738

Severna Park, Md.
Products: "Tape Recording" magazine, "The Sound Salesman," "Audio Industry Directory."

IN ATTENDANCE

Mark Mooney, Jr. — Mrs. Mildred Stagg

MOTOROLA INC. 849

4545 W. Augusta Blvd., Chicago 51, Ill.
Products: Portable, table model, and console radios and radio phonograph combinations.

IN ATTENDANCE

William E. Nelson — Edward Fleissner
George Halsted — William Fife

MOTOROLA-NEW YORK, INC. 833

29-30 Hunters Point Ave., Long Island City 1, N. Y.
Products: Ampro tape recorders; Motorola hi-fidelity phonographs.

IN ATTENDANCE

Paul Lewis — Arthur Weiss
Hank Pierro — Robert Salchek
Harold Brenner — Max Boyarsky
Audrey Annenberg — Mert Firestone
Lew Raskin — Hy Berkowitz

MUSIC AGE, INC. 618

Route 4, Paramus, N. J.
Products: Products of all leading manufacturers.

IN ATTENDANCE

Charles Mendelsohn
Nat Mendelsohn
Phyllis Mendelsohn
Fay Mendelsohn
Wm. Bowman
Lou Mazzola

MUSIC AT HOME 705

207 E. 37th St., New York 16, N. Y.
Products: *Music At Home* Magazine and books.

IN ATTENDANCE

Milton Sleeper
Fred Klingenschmitt
Mary Ylotis
Fred Reynolds

NATIONAL COMPANY, INC. 611-12-13-14

61 Sherman St., Malden 48, Mass.
Products: National "Horizon" line of AM-FM tuners, audio amplifiers, preamp-control units.

IN ATTENDANCE

Lynn Eaton
C. G. Barker
Jack W. Willson
R. S. McQueen
Richard Gentry

NEWCOMB AUDIO PRODUCTS CO. 623

6824 Lexington Ave., Hollywood 38, Calif.
Products: Hi-fidelity home music amplifiers; AM-FM tuner; phonographs; transcription players; public address equipment.

IN ATTENDANCE

Robert Newcomb
Donald Warner

ORRADIO INDUSTRIES, INC. 727

T-120 Marvyn Road, Opelika, Alabama
Products: Introducing the IRISH "Collector's Cabinet" and IRISH Sound-Plate Mylar Tape. Also showing IRISH Green Band and IRISH Brown Band recording tape. Complete line of IRISH Tape accessories.

IN ATTENDANCE

J. Herbert Orr
Jim Kenney
Jules Bressler
Milton Baum
Frank Adams
Jim Williams

THE PENTRON CORPORATION 501, 552, 553

777 S. Tripp Ave., Chicago 24, Ill.
Products: The All-Electronic Orchestra Production presented every half hour. Also exhibiting the Dynacord professional recorder, the Pentron portable with exclusive Monomatic control, Pentron multi-speed recorders, 3-speaker hi-fi recorders with roving speakers, a complete line of tape recording components for custom installation or portable use, and a complete line of recorder accessories.

IN ATTENDANCE

Irving Rossman
Theodore Rossman
Robert L. Farnsworth
Martin Mann
Robert Stang
Walter Fleiser
Bernard Sahlins
Al Sroka
Jay Nichols

PERMOFLUX CORPORATION 640

4900 W. Grand Ave., Chicago 39, Ill.
Products: Hi-fidelity speakers and speaker systems; hi-fidelity headphones; tweeters, and crossover networks.

IN ATTENDANCE

L. M. Heineman
R. S. Fenton
F. J. Van Alstyne
A. H. Binash
George A. Rhodes
Leon L. Adelman

PICKERING AND COMPANY, INC. 624

309 Woods Ave., Oceanside, N. Y.
Products: Magnetic cartridges, pickup arms, equalizers, preamplifiers, equalizer—preamplifiers.

IN ATTENDANCE

Walter O. Stanton
George P. Petetin

PILOT RADIO CORPORATION 729

37-06 36th St., Long Island City 1, N. Y.
Products: Pilotone hi-fidelity amplifiers and preamplifiers; AM-FM and FM Pilotuners; Encore by Pilot hi-fidelity portable phonograph; Pilot remote control television custom chassis.

IN ATTENDANCE

Joseph N. Benjamin
Edwin Cornfield
Richard Shottenfeld
Sol Abilock
W. Hayes
Adolph L. Gross
Jerry Greenberg
Lou Abeles

Audio Fair Exhibitors

PRESTO RECORDING CORPORATION 621

P. O. Box 500, Paramus, N. J.
Products: Disc and tape recording and reproducing equipment; lacquer-coated aluminum blank recording discs.

IN ATTENDANCE

Thomas B. Aldrich
Austin B. Sholes
George J. Saliba
M. M. Gruber
Alfred Jorysz
Thomas L. Aye
Alfred Zrike

RADIO CORPORATION OF AMERICA 840-1-2-3

Front and Cooper Sts., Camden 2, N. J.
Products: Hi-fidelity 'Victrola' phonographs; phonograph records; hi-fidelity components.

IN ATTENDANCE

James M. Toney
Jack M. Williams
Larry W. Kanaga
Richard Weddell
James P. McCarvill

THE RADIO CRAFTSMEN, INC. 726

4401 N. Ravenswood Ave., Chicago 40, Ill.
Products: Hi-fidelity FM-AM tuners; preamplifiers and amplifiers.

IN ATTENDANCE

John H. Cushman
L. S. Hicks
Larry J. Hermann
Robert Finlay

RADIO-ELECTRONICS 716

25 West Broadway, New York 7, N. Y.
Products: *Radio-Electronics* Magazine, hi-fidelity and other Gernsback technical radio-electronic books.

IN ATTENDANCE

John J. Lamson
Lee Robinson
Fred Shunaman
Robert F. Scott
Jerome Kass
G. Aliquo
M. Harvey Gernsback
R. A. Fallath
Angie Pascale
Martin Clifford
I. Queen
Wm. Lyon McLaughlin

RADIO MAGAZINES, INC. 616

204 Front St., Mineola, N. Y.
Products: AUDIO Magazine; **1st audio anthology; the 2nd audio anthology;** "The Wear & Care of Records & Styli," "Electronic Musical Instruments."

IN ATTENDANCE

Henry A. Schober
C. G. McProud
Sanford L. Cahn
Harry N. Reizes
Sanford R. Cowan
Edgar E. Newman

RADIO & TELEVISION NEWS 514

366 Madison Ave., New York 17, N. Y.
Products: Magazines.

IN ATTENDANCE

Oliver Read
Bill Stocklin
Chuck Tepfer
Mike Michaelson
Mike Kaufman
Dick Itanaga
Len Osten
Murray Goldman
Jerry Jacobs

RADIO WIRE TELEVISION, INC. (Lafayette Radio) 645-46

100 Sixth Ave., New York 13, N. Y.
Products: Amplifiers, tuners, speakers, recorders.

IN ATTENDANCE

Arthur Wohl
Bill Nagata
Robert McA. Murray
Seymour Moed
Lionel Zimmerman
Paul Savell
Gerald Russell
Lou Davis
Harold M. Sperber

REEVES SOUNDCRAFT CORP. 603

10 E. 52nd St., New York 22, N. Y.
Products: SOUNDCRAFT magnetic recording materials.

IN ATTENDANCE

Frank B. Rogers, Jr.
Thomas J. Dempsey
William A. Morrison
William H. Deacy
Donald E. Ward
George P. Bassett

REGENCY DIVISION—I.D.E.A., INC. 724

7900 Pendleton Pike, Indianapolis 26, Ind.
Products: Hi-fidelity amplifiers & FM-AM tuners.

IN ATTENDANCE

Verne L. Roberts
R. W. Mitchell
Bea Jones
E. C. Tudor

REK-O-KUT COMPANY 636

38-01 Queens Blvd., Long Island City 1, N. Y.
Products: Manufacturer of precision 12" and 16" turntables; disc recorders; recording amplifiers; and hi-fidelity portable P.A. phonographs with three-speed and continuously variable-speed features; studio consoles; 12" and 16" overhead cutting lathes.

IN ATTENDANCE

George Silber
Avery Yudin
Sydney Simonson
Fred Moulin
Philip Dubson

REVERE CAMERA COMPANY 527-28

320 E. 21st St., Chicago 16, Ill.
Products: Tape recorders.

IN ATTENDANCE

David Gassner
Harry Ellis
Robert Eckert
Louis J. Wald
Lester Berger

JOHN F. RIDER PUBLISHER, INC. 617

460 Canal St., New York 13, N. Y.
Products: Hi-fidelity, audio, tape recorder and other publications on electronics; also, Service Manuals on TV, Radio, and P.A.

IN ATTENDANCE

John F. Rider
Bill Marcus
Irving Berger
Murray Rudomin
Milt Snitzer
Harold Alsberg
Herb Geller
Stan Shiffman

ROCKBAR CORPORATION 641

215 E. 37th St., New York 16, N. Y.
Products: Collaro record changers, players, crystals, transcription turntable, automatic record combination, and accessories.

IN ATTENDANCE

Sydney Wimpie
Edward Straw
W. E. Habig
A. W. Pleasanton
Ray Pfeffer
Mort Wimpie
W. McAteer

RONETTE ACOUSTICAL CORPORATION 521

135 Front St., New York 5, N. Y.
Products: Crystal cartridges; pickup arms; microphones; filtercells; crystal tweeters.

IN ATTENDANCE

S. Storch
J. Bressler
Ira Moley
Anne Rose

SANFORD ELECTRONICS CORP. 711-12

157 Chambers St., New York 7, N. Y.
Products: Webcor (Products of Webster-Chicago Corp.) tape & wire recorders with one speaker and three speakers; radios, clock radios with recorder and phonograph jacks; manual and automatic phonographs; automatic radio-phonogrphs; hi-fidelity tape recorders and phonographs in portable, table model and console model styles; record changers in both chassis and pan models with crystal, ceramic, and reluctance cartridges; portable amplifier with microphone and phonograph inputs.

IN ATTENDANCE

Charles Ollstein
Felix Gilbert
Sidney Koenig
Charles Castle
Noel Mackay

HERMON HOSMER SCOTT, INC. 642

385 Putnam Ave., Cambridge 39, Mass.
Products: Amplifiers; equalizer-preamplifiers; DYNAURAL noise suppressors; tuners; turntables; variable speaker crossovers; sound level meters and analyzers; acoustic instrumentation.

IN ATTENDANCE

H. H. Scott
V. H. Pomper
E. G. Dyett, Jr.
D. von Recklinghausen
Marvin Grossman
David S. Gilson
Samuel Egert
Jack Fields
Bernard Meyer

SIEMANS & HALSKE MANUFACTURING 707

Black Oak Ridge Rd., Wayne, N. J.
Products: Siemens Final Fidelity Radios and Phonographs imported from Western Germany. Also AM-FM-short wave tuners and audio amplifiers with speakers in one package.

IN ATTENDANCE

R. K. Hansen
Henry Goldsmith
Hy Bloom

SIGHTMASTER CORP. 847

111 Cedar St., New Rochelle, N. Y.
Products: Amplifiers; Sightmaster speaker system; record changer; AM/FM tuner; matched unit plan; cabinets and components.

IN ATTENDANCE

S. S. Ramsdell
Herbert Suesholtz
Leonard Shair
Bernard Karlan
Michael L. Kaplan

MARK SIMPSON MFG. CO., INC. 543

32-28 49th St., Long Island City 3, L. I., N. Y.
Products: Hi-fidelity amplifiers; public address amplifiers; tape recorders; disc recorders; intercommunication systems.

IN ATTENDANCE

Miryam Simpson
Henry Berlin
George Watson
Arthur Canahan
Joseph Rice
Ralph Aasen
Salo Nachtigall

SONEX, INC. 743

245 Sansom St., Upper Darby, Pa.
Products: Amplifiers and preamplifiers.

IN ATTENDANCE

Harold Weinberg
David Kratzok
Isadore Cogan
William Shanahan

SONOTONE CORPORATION 740

P. O. Box 200, Elmsford, N. Y.
Products: Ceramic phonograph cartridges.

IN ATTENDANCE

R. L. Lewis
R. N. Mitchell
N. H. Dieter

Audio Fair Exhibitors

SPECTRUTONE SOUND ASSOCIATES, INC. 852

66 E. Gloucester Pike, Harrington, N. J.
Products: Hi-fidelity records.

IN ATTENDANCE

Paul Weathers — Irv. Brown
John Roy George — Martha Cuneo

STANDARD WOOD PRODUCTS CORP. 517

47 W. 63rd St., New York 23, N. Y.
Products: Hi-fi audio and TV furniture: radio-phono cabinets, speaker enclosures, companion cabinets, combination TV radio-phono cabinets.

IN ATTENDANCE

Borys I. Mirkin — Arthur Grinblat
George Entin — Barbara Scott
Earl Gordon — Lewis Kraves
Phil Gordon

STEPHENS MANUFACTURING CORPORATION 601-2

8523 Warner Drive, Culver City, Calif.
Products: Hi-fidelity loudspeakers; loudspeaker enclosures; amplifier; condenser microphones; wireless microphone; multicellular horns; high-frequency drivers; theatre loudspeakers.

IN ATTENDANCE

Robert L. Stephens — Jesse Adams
Harry F. Izenour — Neal Pierce
Robert C. Tetherow

STROMBERG-CARLSON COMPANY 540

1225 Clifford Ave., Rochester 21, N. Y.
Products: Stromberg-Carlson "Custom Four Hundred" Hi-fidelity components and completed units in matching cabinets.

IN ATTENDANCE

A. G. Schifino — F. H. Slaymaker
J. W. Farrow — F. Gardner
R. P. Weis — N. Berkowitz
M. T. Zegel — A. L. Foster

TANNOY (AMERICA) LIMITED 715
in association with
TANNOY (CANADA) LIMITED

36 Wellington St., East, Toronto 1, Ontario, Canada
Products: Tannoy 15" Dual Concentric loudspeaker; Tannoy 12" Dual Concentric loudspeaker; Tannoy 12" direct radiator; Tannoy loudspeaker enclosures; Tannoy hi-fidelity preamplifier; Tannoy hi-fidelity amplifier; Tannoy pickup cartridges.

IN ATTENDANCE

Michael H. Fountain — Mrs. M. Towler
Frederick A. Towler — Robert Brock
Terence B. Livingstone

TECH LABORATORIES, INC. 630

Bergen & Edsall Blvds., Palisades Park, N. J.
Products: Reverberation generators, attenuators, switches, potentiometers, decade boxes, bridges, test equipment.

IN ATTENDANCE

Magnus Bjorndal — Guy Adams
Gerrett Van Baron — Peter Stadnyk

TECHNICAL TAPE CORP. 551

177th St. & Ft. Harlem River, Bronx 53, New York
Products: "Encore" magnetic recording tape and allied products.

IN ATTENDANCE

Paul Cohen — Marvin Line
Frederick I. Kantor — Robert Stang

TELECTROSONIC CORPORATION 525

35-18 37th St., Long Island City 1, N. Y.
Products: Tape recorders, flutter bridges and transformers.

IN ATTENDANCE

Harry Sussman — George Winrim
Stanley Rosenberg — Ted Kaufman
Ralph Rosenfeld — Bernard Raboni
George Brown — David Libsohn

THE TETRAD COMPANY, INC. 733

62 St. Mary St., Yonkers, 2, N. Y.
Products: Diamond phonograph styli. An entirely new exhibit will be shown this year. Free microscope inspection of visitors' styli will be available. New tests for needle wear will be demonstrated. Comparative effects of new and worn styli on hi-fidelity reproduction and record grooves will be shown. Display of replicas of world famous diamonds. Booklets on care and storage of records.

IN ATTENDANCE

Morton V. Marcus — Emanuel J. Marcus
Howard M. Weinberger — Edward P. Delaney

THORENS COMPANY 541

New Hyde Park, N. Y.
Products: Direct-drive, governor-controlled transcription motors contained in record changers, automatic record players, manual record players and transcription turntables.

IN ATTENDANCE

R. K. Kind — J. P. Donohue
P. W. Kind — Adolph Friedman
E. L. Childs — Ben Pinz

TUNG-SOL ELECTRIC, INC. 633

95 Eighth Ave., Newark 4, N. J.
Products: The 5881 beam power amplifier, the 12A7 high mu twin triode, and other electron tubes engineered for hi-fidelity applications.

IN ATTENDANCE

J. D. van der Veer — R. M. Andrews
C. E. Coon — Gene Peet
H. F. Cook — Alex Mitchell
M. Levine — Herb Evander
Fred Warren — Meade Hower

ULTRA HI-FI COMPANY 544

709 Sip St., Union City, N. J.
Products: Hi-fidelity sound systems; radio-phonograph consoles; phonograph consoles; table top radio-phonograph consoles; cabinets; speaker enclosures; bass-reflex speakers.

IN ATTENDANCE

M. Ingram — Mrs. Irene Ingram
Louis Green

UNITED AUDIO PRODUCTS
Division of United Optical Mfg. Corp. 547

202-4 E. 19th St., New York 3, N. Y.
Products: WIGO Hi Fidelity speakers, extended range speakers, tweeters, woofers, coaxial speakers.

IN ATTENDANCE

Julian Gorski — Hugo Price
John Gorski — Edward Wineblatt

UNITED TRANSFORMER CO. 522

150 Varick St., New York 13, N. Y.
Products: Amplifier kits; transformers; filters; reactors; toroids.

IN ATTENDANCE

S. L. Baraf — I. A. Mitchell
H. Russell — T. L. Craige
J. Barreca — M. Martin
J. Cianciulli — J. Knapp

UNIVERSITY LOUDSPEAKERS 501, 552, 553

80 S. Kensico Ave., White Plains, N. Y.
Products: University loudspeaker components, accessories, systems and enclosures.
SPECIAL EXHIBIT: "THE ALL-ELECTRONIC ORCHESTRA."

IN ATTENDANCE

Irving Golin — George Sioles
Larry Epstein — Haskell Blair
Charles Ray — Jock Brittain
Abe Cohen — Lee Weinstein
Saul White — Arthur Gaines
Edward Reese — Jack Pero

V-M CORPORATION 741

Benton Harbor, Mich.
Products: Tape recorders; hi-fi phonographs; record players, record changers.

IN ATTENDANCE

Irving Woolf — Frank Brennan
Allen Woolf — Roy Parr
George Brennan — C. E. Seaman

J. C. WARREN CORPORATION 625

21 Hanse Ave., Freeport, N. Y.
Products: Magnetic tape recorders; self-contained battery or a.c. powered portables; endless-loop 8-hour continuous recorders; recorders for specialized applications; miniature portable and mobile transmitters and receivers. Electronic engineering, research, design, development, production.

IN ATTENDANCE

J. C. Warren — L. A. Wortman
H. W. Hornik — K. Kyle
G. V. Rosenquist — W. Crossman
T. E. Goodwin — V. J. LiPari
A. D. Stern — E. J. Finnegan
G. A. Heyburn

WEATHERS INDUSTRIES, INC. 852-53

66 E. Gloucester Pike, Barrington, N. J.
Products: FM phonograph pickups; FM phonograph manual record players; FM phonograph automatic record players; hi-fidelity records using new processing techniques known as the Weathers Acoustimetric Sound Tracing System.

IN ATTENDANCE

Paul Weathers — Irv. Brown
John Roy George — Martha Cuneo

WEBSTER-CHICAGO CORPORATION 711-12

5610 W. Bloomingdale Ave., Chicago, Ill.
Products: Hi-fi Fonografs; tape recorders; radio fonografs; clock radios; Disk-changers.

IN ATTENDANCE

Charles Ollstein — Charles S. Castle
Sidney Koenig — Noel Mackay
Max Horowitz — Joe Austin
Fred Ressler

WESTMINSTER RECORDING CO., INC. 736

275 Seventh Ave., New York 1, N. Y.
Products: Hi-fidelity records.

IN ATTENDANCE

Henry L. Gage — Edgar P. Talmus
M. Naida — Victor Cohen
Martin Shapiro

STAN WHITE, INC. 706

725 S. La Salle St., Chicago 5, Ill.
Products: Amplifiers, loudspeakers and loudspeaker enclosures.

IN ATTENDANCE

Stan White — Eddie Bracken

ZENITH RADIO CORP. OF NEW YORK 828-29-30

527 W. 34th St., New York 1, N. Y.
Products: Extended range hi-fidelity radio and radio-phonograph combination instruments.

IN ATTENDANCE

R. C. Wallace — Wm. O'Krongley

WQXR 538

229 W. 43rd St., New York 36, N. Y.
Products: WQXR Broadcasts and promotion material.

IN ATTENDANCE

Mary Rice Anderson — Louis Kleinklaus
Robert Kreiger — Zaven Masooman

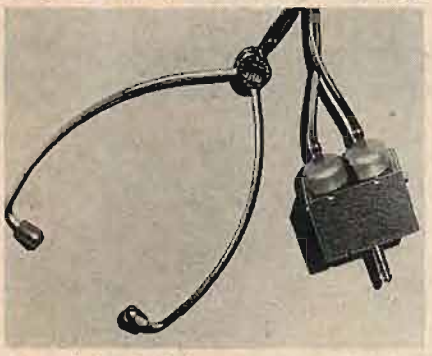
This list is as nearly accurate as possible at press time.

NEW PRODUCTS

• **Compact Hi-Fi Music System.** The "Melodist," a complete home music system recently announced by Altec Lansing Corporation, 161 Sixth Ave., New York 13, N. Y., is small enough to fit on an average record shelf and is guaranteed by the manufacturer to have a frequency range of 90 to 22,000 cps. The loud-speaker is a two-way system using a high-quality 10-inch woofer in conjunction with a tweeter

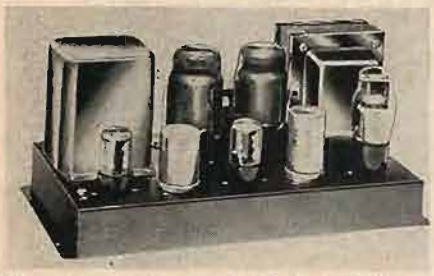
which is the same as that used in Altec Duplex speakers. The 10-watt amplifier has three inputs, crossover selection, separate bass and treble controls, and a loudness control. The Melodist is exceptional in its excellent audio quality, small size, and smart appearance.

• **Lightweight Binaural Headset.** This new under-the-chin-style dynamic headset, recently introduced by Telex, has been en-



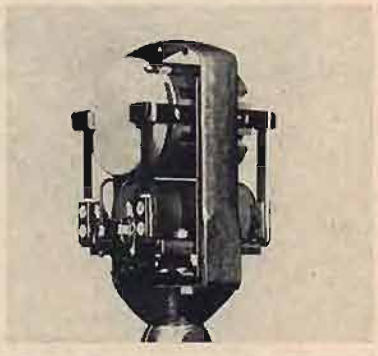
gineered for dual-frequency monitoring of radio programs and for high-fidelity listening to recordings which use dual sound tracks. The unit weighs only three ounces and uses two separate sound channels, one to each ear. Suitable for both speech and music, the headset's frequency range is 70 to 7000 cps. For additional information and prices, write Dept. KP, Telex, Inc., Telex Park, St. Paul, Minn.

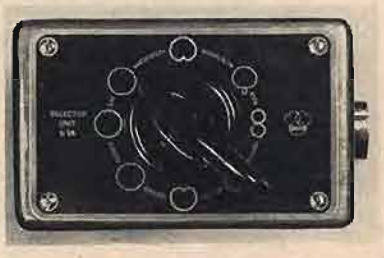
• **Ultra-Linear Amplifier.** Introduced to meet the demand for a moderately-priced ultra-linear amplifier, the McGohan Model WA-330 has less than 1 per cent intermodulation, and harmonic distortion is below 0.5 per cent at rated output of 30 watts.



Frequency response is 20 to 60,000 cps within ±1 db at full output, and 20 to 100,000 cps within ±1 db at one watt. The circuit includes 20 db of feedback, and hum level is 90 db below 30 watts. The KT66's are used in the output stage. Amplifier and power supply are compactly arranged on a single chassis 14 x 7½ ins. attractively finished in metallic maroon. Two a.c. outlets are provided for powering preamplifier and other accessories. Manufactured by Don McGohan, Inc., 3700 W. Roosevelt Road, Chicago 24, Ill.

• **Controllable-Pattern Microphone.** Entirely unique among high-quality microphones, the AKG Model D-36 dynamic unit permits remote control of pickup pattern even while a program is in progress. The recording or broadcast engineer can, from the control room or any other remote point up to several hundred feet, choose between two cardioid patterns in opposite directions, or any of six other characteristics





including omni- and bi-directional patterns. Control is afforded by a selector switch which gives visual indication of the pattern in use. Changes may be made during program pickup to compensate for studio reverberation, alter front-to-back ratio, or to create various effects for enhancing audio value of the program material. Frequency range of the D-36 is 30 to 15,000 cps ±3 db. Output is −50 dbm. Manufactured by Akustische und Kino-Geräte, Vienna, Austria, the D-36 microphone is distributed exclusively in the U. S. by Electrovert, Inc., 489 Fifth Ave., New York 17, N. Y.

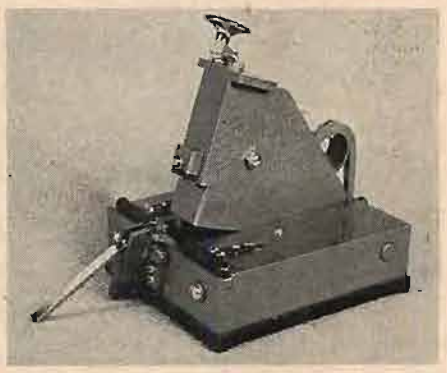
• **Decade Box.** Unique design and excellent versatility are inherent in the "Dekabox," which provides more than one million 1-ohm resistance steps from zero to 1,195,-999 ohms. Mounted on a compact adjustable base which may be set to the most convenient angle for taking readings, the Dekabox displays resistance values in a single horizontal line. All resistors are precision wire-wound, are adjusted to within ±0.05 per cent of rated value and have special windings to minimize frequency error. All switch contacts are solid silver for minimum contact resistance.

Temperature coefficient of individual resistors is less than ±0.002 per cent. Frequency response is uniform to several hundred kc. The Dekabox is manufactured by Electro-Measurements, Inc., 4312 S.E. Stark St., Portland 15, Ore. Catalog sheet with full specifications will be mailed on request.

• **Interconnection Cords.** Audio hobbyists who are less interested in stripping and soldering wire than they are in the enjoyment of music will be quick to recognize the convenience offered by Audio-Aid Unit-Connectors now available to jobbers and dealers from V & V Sales Company, Long Hill Branch, Bridgeport, Conn. Made in

standard lengths of three, five, and seven feet, the connectors consist of low-capacitance shielded cable to which is attached a standard pin plug at each end. They permit instant interconnection of various audio components without the use of tools.

• **Professional Tape Splicer.** Intended primarily for professional use, the new Skila Model K1 tape splicer is a time-saving device which automatically ejects, applies, cuts off, and presses into place the correct amount of splicing tape, at the same time removing a minimum of program material.



In the process of splicing the machine removes a tiny amount of magnetic tape from one edge which makes the spliced section slightly narrower than normal, and thus prevents the tape from jamming on recorder guides. The amount of splicing tape ejected for each splice is adjustable. The entire tape path is non-magnetic. Available through F. Reiter Co., 3340 Bonnie Hill Drive, Hollywood 28, Calif.

• **Handy Wire Worker.** There is certain to be ready acceptance for the Wonder Wire Worker, a handy little tool for everyone who works with electronic equipment. Essentially, the tool is a fine-pointed tweezer

with a cutting edge and insulation stripping notches. It will strip insulation from No. 16 to 22 wire, and will cut up to No. 16 stranded or solid. In addition, it will crimp wire and is useful for holding wires or small parts in place while soldering. Manufactured by Lindly & Company, Inc., 248 Herricks Road, Mineola, N. Y.

hrc HARVEY
the House of Audio

The NEW
REK-O-KUT
Rondine
3-Speed, 12-inch
PRECISION TURNTABLES

Represented to be the result of more than 5 years study, these new record playback units are offered as the closest approach to perfection in turntable performance. Like all Rek-O-Kut units, the turntable is cast Aluminum and exerts no pull on magnetic cartridges.

The following new features have been included: • single selector knob for setting speed: 33⅓, 45 and 78 rpm. • built-in retractable hub for 45 rpm records—requires no external adapter • permanently affixed 3-speed strobe disc for instantaneous speed checking • neon pilot light as 'on/off' indicator • special cork-neoprene mat material to eliminate record slippage • rectangular deck to fit conventional record changer boards.

Two identical Rondine models are available which differ only in the type of motor employed.

Rondine Model B-12 with 4-pole induction motor..... **$69.95**
Rondine Deluxe Model B-12H with hysteresis synchronous motor...**119.95**

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.

Chassis only (for custom installations)..... **$325.00**
Relay Rack Model..... **335.00**
Cabinet Model (Mahogany, Walnut or Blonde)..... **360.00**

HASTINGS
FM TUNER
for Automobiles

A true high fidelity tuner designed for use with any existing AM car radio. Covers the entire FM broadcast band. Employs full Armstrong circuit with permeability-tuned RF. Automatic frequency control simplifies tuning and locks in selected station. Sensitivity is 2 microvolts with full limiting effected with 5-microvolt input. Provided with four controls: tuning, volume, bass boost, and FM-AM selector. Power is obtained from existing AM car radio. Mounts easily under dashboard with no special antenna required.

Complete with mounting bracket, tubes, power cable, and instructions..... **$99.50**

Specify 6 or 12 volt ignition system

Visit the HARVEY Audio Exhibit at the AUDIORAMA
Room 631, New Yorker Hotel, October 14th thru 17th

HARVEY'S AUDIOtorium
. . . has become a famous rendezvous for audiophiles. An ideal place to see and hear the finest in high fidelity equipment . . . and to talk hi-fi with qualified experts.

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

PULTEC
PROGRAM EQUALIZER
Model EQP-1

A high quality, no-loss, passive equalizer and push-pull amplifier designed for broadcast and recording studio applications. Provides an unusually wide range of controls:

• 0 to 13.5 db boost at 30, 60 or 100 cycles • 0 to 18 db boost at 3, 5, 8, 10 or 12 kc • 0 to 17.5 db attenuation at 30, 60 or 100 cycles • 0 to 16 db attenuation at 10 kc • shape control of high boost curves from sharp to broad • impedances are 600, 250 and 150 ohms, in and out • noise is 92 db below +10 dbm • distortion is 0.15% at +10 dbm • key switches equalizer 'in' and 'out' without 'clicks' or changes in level • self-contained power supply.

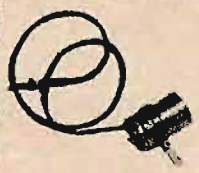
Complete with tubes..... **$395.00**

Complete data and curves on request

Write for the NEW HARVEY Audio Catalog

FAIRCHILD
Moving Coil
PICKUP CARTRIDGES

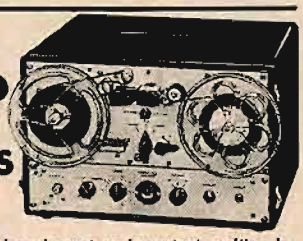
Designed to professional quality standards, these playback cartridges permit the highest quality record reproduction thus far attained. Unusually high lateral compliance has reduced tracking error distortion to an absolute minimum. Each Fairchild cartridge has a carefully selected diamond stylus. The 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 Model 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**

New
MAGNECORD
Portable
TAPE RECORDERS



Model M-30 Precision built to standards which have gained for Magnecord equipment an important position in the professional field, the Model M-30 has been priced within reach of the high fidelity enthusiast, the musician, and others concerned with high quality recording. Frequency response at 7½"/sec. extends from 50 to over 10,000 cycles ±2 db, and at 3¾"/sec. from 50 to 5000 cycles ±2 db. An oversize, 4-pole motor is employed for excellent speed regulation. An eye tube permits control of recording level.

Two inputs are provided for recording from high impedance microphone, and from phonograph, radio tuner, or other high level source. The output is high impedance, and can be fed into any conventional high quality amplifier. A monitoring jack permits the use of earphones or external VU meter. Uses tape reels up to 7", dual-track (full-width track optional). Weight: 35 lbs.

Supplied with AC cord, 7" take-up reel, and maroon leatherette-covered case measuring 17¾x11¼x13¼"..... **$299.00**

Model M-33 The model M-33 is identical in all respects to the Model M-30, except that it is provided with a built-in amplifier and loudspeaker. The M-33 is also provided with an output connection for playback through an external amplifier system.

Supplied as the Model M-30 plus a high quality ceramic microphone..... **$329.00**

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

• **Walkie Tape Recorder.** Although entirely portable, this latest version of the Tapak tape recorder includes a 4 x 6 in. loudspeaker for playback to room-size audiences. Known as the Narrator, it is similar in appearance and design to the Newscaster model which is used extensively by radio and TV stations for remote pickup. A spring-wound motor drives the transport mechanism and amplifier power is supplied by self-contained batteries. The recorder erases, records, monitors, rewinds fast, and plays back. All accessories are contained inside the 14 x 10 x 6 in. case.

Available in two models, the Standard Narrator has a frequency range of 100 to 4000 cps and a dynamic range of 40 db, while the Custom model goes up to 5000 cps with dynamic range of 55 db. Both models record up to 50 minutes continuously at 3¾ ips. Broadcast Equipment Specialties Corp., 135–01 Liberty Ave., Richmond Hill 19, N. Y.

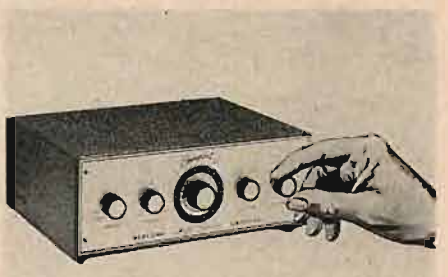
• **Broadcast Tape Recorder.** Although designed to meet professional standards of recording and reproduction, the new Berlant Model BR-1 tape recorder is compact enough for installation in a portable carrying case. For permanent mounting it may be installed in a standard 19-in. rack panel or in a console. Exclusive features include a new "Unisync Drive" motor employing a reversed-field principle which is exceptionally quiet in operation and operates at a total temperature rise of 30°. The BR-1 has provision for up to five heads, which makes possible the simultaneous recording and playback of two different signals, or use of the machine for either single- or dual-track recording.

A single control governs all mechanical operations. Editing is facilitated by instant switching from "cue" to "edit" position with full exposure of the tape. Manufactured by Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif.

• **E-V Broadcast Microphone.** Designed with co-operation from network engineers, the new Electro-Voice Model 666 dynamic microphone provides smooth wide-range response with uniformly high front-to-back discrimination at all frequencies. It is a slim, lightweight unit for boom, fish-pole, stand or hand operation. Frequency response is 30 to 15,000 cps. Average front-to-back discrimination is 24 db. Output level is −57 db. The 666 features in its construction the E-V-developed Acoustalloy diaphragm which is highly resistant to even the most abusive operating conditions. A blast filter minimizes wind and breath blasts, and traps iron filings. The case is made of aluminum finished in TV gray. Dimensions are 7½ x 1½ ins. and weight is only 11 oz. Swivel tilt is up to 90°. Built to meet the most stringent demands of broadcast operation, the 666 closely matches other high-quality pressure-type microphones, such as the E-V 655, and thus facilitates fading from one

microphone to another without noticeable change in sound quality. For full details write for Technical Data Sheet No. 39 to Electro-Voice, Inc., Buchanan, Mich.

• **Compact 10-Watt Amplifier.** Combining the advantages of small size, simplicity of operation, and ease of installation, the new Newcomb "Compact 10" is ready for use "as is." The user simply plugs a record changer and/or tuner into the proper



input receptacle, connects the output terminals to a speaker, and his music system is complete, ready for use. Weighing but 9 lbs., the Compact 10's overall dimensions are 9⅜ x 7¾ x 3⅞ ins. Controls include bass, treble, input selector, loudness control, and a six-position recording-curve selector. Distortion is below 1 per cent at 10-watt output, and frequency response is 20 to 20,000 ± 1 lb. Newcomb Audio Products Company, 6824 Lexington Ave., Hollywood, Calif.

• **Coaxial Speaker Assembly.** New convenience in mounting Bozak woofer-tweeter combinations is offered by the Model B-207A, which comprises one B-199A

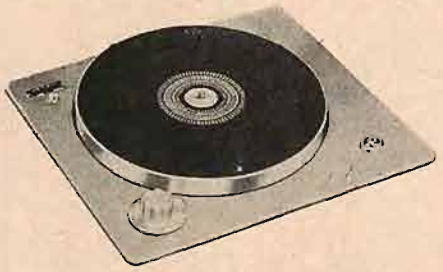
woofer, one B-200X dual tweeter, and a 4-μf crossover filter, ready-wired and attached to a cast aluminum mounting ring.

Dimensionally, the complete unit is the equivalent of a conventional 15-in. speaker, although it may be used behind cutouts for 12-in. speakers as well. Acoustically, the B-207A is a two-way wide-range speaker system with a crossover rate of 6 db/octave and flat response from 40 to 16,000 cps with useful output beyond 20,000 cps. Power rating is 15 watts and impedance is 8 ohms. Recommended optimum housing is a totally-enclosed box of 9 cu. ft., rigidly braced and fully lined with two inches of acoustical damping material, although volumes from 4½ to 12 cu. ft. are acceptable. Further information is available from R. T. Bozak Company, Stamford, Conn.

• **Improved Stephens Woofer.** Although retaining the model designation 103LX, the newly-engineered version of this Tru-Sonic low-frequency driver includes a number of design improvements. The 4¼-lb. Alnico V magnet is fully enclosed, thus retaining a heavy concentration of magnetic force within the motor structure,

and eliminating losses due to dispersion which are inherent with an unenclosed magnet. A 35-cps cone resonance is obtained through use of an exceptionally large spider assembly and edge damping which permit the straight-sided seamless cone to operate in true piston-like fashion. Power capacity of the improved 103LX is 25 watts. Stephens Manufacturing Company, 8538 Warner Drive, Culver City, Calif.

• **Three-Speed 12-Inch Turntables.** The demanding requirements of high-fidelity reproduction are fully met by the new Rek-O-Kut Rondine turntables. Available in two models, the B-12 is powered by a 4-pole induction motor, while the B-12H employs a motor of the hysteresis type. Random tests on regular production models indicate rumble and noise content of the B-12 to be more than 40 db below average recording level, while the B-12H is down more than 50 db. Aside from the motor the two models are identical. Flutter and wow are virtually non-existent. A single selector knob is used for speed selection. Between speed settings are intermediate "off" positions. In the "off" positions the turntable is electrically disconnected and all



couplers are disengaged. The Rondine features a built-in, retractable hub for 45-rpm records, and therefore requires no external adapter. A permanently-affixed 3-speed strobe disc permits instantaneous speed checking. The deck on which the chassis is mounted is rectangular in shape and is dimensioned to fit conventional record changer mounting boards. For data and specifications, write to Rek-O-Kut Company, 38-01 Queens Blvd., Long Island City 1, N. Y.

(Continued on page 101)

LABORATORY REFERENCE LOUDSPEAKER

(*from page 36*)

Frequency division is accomplished electrically as shown in *Fig.* 4. Networks are of the constant resistance type. Inductors are generous size air-core coils to provide linear low-loss operation. Attenuation is 12 db per octave outside the network pass bands.

Figure 5 shows a phantom view of the operating elements of the RS-100. The woofer is placed in an acoustically adjusted chamber at the bottom of the enclosure, radiating through a slot throat along the bottom. Sound from this back-radiation emerges at the top front and at the top sides. Also radiating from the top front is sound from the midchannel and tweeter units. The middles and highs emanate at about ear level, for most realistic space positioning and phasing effect. All networks are clear of the sound paths, being placed on a demountable panel in the frontal cavity below the main horn mouth. Access to the woofer is by means of a removable panel just behind the speaker, and access to the whole system is by means of a removable back to the enclosure. The over-all dimensions of the RS-100 are 52⅜ in. high, 32⅞ in. wide, and 24-11/16 in. deep.

Construction is of heavy (¾ in.) plywood, each joint being glued and reinforced with wood screws; bracing is used where there is any tendency toward panel resonances of vibration during operation. The RS-100 is finished in two-tone enamel, with contrast similar to that styled into much professional equipment. The power rating is 35 watts input, and the impedance is 16 ohms. The same performance may be had from the Imperial, model PR-100, which is designed in Suburban Modern furniture styling in blonde or mahogany.

Construction details

Figure 6 is an exploded view of the construction employed in the RS-100 cabinet, and shows clearly the various panels in relation to each other, as well as showing the bracing. *Figure 7* is a complete constructional drawing, but details of dimensioning are not shown in order to simplify the drawing. However, for closer study of the construction, it should be pointed out that the drawing is accurately scaled. with 1/16 in. representing 1 inch, and dimensions of the horn structure can be determined by measurement.

Before leaving the factory, each individual RS-100 or PR-100 is tested by instruments and by ear, and each is accompanied by a certificate guaranteeing its performance.

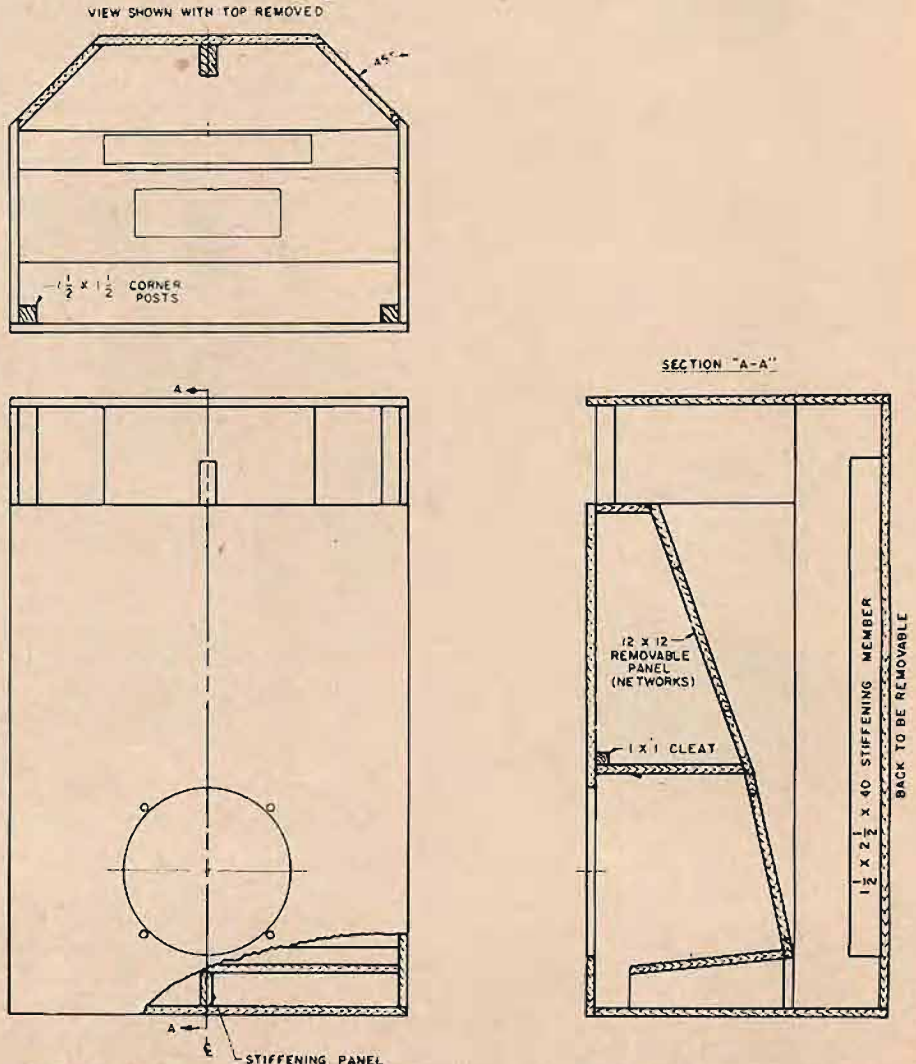


Fig. 7. Constructional drawing of the RS-100 enclosure. Dimensions are omitted in the interests of simplification, but the drawing is to scale—1/16 in. = 1 in.

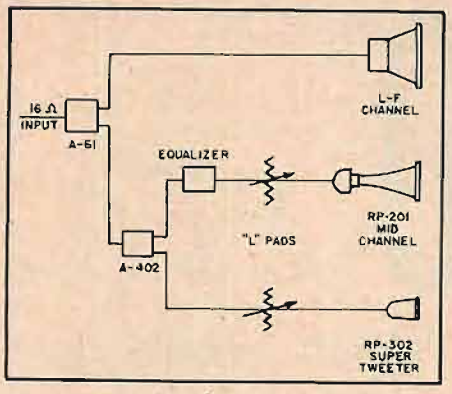


Fig. 4. Block diagram of components of the reference loudspeaker.

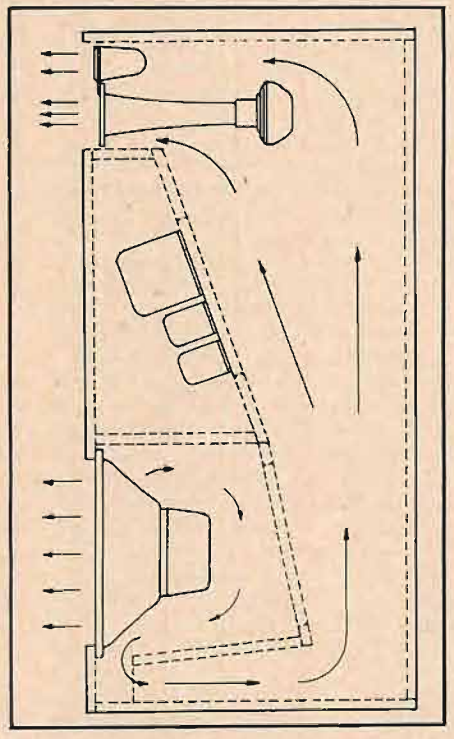


Fig. 5. Cross-section through center of enclosure to show placement of loudspeaker units and dividing network.

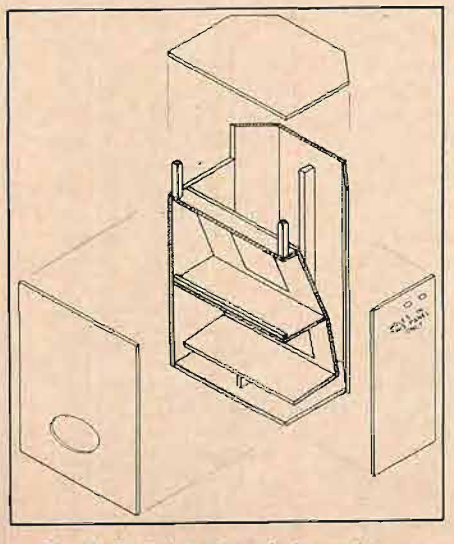


Fig. 6. Exploded view of the enclosure.

AUDIO ETC.

Edward Tatnall Canby

The Allen Organ

A BRIEF ASIDE, at the beginning, to say that thanks to publishing time-lag I hadn't seen the Dorf article on the Allen electronic organ in our July issue when I wrote last month's (September) column with its item concerning G. Donald Harrison's LP organ lecture for Aeolian-Skinner. It's all the more a pleasant coincidence, then, that this electronic organ, of which I knew next-to-nothing, comes so remarkably close to a practical embodiment of the hypothetical electronic organ discussed here last January. (Plans for a Pipeless Organ.)

I think that those who are bugs on the always-tantalizing organ question—either the "real" or the electronic, or both types—will find it extremely interesting to take these three items into direct comparison, the Harrison recorded lecture, the Dorf article and my own. Between the three you'll find, directly or implied, the major technical-aesthetic questions, with answers (both musical and technological) to a good many of them. You'll also begin to gauge for yourself the fearful extent of the necessary compromises that must be made in any saleable electronic instrument, and the enormous subtlety of the interlocking factors that have to be weighed in that compromise.

Note particularly that the most basic premise of Jan Syrjala's and my theoretical organ was the necessity of separate oscillators, for independence of each tone. That, in practical form, is exactly what the Allen people offer. Naturally, the maximum independence is found only in their largest and most expensive instruments—and I suspect that the "ideal" Allen organ, carrying its electronic-musical principles to the ultimate, will never be built. But it could be. And the smaller, more practical Allen compromises are the more satisfactory, because of the thinking that has set up realizable and specific standards for an advanced instrument.

Without ever having heard it, I congratulate the Allen company on the excellence of its electronic sound. It couldn't help being good.

Hum Pickup

Have just installed Maximilian Weil's new Audak cartridge, the Hi-Q7, in place of the well-known L-6. Identical in shape, same general construction, but it has an all-important higher output, about double the old. (New red identification marking for the LP side of the cartridge is an added convenience.) As Weil puts it, the new output was achieved by "squeezing" the parts, for greater magnetic efficiency without loss of quality. You figure that one out—but the increase is there, and I detect, so far, no loss of tonal quality over the L-6.

This is an interesting development, because it is a kind of final word in a gradual improvement that is typical of the hi-fi field, the elimination of hum pickup. The new Audak Hi-Q7 further defeats hum—but that problem was already well defeated by other concurrent developments.

When the Audak Polyphase (the present production model) first appeared there were a good many complaints of excessive hum pickup. I ran into that very trouble with it myself and was constrained to warn all and sundry about it. With good equipment—no. But in plenty of then-standard installations, the hum was apt to be there. The factors in the actual hum pickup, from the semi-amateur viewpoint, were two: low cartridge output, requiring high amplifier gain that magnified the hum, and the Audak's one-coil construction that promoted hum sensitivity. So I was told, anyhow.

But there were more important outside factors. Poorly shielded phono motors then abounded, with hum-radiating two-pole motors mounted haphazardly under changer tables, often in the strategically worst spot for hum pickup, directly under the cartridge's arc of travel. The crystal cartridge was universal then. The idiosyncrasies of the magnetic cartridge were simply ignored in a large proportion of home equipment on sale. In addition, amplifier transformers, through the same sort of inattention or ignorance, were often placed too close to the pickup, with resultant hum. As of then, the Audak was a touchy instrument.

But look what has happened. Yes, Audak soon extended its shielding all the way around the cartridge, for a significant gain in the hum situation. But, again more important, the possible sources of the hum began to be removed, as hi-fi spread and equipment makers began to catch on to the problem. The English changers, carefully designed for hum-reduction, eventually led to the alteration of almost all U. S. changer models, so that most now have four-pole shielded motors, carefully placed. Even the original Audak is OK on virtually all of them, as things now stand. And of course the fancier motor-tables have been anti-hum from the beginning.

Thus even before this new high-ouput Audak appeared, I had found it necessary to change my "warning" anent possible hum pickup to sound milder and milder, until it had all but vanished. Now the *coup de grace*, and it's gone for good. Thus does Audio progress, on all fronts.

Portable Klipsch

I've been trying out the Rebel V, the latest adaptation of the Klipsch idea to the inexpensive, small-space home speaker enclosure field, and it fits very nicely into my own special-interest category of really practical low-cost enclosures, making maximum use of space and speaker potentialities with minimum complications.

This model is a corner "box," unfinished (it comes in finished models too), less than two feet high and less than a foot wide, but taking 8-inch, or 12-inch, or two 8's-plus-cone-tweeter—quite adaptable. I've got a Rebel V with *two* Lorenz 8-inchers in it plus two Lorenz baby cone tweeters, all mounted in that small space. But one set would do very nicely for most purposes—and with 12-inch potentialities of the enclosure, anything up to the quite fancy speakers in that size will go into the system neatly.

A pet gadget of my own appears on Rebel V, pointing up its practical nature, a plastic suitcase handle mounted on the top. I added a handle to the ends of my 8-inch R-J enclosures long ago, for convenient portability. I've always felt that even the largest speaker enclosure—for *musical* listening—should remain portable in principle, or at least movable.

There's entirely too much of an urge among hi-fi fans to build-in their enclosures permanently, as part of the decor. The various hi-fi installation services, naturally, are all for this and promote it right and left, not only because it brings them in more cash for the fancy installations, but on honest grounds of visual good looks. I can understand all that. Makes your hi-fi system part of your home, and so on. But I remain unconvinced, musically.

At best, no speaker system, however big, should be set up permanently, screwed to the wall, built into a closet, drafted into the interior decoration scheme, unless you have tried out exhaustively all the possible speaker arrangements in your home—which practically nobody ever does. Even then, a change of room furniture, alteration of room acoustics via new drapes, wall paint, pictures, opened doors and windows, even a mere change of weather, may upset the balance. And, more important, listening requirements do change from record to record and from one type of music to another. You will want wide distribution of sound-source for a full orchestra, but not as much for a piano trio, and a solo folk singer deserves a better fate than to be spread over a dozen feet of wall! My own immutable arrangement for such situations, is the movable speaker. For a folk singer or a speaking voice I aim the system right at the audience, in any room; but for an orchestra I turn it aside, for reflection, or reverse it, according to acoustic circumstances. A much-needed musical freedom of action, I insist, whatever your system may be.

And so, the Rebel V and similar easily movable systems have an extra advantage musically that for some of us musicians may "outweigh" the advantages of the massive and immovable ten-ton speaker system! The handle on the top merely symbolizes a sound principle. And don't forget that you can find very acceptable compromises between portability (movability) and good looks.

Set your movable speaker enclosure inside a chosen area, corner or elsewhere, with perhaps a decorative grille cloth arrangement in front to hide it. Then you can move it about, behind the scenes, as an enclosure within an enclosure and so alter your acoustical set-up enough to cope with most musical situations.

For those who move to the country for the summer, a "built-in" system of this sort where the essential speaker box may be lifted right out and carried off for use elsewhere (and for others who give portable concerts) is a wonderful plan. Build another permanent housing to enclose it, if you wish, in your summer home or in your hi-fi clubroom—and when it comes to transportation, just pick up the speaker element by its handle and dump it in the back of your car. It'll always work as is, without the decorative front, if you so desire, and it'll sound just as good.

But back to Rebel V after this handle-type digression. Rebel V is strictly a corner enclosure. It follows the Klipsch-license principle, making use of the walls out from the corner as part of the bass loading system, and the proof of this is very quickly audible in practice as I found out. The Rebel V will stand against a flat wall (it has the now-common flat back) and it'll play very nicely. But the difference in bass between flat-wall positioning and corner placement is quite extraordinary. The veriest dub will notice it at once. Don't try this or any other similar corner arrangement large or small unless you can figure out a corner with minimum obstructions along the wall in either direction. That's not always easy in modern homes. A plush sofa on one side and an upholstered chair on the other will swallow up this system's sound with a vengeance.

In constrast, I should note that the R-J enclosure, also a big-bass, small-space system, has noticeably different attributes when it comes to room-placement.

Granted that any speaker system gives improved bass in a corner, the R-J as well as the rest. But the Rebel V, like others of its type, depends directly upon the corner wall surfaces as part of its acoustical system. When placed against a flat wall this type of enclosure lacks adequate loading and loses much of its bass response. Rebel V is for corners only, as you'll find for yourself if you try it. (Many corner-shaped systems are acoustically complete and will operate just as well outside of the corner.)

The R-J, operating on a wholly different principle, provides its full speaker loading in a corner or out. But it loses bass when it if lifted off the floor, or when placed vertically on its end. In the horizontal floor position (the 8-inch "bookshelf" model), the floor-plane increases propagation of the bass very noticeably. The R-J 8-incher is definitely a floor model, not for tables or high shelves. (R-J ads always show it

mounted in a bottom shelf next to the floor.) But it doesn't need a corner.

Choose, then, to fit your requirements, and you may turn these characteristics to extra advantage, too, as a kind of tone control. With speech records, for example, where deep bass is unwanted, you can increase naturalness (and reduce turntable rumble) by taking Rebel V (or equivalent) out of its corner, or by standing R-J right up on its little end. When you want bigger bass for music, put them back to normal.

Boom?

Which prompts me to an added note on boom. There are good indications, as far as I can figure, that many makers of the small enclosures now selling so widely have deliberately tuned their reflex systems to a well-bred but distinctly noticeable boom.

As anyone in the trade knows, you may rig a bass reflex system (in any of its modifications) for maximum flatness—or for a modified bass with a boom, a discreet "peaking" that adds weight to the total musical sound.

My own feelings in this matter have long since crystallized for good. I do not like boominess of any sort, whether via bass reflex or (as often happens) due to room standing waves. My ear, alas, has learned to tell the difference and I can't unlearn it. Nor can any of our readers who have caught onto the sound of peaky bass.

But we cannot put aside the fact that many people don't hear it, and won't ever. I can remember when I didn't know the difference, nor did I care. I liked music. Musical balance between *apparent* bass and *apparent* highs is of tremendous importance, and unlike booms and peaks, the untrained ear can detect an unbalance here instantly, without the slightest training. Balance comes first.

Forced bass boom, accenting middle-low bass, sounds better to many a beginner than true extended bass. Don't forget the juke box business which (with improved bass nowadays) is still a going concern. Indeed, if a compromise must be made, as in the new small "hi-fi" phonographs, a tricked-up boom-bass is decidedly better than an inadequate flat bass, such as there can be in this type of machine.

The small separate speaker enclosure is on the borders of this area of musical operation. A few of them, the above Rebel V and R-J models included, can give enough true, un-peaked bass for legitimate musical listening and good balance against an extended-range tweeter. There's no excuse for boom in these enclosures, and when used rightly there is very little of it.

But other small enclosure makers may—considering the market for the type of equipment—be well justified in this deliberate introduction of boom, via calculation. People are going to like it, and, as I say, they have good justification for it in the matter of bass-to-treble musical balance. You cannot add highs at the upper end without compensating with more bass at the bottom. And, for *musical balance*, that bass may be either true lower bass, extended range, *or* louder mid-bass, via calculated boom. Don't ever forget that both arrangements fill the bill, for musical balance.

But I still don't like boom.

Testing with White Sound

(*from page 46*)

tiometer is a "fine" frequency control, and the capacitors shown give ranges 100, 1,000, and 10,000 cps. A cathode follower, ½ 6SN7, has the volume control in its cathode circuit, and the forward and reverse switch, ½ 6SN7 split load, gives the output either side up. Some amplifiers give different results when fed opposite polarity sawtooth waves. Such amplifiers are usually those with single-ended outputs.

The 884 tubes are quite uniform, though differing slightly in their rise times. The "fine" adjustment knob may have the exact point marked for precise frequency values, and it also gives a useful frequency variation about plus or minus 30 per cent. This allows changing of frequencies in case a resonant point is suspected.

Into a load of 0.1 meg or higher, the generator of *Fig.* 3 supplies 20 volts peak-to-peak.

Appendix 2. Square Wave Generator Circuit

Square waves can be made from sine waves by using a clipper and shaper circuit[16]. On the other hand, the simple circuit[17] of *Fig.* 9 may well find a place on the workbench. Four potentiometers are used, the first two are the set and forget type; 1. T & B (top and bottom) adjusts the ratio of plus to minus part of wave; 2. Clip, negative part of wave is clipped by cathode follower 6J5; 3. Range, three fixed internal positions, plus one external connection; and 4. Volume. Good wave shape is obtained into a 0.1 meg load, with 10 volts peak-to-peak.

The 6SJ7 is a transitron oscillator. Grid 1 is grounded to the cathode, which in turn goes to the usual negative terminal Y. Grid 2 goes to the positive terminal X by way of a 47,000-ohm resistor. Grid 3 is connected to a point between Y and Z, selected by the T & B control, always more negative than the cathode.

Not all 6SJ7 or 6SJ7GT tubes will work as transitron oscillators. Checking eleven tubes of five manufacturers, nine would oscillate in this circuit. Excellence in tubes which *would* oscillate was considered to be the squareness of the upper right corner of the wave. The best 6SJ7GT was the same make as one "dud."

A rotary range switch can be a sp4t giving 100, 1,000, 10,000 cps for three positions, the fourth position being wired to external terminals to give some other frequency, depending on the external capacitor connected. Note that a single capacitor determines the frequency.

The power supply is special, but not tricky. The oscillator requires about 600 volts d.c. X to Z, center-tapped at Y. This is readily obtained since the current drain is about 10 ma. for each half. A 6X5 is suggested for the XY section so that the plate voltages are applied later than the grid biases. The latter are furnished by the YZ section and a 5Y3GT rectifier. Most dual capacitors have a common negative and filter resistors can be connected between the positive terminals. Note that the negative terminal of the YZ filter capacitor is 300 volts negative below chassis ground, and must therefore be insulated from the chassis.

[16] Sine Wave Clipper, Barker & Williamson Model 250.

[17] O. C. Wells, "Square wave generator," *Wireless World*, Jan. 1951, p. 35.

THE EMPLOYER'S RIGHT

(*from page 37*)

work for which he was employed, plead title thereto as against his employer. That which he has been employed and paid to accomplish becomes, when accomplished, the property of his employer. Whatever rights as an individual he may have had in and to his inventive powers and that which they are able to accomplish he has sold in advance to his employer."

The essential factor in determining the rights, if any, which an employer may have in the inventions and patents of employees that have been conceived and perfected on the time of the employer and for which the inventor has received payment in salary or wages, are the terms of his employment agreement.

In another action involving this illusive feature the employer insisted that any inventions resulting from the efforts of employees should as a matter of course, be assigned to the employer.

An employee of this company after his term of employment had ended, sued the company for a judgment that the patents on the inventions he had discovered while with that company should be decreed by the court to be his property.

In a decision of the Federal District Court, later affirmed by the Court of Appeals, the determining factor was there again held to be the conditions and terms of the employment contract.

"A patent is property, title to which passes from the inventor only by assignment and an agreement to assign will be specifically enforced. As between employer and employee, rights are determined by the contract of employment.

"Absent a contrary understanding the mere existence of an employer-employee relationship does not entitle the employer to ownership of the invention of the employee. This is true even though the employee uses the time and facilities of the employer although the latter in that event may have 'shop rights' therein, that is, the right of a free non-exclusive personal license to use the invention in his business.

"On the other hand if the employee is hired to invent or is assigned the duty of devoting his efforts to a particular problem, the resulting invention belongs to the employer."

A more noteworthy incident of this character was the invention of a method for using the alternating electric current or residence lighting power instead of the direct current from batteries in radio receiving sets, thereby eliminating the hum in the vacuum tubes.

The two inventors of this method had been employed by the government on a project for developing a "visual indicator for radio signals for air, ship, bomb and marine torpedo control by radio." While working on this project they conceived and perfected this method for the use of alternating current in radio receiving sets.

The Federal Government as an employer concededly had shop rights in the invention but insisted upon an assignment by the patentees and ownership of the invention itself.

"One employed to make an invention who succeeds during the term of his service in accomplishing that task, is bound to asign to his employer any patent obtained," asserted the Supreme Court affirming the judgment of the lower court holding the ownership of this invention was in these two employees.

"The reason is that he has only produced that which he was employed to invent. His invention is the precise subject of the contract of employment. A term of the agreement necessarily is that what he is paid to produce belongs to his paymaster.

"On the other hand if the employment be general, albeit it cover a field of labor and effort in the performance of which the employee conceived the invention for which he obtained a patent, the contract is not so broadly construed as to require an assignment of the patent.

"A manufacturing corporation which has employed a skilled workman for a stated compensation to take charge of its works and to devote his time and service to devising and making improvements in articles there manufactured, is not entitled to a conveyance of patents for inventions made by him while so employed, in the absence of an express agreement to that effect.

"The reluctance of courts to imply or infer an agreement by the employee to assign his patent is due to a recognition of the peculiar nature of the act of invention, which consists neither in finding out the laws of nature not in fruitful research as to the operation of natural laws, but in discovering how these laws may be utilized or applied for some beneficial purpose, or by a process, a device or a machine.

"It is the result of an inventive act, the birth of an idea and its reduction to practice, the product of original thought, a concept demonstrated to be true by practical application or embodiment in tangible form."

References

North American Philips Co. *v.* Brownshield, 111 Fed. Suppl. 762
United States *v.* Dubilier Condenser Corp., 289 U. S. 178 aff'g. 59 Fed. 2d 381
Kober *v.* United States, 170 Fed. 2d 590
Houghton *v.* United States, 23 Fed. 2d 386
Marshall *v.* Colgate-Palmolive-Peet Co., 175 Fed. 2d 215

LONDON LETTER

(*from page 18*)

time, their new LP records. That progressive radio and electronic firm, Pye Limited, who recently acquired the Nixa Record Company, gave demonstrations of the latest Nixa records which included the Westminster trade mark, in a soundproof demonstration room.

EMI also had a separate stand devoted to tape recorders and their new type 88 recording tape of which quite good accounts have been heard.

Over a quarter of a century ago British valve, or as you call them, tube manufacturers, promoted the sales of their tubes by issuing designs of simple radio sets which could be made up by the non-technical members of the public.

At the 1954 Radio Show two of England's largest tube manufacturers, Osram and Mullard, demonstrated for the first time 10-watt amplifiers made from components which are readily available and which of course, incorporate the respective company's tubes. Comprehensive instruction books are being sold by each tube manufacturer which include practical stage-by-stage wiring diagrams and detailed information covering every assembly operation. The prices of all the parts including the tubes amount to about $45.

Demonstrations of these amplifiers were given throughout the duration of the Show and there is little doubt that during the winter evenings many of Britain's younger hi-fi enthusiasts will be hard at work assembling an Osram or Mullard amplifier using, we hope, a considerable amount of Ersin Multicore Solder.

The exhibit on the Multicore Solders stand this year was the assembly of television tuner units by Ferguson Radio, who are the British licencees for Sylvania, using, of course, the new 5-core Ersin Multicore Solder. With the introduction during the next year of commercial TV programmes, all British television manufacturers are busy producing sets for the first time with tuner units. Previously it has only been possible for one station to be received by each viewer and thus the several million of British TV sets made since 1936 have never incorporated any means of switching from one transmitter to another. Also shown behind the scenes at the Multicore Solders stand was the new Bib Recording Tape Splicer which should be on sale in England before Christmas.

American hi-fi enthusiasts visiting Britain in 1955 would be well advised to postpone their visit to late Summer so that they too can enjoy a visit to the marvelous Annual Shop-window of the British Radio Industry.

ERRATUM

Anyone who has ever seen both the Electro-Voice Patrician and the Electro-Voice Georgian has already observed that we made an error in the LOUDSPEAKER AND ENCLOSURE section in the August issue by stating that the Georgian "was the most elaborate."

The Patrician is the "top of the line," and consists of an 18-in. low-frequency driver in a Klipsch-licensed folded horn for the extreme lows; a 12-in. low-frequency direct radiator; a diaphragm-type mid-range driver and mid-range horn; and a Super-Sonax super tweeter. Crossover frequencies are 200, 600, and 3500 cps, and the unit is 60 in. high, 41 in. wide, and 30 in. deep. It weighs 400 pounds. The *Patrician* is the most elaborate, definitely.

Hi-Fi-manship at The Fair

(from page 31)

What to do? Obviously a switch in tactics is called for, since your area of audio criticism has been curtailed. Use the "Toscanini Ploy," as follows:

Hi-Fi-man: (Thoughtfully) "H'mmmm."

Salesman: Sounds pretty good, doesn't it, Sir? Just *listen* to that orchestra. Bet it doesn't sound that good when you play this tape at home, now does it?"

Hi-Fi-man: (Truthfully) "No, it doesn't." (Then:) "But just the same . . . I mean, somehow I can't help wondering . . ."

Salesman: "Something wrong, Sir?"

Hi-Fi-man: "Oh, no." (Pause) "At least not from an *engineering* standpoint, exactly . . ."

Salesman: "Sorry, sir. I don't quite follow."

Hi-Fi-man: (With air of "one-upness") "Well . . . I'll see if I can make it simple."

Salesman: (Meekly) "Yes, sir."

Hi-Fi-man: "Take the way your speaker handles those 'modernities' of Mozart's concerto, for instance . . ."

Salesman: (At a loss) "Modernities?"

Hi-Fi-man: "Yes. Well, at any rate, they *were* 'modern' in 1785. You know . . . that diminished seventh and the sweeping skip in the first bar . . . that wonderfully unexpected transition to the tonic minor in the second . . . and those—how shall I say it?—*gemütlich* discordant suspensions in the next three . . ."

Salesman: (It dawns) "Oh, I *see*, sir. You're a *musician*."

Hi-Fi-man: (Plonking tone) "No, I'm not. That isn't the point I'm making at all."

Salesman: (Completely lost) "What then, sir?"

Hi-Fi-man: "Your speaker just doesn't generate the correct psycho-acoustic reaction."

Salesman: (Stunned) "It doesn't?"

Hi-Fi-man: "Not in the least. I'm accustomed to hearing that concerto from the center of the First Tier boxes at Carnegie Hall. I expect it to be reproduced that way. I'm sorry, old boy, but your speaker definitely gives me the feeling of Row 'Q' in the back of the Balcony."

How To Give Advice

Sooner or later, as you make the rounds of the Audio Fair, some novice will ask for your hi-fi advice. This, of course, you should be delighted to extend, particularly if it involves your judgment of equipment.

Suppose, for instance, you are standing before a group of control amplifiers. Layman, the typical tyro, observes your detached air, hears your thoughtful "H'mmmm" as you inspect, and naturally assumes you are an expert. Don't disappoint him.

Layman: "Pretty nice, huh?"

Hi-Fi-man: (Noncommital) "Not bad, really."

Layman: (Eager) "I'm thinking of getting one . . ."

Hi-Fi-man: "Oh? Well . . . lots of luck."

Layman: "Er . . . thanks. But before I did, I thought I'd sort of ask around a bit. You know, seek expert opinion. You don't mind if I ask you . . ."

Hi-Fi-man: "Certainly not. Delighted to help. What would you like to know?"

Layman: "Well . . . what do *you* think of this amplifier?"

Hi-Fi-man: (Thoughtful pause) Business of puffing pipe, twiddling with bass control, saying "H'mmmm," etc. Then:) "Oh, I suppose it's a good way to get started. But control amplifiers do leave the field wide open for a certain amount of distortion, don't you think? I mean . . . your tone control circuits *are* right in there among your amplifier circuits, aren't they? No . . . it might be best to figure on having all your controls across the room on a front-ended tuner or preamp."

Layman: (Making notes furiously) "I get it. Thanks."

Hi-Fi-man: "Don't take that as the final word, though. On the other hand, it might be best for you to build around a good control amplifier. After all, the amplifier is the heart of the whole rig and your tuner and preamp are *really* just accessories, don't you think?"

Layman: (Still making notes bravely) "Er . . . yes. I guess so."

Hi-Fi-man: (Brightly) "Look . . . I've got a splendid idea. This whole amplifier business is Dave Williamson's specialty. It's sort of . . . well, awkward . . . if I go barging in on his territory. Williamson's really a very nice guy. If you'll just drop him a note at his London address, mentioning my name of course, I know he'll be delighted to give you the real inside stuff. Now . . . you must excuse me. I *must* run . . . appointment with Dr. Olson and the General for cocktails. Hope I've been helpful."

You weren't. You can now leave the Audio Fair in a complete state of "one-upness" and go home.

Avoid dark alleys.

About Music

(*from page 64*)

qualify for the Bardic Circle. He was shoveling tobacco into a dirty pipe, from a large and dented tin. Papers flopped out of the capacious pockets of his tweed jacket."

With the zeal of a big-game hunter, the great, massive figure of Vaughan Williams began his safaris in search of authentic English folk tunes during the first decade of the century. The bulk of his output is deeply affected by this research. Those of Vaughan Williams' works which use or quote parts of folk songs number over forty.

The "abstract" composer has often made Vaughan Williams the butt of critical attacks. In his *Musical Autobiography* (Oxford University Press, New York, 1950—from Hubert Foss' *Ralph Vaughan Williams*) Vaughan Williams replies to these criticisms: "There has been a lot of cheap wit expended on folk-song composers. The matter seems to boil down to two accusations:

"(1) That it is 'cheating' to make use of folk-song material. This is really nothing more than the old complaint of the vested interests who are annoyed when anyone drinks a glass of pure water which he can get free, rather than a glass of beer which will bring profit to the company. This appears to involve a moral rather than an artistic question; from the point of view of musical excellence it seems to me that so long as good music is made it matters very little how it is made or who makes it. If a composer can, by tapping the sources hidden in folk-song, make beautiful music, he will be disloyal to his art if he does not make full use of such an avenue of beauty.

"(2) The second accusation is made by people who affect to scorn what is 'folky' because it does not come within the ken of their airless snuggeries, because it does not require any highly paid teachers to inculcate it or the purchase of text-books with a corresponding royalty to the author."

Even in his most 'folky' compositions, however, Vaughan Williams is no mere arranger of folk songs. For instance, nine folk tunes are employed in *Hugh the Drover*, not in a literal fashion, but rather as the raw material for musical development. Many of the themes with an earthy flavor that crop up throughout Vaughan Williams' work are actually inventions of his own and not culled from field trip notebooks. The solo soprano recitative in the last movement of the *Pastoral* Symphony, while perfectly in keeping with the growth of the work, seems also to breathe forth the fragrance of the English countryside. The melody is wordless and beatless, almost an apotheosis of English folk music. There are, of course, those who will agree with Peter Warlock's description of the *Pastoral* as "a cow looking over a gate." Now it may not necessarily follow that the person who fails to appreciate the misty, pastel-toned English countryside would be unlikely to respond to works like the *Pastoral*, *Norfolk Rhapsody* or *The Lark Ascending*. But there can be no denying the fact that there is an almost mystic reflection of this landscape in Vaughan Williams' music.

Not that we can label Vaughan Williams as a 'landscape' composer. Far from it. This merely represents one facet of his extraordinary musical personality. Neither does it mean very much to write that Vaughan Williams is a "modal" composer. What then is the total picture? In an examination of his heritage, Hubert Foss wrote: "With slight exceptions, the music of the nineteenth-century composers seems to have passed him by, and indeed, the music of most of the eighteenth-century composers, too. His genealogical line springs from the Tudor school and English folk song."

The above is well borne out by such works as the Mass in G Minor, an inspired evocation of the Elizabethan style of choral writing, particularly that of William Byrd. Yet the themes are all Vaughan Williams' own. There is no cribbing here—even though he openly defends the art of legitimate cribbing. When he submitted the Mass to Sir Richard Terry for comment, Terry wrote back: "In your individual and modern idiom you have really captured the old liturgical spirit and atmosphere." As in other works of this sort, Vaughan Williams' approach is reverent but not obsequious.

It is this combination of dignity and—to use that much-abused word—humility, that prompted Howard Taubman's description of Vaughan Williams as "altogether charming and impressive." Mr. Taubman wrote of a 1939 meeting with the English composer which, incidentally, was granted on one condition: that nothing be written about it. Mr. Taubman, however, broke his silence on the subject thirteen years later when, on the occasion of Vaughan Williams' eightieth birthday, he could not resist devoting an article to the interview: "We met for tea in a small room at the Royal College of Music, where the composer was teaching composition at the time. He turned out to be a large man, tweedy and almost shaggy in appearance. He was reticent but not shy. He talked about the state of English music, about the qualities of the young composers on their way up, about the horrors of nazism. But about himself hardly a word."

Without fanfare Vaughan Williams has made a contribution to English music that may be likened to that of Debussy in France: each rejected the Teutonic domination. Vaughan Williams' musical education was in the Victorian tradition; his influences were Stanford, Elgar and Parry. But his own individuality emerged forcefully with the *Norfolk Rhapsody* (1906), *The Wasps* (1909), the *Tallis Fantasia* (1910) and *Five Mystical Songs* (1911). "In fact," Scott Goddard wrote, "no music was being written in Europe that had the translucent massiveness of the *Tallis Fantasia* or the gentle urgency of the *Mystical Songs*."

In one of those typically facetious remarks when speaking of his own music, Vaughan Williams said: "Whenever a young composer writes worse than usual, the critics always say he was influenced by me!" A more accurate appraisal is given by Mr. Goddard who refers to Vaughan Williams' art as the "most individual in the history of this country's music since Purcell, [created by] a mind so protean and still magnificently active."

FEEDBACK FILTERS

(*from page 33*)

Taking the second factor of (*10*),

$$db = 10 \log_{10} [1 + \sqrt{2x^2} + x^4]. \quad (14)$$

The 6-db-per-octave slope point again occurs at $x = 1$, giving an attenuation at this point of

$$10 \log_{10} (2 + \sqrt{2})$$

or 5.33 db. Again using two identical networks, the feedback factor is given by F in

$$\frac{4}{F} = 2 + \sqrt{2} \text{ or } F = 2(2 - \sqrt{2}) = 1.172 \quad (15)$$

representing 1.38 db feedback.

The original turnover frequency of each network is given by writing

$Fx^2 = 1$, or $x = 0.924$.

This information is shown schematically for both low- and high-pass units in *Fig* 4.

Practical Features

The increasing difficulty of adjusting the more complex arrangements will be apparent from the foregoing treatment, but there are certain features to be watched with the simpler arrangements as well. In the circuit of *Fig*. 2, the 10 to 1 attenuation at the input to each filter is intended to prevent any interaction, because this method does not work on a constant-resistance basis, as do its cross-over-filter counterparts, although the attenuation and phase response are identical with that of the constant-resistance L-C types. If care is not exercised to see that the level is well above noise before the input attenuation, the signal coming out is likely to contain more noise than is present without a filter.

Another question that arises is where to incorporate the filter. Should it be part of the input stage of each output amplifier, or should the whole arrangement be included in the output of the preamplifier? This question can best be answered in relation to the actual circuits used. If the output amplifiers use a suitable type of input stage and have more gain than is necessary in conjunction with the preamplifier, these input stages could probably be modified. On the other hand, if the output amplifiers are of the low-gain type, the filter stages could well be added to the preamplifier, attenuating down, if necessary, after the filters, rather than before them, in order to avoid introducing noise by getting too low a signal level on the filter-tube grids.

A word of warning against the use of triode tubes in these circuits. These might appear at first sight to provide an economic advantage, because two are obtainable in one envelope. But from the performance viewpoint they are not suited too well. The plate load of the low-pass unit goes into a reactive short circuit, which triode tubes do not like. As against this, for pentodes the plate load rises on the high-pass unit, but only by a fraction, from 70,000 to 100,000 ohms in the case shown. Thus, a circuit designed around pentodes is less likely to introduce distortion. Another reason is that the a.c. resistance of the plate is a prominent factor in turnover-frequency determination with triodes, whereas using pentodes, plate resistance is shunted by the plate coupling resistor so that variation in tube characteristics has negligible effect on response. For these reasons the author does *not* recommend double triodes as a basis for these circuits.

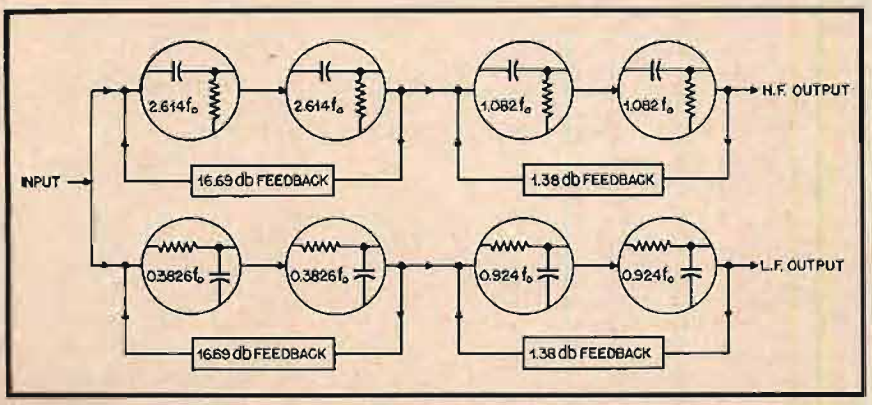


Fig. 4. Arrangement of two 2-stage loops whose combined response is a crossover with ultimate slope of 24 db per octave.

AES CONVENTION PROGRAM

(from page 53)

ing techniques, a precision tape has been developed virtually eliminating coating imperfections as a source of dropouts.

LOCATING DEFECTS IN MAGNETIC RECORDING TAPE

ANDREAS KRAMER, *Audio Devices, Inc., Glenbrook, Conn.*

Since the adoption of magnetic recording tape for the more critical types of recording, it has been found that new tape testing methods are necessary.

This paper will describe an instrument capable of locating and registering the number of individual cycles of output voltage that are below a pre-set level.

In precision tape, such drop-outs are now almost entirely caused by extraneous matter on the surface; though two years ago, physical imperfections in the tape coating caused the major number of defects.

NEW USES AND NEW MAGNETIC PRODUCTS IN TAPE, FILM, AND INSTRUMENTATION APPLICATIONS DURING THE PAST TWO YEARS

E. W. FRANCK AND E. SCHMIDT, *Reeves Soundcraft Corporation, Springdale, Conn.*

In the last two years, advances in the manufacture and application of magnetic products have been made. This paper will cover the physical and electrical characteristics of current standard and various gauge mylar tape; and will discuss some of the interesting phenomena such as level differences between forward and reverse recording; a report on print-through characteristics of materials on base supports on as thin as ½ mil mylar; present the data on tests run according to mil T 61A, United States Navy specifications and Camesa Spec. number F-42 for the Canadian Government. In the motion picture field a review of the use of stripped magnetic film in the theatre and television industries; and a discussion of the potential of pre-stripped photographic film will be included. Actual use of magnetic products for geophysical recording is under way. The variations required for different equipment will be discussed. Major strides have been made in improving the friction characteristics of tape and film which have solved some of the problems associated with telemetering and other instrumentation applications. The characteristics of these lubricated products will be discussed.

2:00 p.m.

RECORDS & RECORD MANUFACTURING

Chairman: Charles Lauda
Decca Records

QUALITY CONTROL IN RECORD MANUFACTURING

E. H. UECKE, *Capitol Records, Inc., Hollywood, Calif.*

Covers number and types of test and inspection beginning with lacquer masters through finished product. Discusses methods and procedures set down to determine adherence to specifications, including process controls, material acceptance inspection, and quality audit of finished records. Consideration is given to selection of inspection points to exercise degree of control required.

RECORD QUALITY AND ITS RELATION TO MANUFACTURING

A. M. MAX, *RCA Victor Record Division, Indianapolis, Indiana*

Developments in record manufacturing over the past ten years are reviewed with particular emphasis on matrix operations. These developments have been necessary to keep abreast or ahead of developments in recording and reproduction of sound. Some of the sources of degradation in manufacturing will be discussed and steps taken to reduce or eliminate them described. The importance of solution controls are shown to be necessary to meet RCA Victor record quality standards.

ADVANTAGES AND PROBLEMS OF FULL FREQUENCY RANGE PHONOGRAPH REPRODUCTION

PAUL WEATHERS, *Weather Industries, Inc., Barrington, New Jersey*

Ten years ago anyone suggesting that a phonograph record reproducing system would extend beyond 6,000 to 7,000 cycles was frowned upon as a very impractical dreamer. In the advent of high fidelity in more and more homes, with studio programs available on Frequency Modulation stations the public became more and more critical. Top limit was then moved up to 9,000 and 10,000 cycles and satisfied people.

Today, no high fidelity enthusiast is happy with phonograph reproduction which does not extend to 15,000 cycles. He also likes to hear bass tones as low as 30 cycles. We are becoming so critical that many of us detect improvements when the reproduction is extended from 20 to 20,000 cycles.

The problems in recording such a range are even greater. The author feels that advantages of of this extended range, particularly in the reproduction of transient sounds, are necessary to true high fidelity. He will discuss the problems of reproducing this range without increasing objectionable distortion and noise.

SPECULATIONS ON THE CAUSE AND PREVENTION OF NEEDLE WEAR AND SURFACE NOISE IN THE PHONOGRAPH PLAYBACK PROCESS

F. V. HUNT, *Acoustics Research Laboratory, Harvard University*

Substantially less needle wear and lower surface noise may reward a relatively modest further reduction of conventional dynamic loads on the stylus-groove contact. Scattered observations appear to confirm this and its plausibility can be supported by reasoning based on recent studies of rubbing wear and of the size effect in strength and hardness testing.

AN EVALUATION OF RECORD STYLUS PRESSURE CALCULATIONS

A. M. MAX, *RCA Victor Record Division, Indianapolis, Indiana*

Previous calculations of record stylus pressure have been based upon the classical theory of elasticity. These are shown to result in stresses in the record above the ultimate strength of the plastic. It is known that the classical theory of elastically falls far short in describing the mechanical properties of plastics. These properties are briefly described, and a quantitative evaluation of their effect on the stresses produced by the stylus is presented. This evaluation is correlated with small differences between mechanical properties of polystyrene and vinylite and record wear.

Saturday, October 16th

10:00-12:00 a.m.

PICKUPS

Chairman: Norman C. Pickering
Pickering & Co.

A DISCUSSION OF PRESENT DAY DEVELOPMENTS IN MAGNETIC PHONOGRAPH PICKUPS

WALTER O. STANTON
Pickering & Company

A TWIN LEVER CERAMIC CARTRIDGE

B. B. BAUER, L. GUNTER, JR. AND E. SEELER, *Shure Brothers, Inc., Chicago, Illinois*

High fidelity is reaching into millions of American homes and with it comes the necessity of providing high quality pickup cartridges suitable for this purpose. The Twin Lever Ceramic Cartridge is designed to meet this need. Advantages of ceramic elements in this type of application are described. In the Twin-Lever Cartridge a

double lever arrangement is used to provide high compliance and efficient coupling. Individual needles are provided for the fine groove and 78 rpm discs and a cam operated transport mechanism positions the required needle in the transducer assembly. Especially convenient is the easy needle replacement feature which permits sightless replacement of worn or damaged needles. The new cartridge fits standard mountings and weighs 7½ grams. The response equals that of many custom built high fidelity pickups.

AMPLIFIERS FOR MUSIC REPRODUCTION

HERMON H. SCOTT AND HERBERT P. KENT, *Hermon Hosmer Scott, Inc., Cambridge, Mass.*

The classical concept of the function and measurement of amplifiers with continuous sine-wave signals does not apply rigorously to amplifiers designed for the high-fidelity reproduction of music. Usually the designer must choose between providing either maximum instantaneous short-time output or maximum continuous sine-wave output. Since the usual musical waveform is complex, having peaks 10 or more db higher than the average level, it is obvious that the former condition is best for the reproduction of music.

With higher powered amplifiers, the maximum available continuous power can actually burn out the loudspeaker on a continuous overload. A "snubber" circuit has been developed that does not affect the power handling capacity of the amplifier on music waveforms but which protects the loudspeaker from continuous high power levels. By this means, high powered amplifiers can provide maximum realism on peak music levels without the usual danger of speaker burnout. Such a device can be adjusted by the user to provide any degree of "snubbing" action.

Another important amplifier factor, much misunderstood, is the internal output impedance or damping factor. Many amplifiers have output impedances approaching zero, while actually most loudspeaker manufacturers recommend a finite source impedance of a magnitude which may be as high as the rated speaker impedance. A system providing adjustable output impedance without adversely affecting amplifier performance allows optimum damping for all types of loudspeakers.

1:30-4:00 p.m.

LOUDSPEAKERS

Chairman: Hugh S. Knowles
Industrial Research Products

LOUDSPEAKER QUALITY CONTROL AND THE CONSUMER

EDWARD V. REISS, *University Loudspeakers, Inc., White Plains, N. Y.*

A consumer's investment in a loudspeaker is guaranteed by the design built into the speaker and the production checks employed in its fabrication. These built-in design fundamentals which while not immediately visible contribute to the longevity and the durability of the product will be examined along with the various production tests and checks guaranteeing uniform performance and consistent quality.

CORRELATION OF TRANSIENT MEASUREMENTS ON LOUDSPEAKERS AND LISTENING TESTS

MURLAN S. CORRINGTON, *RCA Victor Television Division*

The transient distortion of a loudspeaker is measured by applying a burst of a sine wave of four or sixteen cycles, starting and stopping when it crosses zero. The burst is followed by an off period of equal duration, and the burst is then repeated. A microphone in front of the loudspeaker is gated to measure the sound "hangover" during the "off" period. A curve is drawn of this transient hangover as a function of frequency. The paper discusses the correlation of this curve with listening tests.

A TWENTY INCH CORNER HORN OF UNUSUAL DESIGN

PAUL KLIPSCH, *Klipsch & Associates, Hope, Ark.*

A study undertaken in 1954 to devise an enclosure 20" to 24" high in conformance with

Klipsch corner horn principles has been concluded with the development of the KR-5.

While crowded, it was possible to use a separate 3-way system with a 12" woofer with crossover points at 1,000 and 5,000. This design is not intended to give a great powerful boomy bass, nor to approach the tonal response of a Klipschorn, but rather to give a response which is as smooth as can be possible in the size and as free of distortion as is possible with the necessarily high crossover frequencies.

ACOUSTICAL CALIBRATION OF LOUDSPEAKERS AT HIGHER FREQUENCIES

JOHN K. HILLIARD, *Altec Lansing Corporation, Beverly Hills, Calif.*

This paper will outline the techniques used to calibrate the free field response of a loudspeaker in the higher frequency range.

The specific apparatus used and the results that are obtained will be discussed. Several microphones and loudspeakers which are reversal transducers will be described.

RECENT DEVELOPMENTS IN HIGH FIDELITY LOUDSPEAKERS

HARRY F. OLSON, JOHN PRESTON, AND EVERETT G. MAY, *RCA Laboratories, Princeton, N. J.*

Three high fidelity loudspeakers have been developed and commercialized. These include eight, twelve, and fifteen inch units. The characteristics of these loudspeakers are uniform response over a wide frequency range combined with broad directivity, low non-linear distortion and faithful transient response. Cabinets and other loading systems for these loudspeakers have also been developed.

AN ELECTROSTATIC LOUDSPEAKER DEVELOPMENT

ARTHUR A. JANSZEN, *Engineering Consultant, Cambridge, Mass.*

An electrostatic loudspeaker which covers the 1000–20,000 cps range with a new order of efficiency, and in which the moving element functions essentially as an imaginary boundary in the transmitting medium, will be described. Performance data will be presented, and capabilities in music reproduction will be demonstrated.

MULTI-CROSSOVER, MULTI-IMPEDANCE NETWORKS FOR COMPATIBLE MULTI-SPEAKER SYSTEMS

ABRAHAM B. COHEN, *University Loudspeakers, Inc., White Plains, N. Y.*

Multi-speaker high fidelity systems which are designed so that the individual speakers operate in discrete frequency bands must work in conjunction with cross-over networks which are compatible with the roll-off characteristics of the speakers of the system. The choice of cross-over frequency and the rate of attenuation will be determined by the roll-off characteristic of the speakers of the system. Where level control attenuators are employed, the cross-over points will vary greatly with changes in level. A unitized network system will be discussed which makes possible a wide choice of cross-over points, a choice at attenuation rates, matched to a wide range of speaker impedances; the total effect of which is to achieve the most compatible performance from the speakers chosen for a multi-speaker system.

HIGH EFFICIENCY 3-WAY SPEAKER SYSTEM

SAUL J. WHITE, *University Loudspeakers, Inc., White Plains, N. Y.*

With the improvement in response of "extended-range" single loudspeakers, the question has been raised as to the advantages of multi-channel systems particularly for home use. This paper discusses these advantages and describes a specific triple-range system consisting of a folded-horn woofer, horn type mid-range and tweeter units, all of the indirect radiator type. The use of all compression type, horn-loaded units results in substantial improvement in efficiency, reduction of distortion and increase in overall response. An integrated system of acceptable dimensions for home use will be demonstrated.

TRANSISTOR PHONOGRAPH PREAMPLIFIER

(*from page 40*)

such as GE or the L-6 Audax. For the 10-millivolt class we need about 35 db at 1 kc, and with a 400-cps turnover we need another 22.5 db if we expect to go down to 30 cps, a total open-loop gain of at least 57.5 db without allowing any negative feedback for the low frequencies. Transistors giving gains of this order are not available yet. The Pickering line, on the other hand, giving a nominal output of as much as 70 millivolts, will work every satisfactorily with this circuit, giving an output of as much as 1 volt once the value of R_1 is adjusted. Using a low-impedance, (professional-type) GE cartridge, the problem of input impedance matching is somewhat improved and it should be possible to cascade two junction transistors to get the necessary gain of 57.5 db for that pickup.

Figure 10 shows the response of the preamplifier with a Pickering cartridge, Model 140, and a London LP frequency test record. Four pickups tested all gave substantially the same response. In listening tests the unit measures up very well, although we doubt that, at least at present, it is going to render obsolete its vacuum-tube counterpart. The complete absence of 60-cps hum and the elimination of any possible speaker mechanical feedback (microphonics) gives a new experience in the reproduction of sound, especially of the low-frequency band.

Power Supply

Although the complete preamplifier draws only 1.5 ma at 22.5 volts, this advantage is somewhat nullified by the fact that the voltage required is negative and is not found in the average present-day audio amplifier. This bias can be obtained, however, by several methods:

(1) Employing the same bias as the power amplifier, in the event fixed bias is used for the power tubes, since this bias will be in the same order of magnitude as the 22.5 volts originally used.

(2) The center tap of the high-voltage winding of the power supply transformer in most audio amplifiers is usually grounded, but if the center tap is returned to ground through a suitable bleeding resistor, a negative voltage is developed across the resistor which can be employed for power supply for the transistors. The value of this voltage will have to be subtracted from the total available B-plus, however, and the method may therefore prove unsatisfactory in some cases.

(3) A small power supply can be built with either a line-isolation transformer or two filament transformers connected back to back, using germanium crystals for rectifiers. Filtering is no problem because of the small current drain.

(4) The most obvious method will be to use a B-battery. Burgess type 5156 and the miniature hearing-aid type U15 have been found very satisfactory. By modifying the automatic shut-off mechanism of most record players, a d.p.s.t. switch can replace the present s.p.s.t. and the battery can be connected to the preamplifier through the extra pole of the switch. Since there is no warm-up time, the unit will go on immediately when the record player is started and will be disconnected automatically after the last record is played, resulting in a considerable extension of the life of the battery. For an average (!) record playing time of six hours a day, a U15 is expected to last about six months and with the new mercury batteries this may well be doubled.

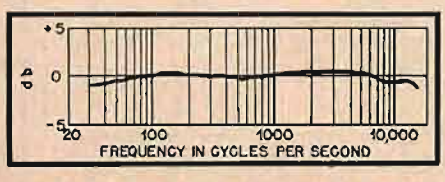


Fig. 10. This curve shows the result of an actual test with a Pickering cartridge and the London LP test record, which contains tones graded in level to conform to the usual LP music equalization.

Conclusion

In this article an attempt has been made to present some of the advantages and limitations of transistors, their basic circuit configurations, and their electronic equivalents and to show how these concepts can be applied in designing audio components that will compare favorably with their vacuum-tube counterparts. A complete preamplifier-equalizer employing a total of five transistors with a total drain of 4 ma at 22.5 volts is under development at present. Preliminary runs and listening tests give satisfactory performance and an article on the unit will be submitted for publication when performance tests and evaluations are completed.

Although an adventure into transistors and tantalum capacitors is likely, at present, to prove rather strenuous financially, it is certain that future improvements in higher gain, lower noise level and distortion, better stability and uniformity, together with lower cost, will prove the transistor to be an indispensable part of the preamplifiers and remote controls of the future.

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REVOLUTIONARY SPEAKER and ENCLOSURE

(from page 27)

resonant impedance peak is broadened. The Q can be controlled at will; too little Fiberglas yields an output peak in the bass, while too much overdamps the system and attenuates the bass response.

Since the enclosure is actually an integral part of the speaker it cannot be built like conventional cabinets. An acoustical seal must be provided, and the unrelieved pressures that are built up are so great that an unusually large number of ribs and braces are required, together with ¾-inch walls. *Figure* 3 is a photograph of the experimental model of the loudspeaker, its outside dimensions measuring 19 × 19 × 11 in. It uses a twelve-inch woofer and an outside tweeter, the latter not shown. The production model of the acoustical suspension loudspeaker that will be exhibited at The Audio Fair will not be square, for greater convenience in use on shelves or bookcases, and will utilize a twelve-inch woofer with 52-oz. Alnico 5 magnet, plus a high-frequency section mounted within the enclosure. Either the speaker mechanism or the enclosure is useless by itself. The speaker mechanism alone is only half a speaker, and mounting it in any conventional cabinet would be no more feasible than mounting a conventional twelve-inch speaker in the totally enclosed cabinet of approximately 1.7 cubic ft. interior volume.

Figure 4 illustrates by electrical analogy the substitution of acoustical for mechanical stiffness in the moving system. The total compliance, that is,

$$\frac{C_{speaker}\ C_{air}}{C_{speaker} \times C_{air}},$$

is not changed by the new design from its optimum value in terms of the moving mass and length of linear magnetic path.

An examination of the negative side of the ledger will reveal the fact that the acoustic suspension speaker system is relatively inefficient. The efficiency rating does not, however, fall outside the range of values for conventional direct radiators and a 10-watt amplifier is sufficient to provide ample volume for a room of 3,000 cubic feet. Some of the reasons for the relative inefficiency are:

1. There are no acoustical resonators employed in coupling the cone to the air.
2. The moving system has purposely been given a low Q, to damp the bass resonant peak, and has a relatively high mass reactance in the commercial model.
3. The voice-coil gap cannot be made very narrow due to the nature of the centering spider, although the gap width does not fall outside the range of values for conventional units. The acoustical suspension speaker system can, of course, be used as the driver unit for a horn where high efficiency is required.

A patent application for the speaker system described in this article has been filed by the author.

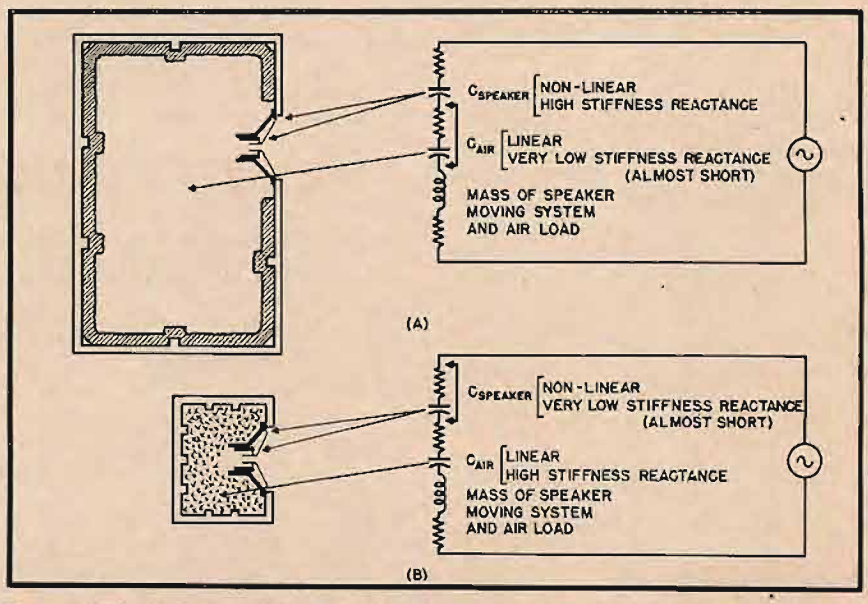


Fig. 4. (a) Electrical-mechanical analogy of the moving system of a conventional speaker in a totally enclosed cabinet. Since C_{air} is made as large as possible, the non-linear $C_{speaker}$ determines the elastic stiffness of the system.

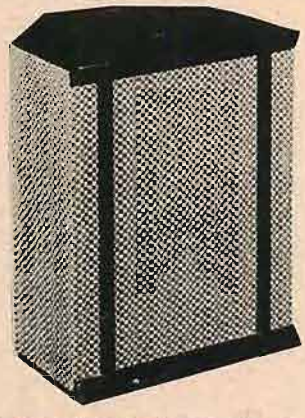
(b) Electrical-mechanical analogy of the moving system of the acoustic suspension speaker. Since $C_{speaker}$ is made very large, the linear C_{air} determines the elastic stiffness of the system. The resultant total elastic stiffness, however, is not changed from its optimum value.

NEW PRODUCTS

(from page 83)

• **Professional Playback System.** Recording studios, advertising agencies, radio and TV stations, as well as other organizations with similar playback requirements, will find many uses for the new Fairchild compact professional playback system. Utilizing the widely-known Model 530 3-speed transcription turntable as its heart, the system is furnished complete with all necessary equipment, excepting speaker. Included is the Fairchild 3-way turret-head transcription arm, cartridges for standard and microgroove recordings, 6-position program equalizer, preamplifier, and 10-watt power amplifier. Despite the small space it occupies, the system meets highest professional operating standards. Fairchild Recording Equipment Company, 154th Street and 7th Ave., Whitestone, N. Y.

• **Compact Corner Speaker Enclosure.** Designed by Paul Klipsch, and known affectionately as the "Little Monster" and officially as Model KR-5, this new Cabinart enclosure is only 21 ins. high, yet approaches Klipschorn performance on light



middle bass. Considering its size, performance is substantially superior to conventional box-type enclosures. Based on design of the original Klipschorn, the KR-5 makes use of the walls of the room in which it is used as the final extension of an exponential horn, thereby extending bass response. Constructed to handle either 8- or 12-in. speakers, the cabinet is built with a 12-in. cutout bushed with an 8-in. plate. G & H Wood Products Co., 75 N. 11th St., Brooklyn 11, N. Y.

LETTERS

(from page 10)

harmonic only and got a fairly good correlation. We concluded that if the fifth harmonic were held below one tenth of one per cent, the second and third could be anything in reason without causing offense to the ear.

When (C) and (D) are answered satisfactorily, I will present (E) and (F). (E) involves certain doubtful assumptions about push-pull, while (F) involves the question of triodes *vs.* tetrodes for driving reactive cones.

At a certain pub out here—one which specializes in Music Moderne with lots of brass and tympani and a PA system up 20 db at 50 and 7000 cps—a waiter dropped a tray full of dishes and six couples got up and started to dance. Is this what hi-fi is coming to?

JOHN N. A. HAWKINS
The Rollin Company
2010 Lincoln Ave.,
Pasadena 3, California

Industry Notes...

National Company, Inc., has established a New Products department, under the direction of Robert J. Caldwell, to coordinate the firm's program of expansion and development, it was announced recently by Lynn Eaton, vice-president in charge of sales. Caldwell will be responsible for analyzing and making recommendations on a wide variety of new products under consideration for manufacture and sales.

Dan Karp, vice-president in charge of sales, engineering and production for **Karp Metal Products Company,** Brooklyn, N. Y., recently announced formal affiliation of his company with the West Coast division of the **H and B American Machine Co., Inc.,** Culver City, Calif. One of the world's largest fabricators of sheet metal enclosures, **Karp** manufactures a wide selection of custom cabinetry for electronic equipment.

An all-out celebration, including many celebrities from the world of music among hundreds of guests, was conducted by **Pentron Corporation** to dedicate its new plant located at 777 S. Tripp Ave., Chicago. Guests were treated to a performance of the All-Electronic Orchestra, **Pentron's** fascinating example of stereophonic reproduction. The new plant, which covers 75,000 square feet, highlights the simultaneous growth of **Pentron** and the rapidly-expanding tape-recorder industry.

A nationwide coordinated sales program for **Encore** magnetic recording tape was launched by **Technical Tape Corporation** at a three-day sales seminar beginning August 16 at the Hotel Commodore in New York City. Twenty-six representatives from all parts of the country were present as were Paul Cohen, company president; Fred I. Kantor, national sales manager; Lou Seda, production and research director; Marvin Kline, assistant production and research director, and Arthur M. Gasman, advertising counsel.

Popularity of **Fleetwood** custom TV receivers and chassis is reflected in a new building which is being constructed at Glendora, Calif., by **Conrac., Inc.,** whose products are sold under the **Fleetwood** trade name. No small portion of the increased demand for **Fleetwood** TV chassis lies in the fact that are designed especially for custom installation, and are equipped with wide-range high-fidelity audio outputs.

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25–50% DISCOUNT, Factory-fresh guaranteed LP records, 60¢ and up send 20¢ for catalogue. SOUTHWEST RECORD SALES, Dept. A, 4710 Caroline, Houston 4, Texas.

Hi-Fidelity plastic-base recording tape, 1200 ft. on 7" plastic reel, $2.19 ea., 6 for $12. Hi Fi Shop, 2 N. Howard St., Baltimore 1, Md.

FM ANTENNAS. Broad band Yagis and standard types. Wholesale Supply Co., Lunenburg, Mass.

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SELL: Craftsmen C-500 amplifier, perfect condition. M. L. Amundson, 7303 Charlotte St., Springfield, Virginia.

FOR SALE: U-L Williamson Amplifier with Peerless S-265-Q transformer and oil capacitors, $25. APPROVED A-800 Preamp, $10. Charles Leigh, 162 Passaic St., Trenton 8, N. J.

FOR SALE: ALLIED 16-in. Professional Recorder (similar to Presto 6N), Fairchild pickup, in console, no head. New condition. New York BE 3-6587. Box CP-1, AUDIO.

NEW U-L Williamson—all Peerless transformers—two chassis, $89.50. One Electro-Voice Georginn, unused, $395. Box CP-2, AUDIO.

DIAMOND NEEDLES: Custom re-tipping of your phonograph needle or cartridge with broadcast quality diamond. For information and price write to: Transcriber Company, (Diamond Stylus Manufacturers), 70 Pine St., Attleboro, Mass.

HI-FI AUDIO amplifier, custom-built, push-pull feedback circuit, 20 watts output, with mixing panel and Rek-O-Kut 16-in. cutting mechanism mounted on Robinson 16-in. 2-speed turntable. All in excellent condition. Originally cost more than three times bargain price of $350. Box CP-3, AUDIO.

HI-FI EQUIPMENT: Fisher, Thorens, Altec-Lansing; tape recorder, other items. All unused and perfect. Will sacrifice. Philip Lance, Greenwich, N. J.

FOR SALE: 600 NEW Phonograph records, 78 rpm. JAZZ—POLKAS—POPULAR—WESTERN. Likewise 16-in. Transcriptions, plus many other audio and office items. Write for complete list and prices. Box 485, Passaic, N. J.

LIKE NEW Ekotape 101 for sale at low price. Norman M. Paulson, P. O. Box 301, Danville, Illinois.

FOR SALE: 5 Western Electric 9B Reproducers. Brand new. Original list $85 each. Lot price, $30 each. Individual, $35. Box CP-4, AUDIO.

MAGNECORDER "VOYAGER" 2 months old, hardly used; $350. Sam Eskin, Woodstock, N. Y.

FOR SALE: CONCERTONE tape recorder, model 1501, in portable case with amplifier, speaker, NAB reel hubs. Condition perfect. Best offer over $295. E. Levine, 115 Brightwater Ct., Brooklyn 35, N. Y. Days: WA 4-0650; Eves: SH 3-0813.

WANTED: Magnecord PT-63 tape recorder mechanism only. WAtkins 4-7983 (New York) or Box CP-5, AUDIO.

PRESTO 6-N, 2-speed recording machine, console, 90-B amplifier, Shure microphone. Practically new. Original cost $1500, will sell for $500. Box CP-6, AUDIO.

Industry People...

Adolph Gross, head of the representative firm bearing his name, on the receiving end of industry congratulations for the speedy job he performed in placing the new Miracord XA-100 record changer in the sound rooms of virtually all leading New York dealers . . . **Jay Carver,** formerly with Electronic Workshop, Inc., getting his share of handshakes because of his appointment as advertising manager for G & H Wood Products Company, makers of Cabinart speaker and equipment enclosures.

Elmer O. Wilschke has resigned as operating manager of Altec Service Corporation to become vice-president in charge of operations for Fine Sound, Inc. . . . **Dr. Frederick E. Terman,** dean of Stanford University's school of engineering, elected to the board of directors of the Ampex Corporation at annual stockholders' meeting . . . **Douglas Y. Smith,** formerly marketing manager, has been promoted to vice-president and general manager of the Tube Division of RCA . . . **John D. van der Veer** is newly-appointed assistant general sales manager of Tung-Sol Electric, Inc.—was formerly manager of initial equipment sales.

Joseph F. Hards, president of the Magnetic Recording Industry Association, announces the appointment of **Robert Leon** of Brush Development Company as chairman of the Standards and Engineering Committee. Next meeting of the committee is planned for New York during the Audio Fair . . . **Mrs. Helen B. Anderson,** formerly a technician for Federal Telephone and Radio Company, has joined Pyramid Electric Company, North Bergen, N. J., as sales engineer.

Frank Adams, with ORRadio Industries since last Spring, is new sales manager of the company's Mid-Atlantic Division with headquarters in Philadephia . . . **R. T. (Rudy) Bozak,** president, The R. T. Bozak Company, reports that increasing demand for Bozak speakers has forced the company to expand into larger quarters for the third time since it was founded in 1949—new plant is on Post Road, South Norwalk, Conn. . . . **Avery Fisher,** president, Fisher Radio Corporation, entertained music critics and technical editors at cocktails September 17 to introduce the new Fisher Z-matic control for automatically varying the output impedance of Fisher amplifiers.

ADVERTISING INDEX

Acoustic Research, Inc.	85
Acro Products Co.	94
Allied Radio Corp.	69
American Elite Co.	18
Ampex Corporation	17
Argos Products Company	99
Asco Sound Corp.	101
Audak Co.	59
Audio Devices, Inc.	Cover 2
Audiogersh Corporation	Facing page 52
Beam Instruments Corp.	19
Belden Mfg. Co.	15
Bell Sound Systems, Inc.	96
Bell Telephone Laboratories	24
Bogen, David, Co., Inc.	63
British Electronic Sales Co.	102
Brush Electronics Company	97
British Industries Corp.	3, 83
Capps, Frank L. & Co., Inc.	51
Carter Motor Co.	14
Cinema Engineering Co.	95
Cousino, Inc.	103
Classified Advertisements	102
deMars Engineering & Mfg. Co.	47
Electro-Voice, Inc.	1, 12, 13
Electro-Voice Sound Systems	103
Fenton Company	74
Ferranti Electric, Inc.	85
Fisher Radio Corp.	67, 77
Freed Electronics and Controls Corp.	88
General Electric Co.	71, 76
G & H Wood Products Co.	68
Goodmans Industries, Ltd.	89
Hartley, H. A., Co., Inc.	104
Harvey Radio Co., Inc.	81
Heath Co.	89
High-Fidelity House	103
Hollywood Electronics	103
Hughes Research and Development Laboratories	2
Hycor Co., Inc.	103
International Electronics Corp.	55
Interelectronics	60
J K M Incorporated	102
K D Cabinet Division, Oak Electric Motors, Inc.	93
Kierulff Sound Corp.	103
Klipsch & Associates	86, 87
Laboratory of Electronic Eng., Inc.	82
Langevin Mfg. Corp.	4
Leonard Radio, Inc.	57
Lowell Manufacturing Co.	7
Magnasync Mfg. Co., Ltd.	16
Marantz, S. B.	93
Minnesota Mining and Mfg. Co.	5
National Company	20, 21
Partridge Transformers, Ltd.	101
Pentron Corporation	70
Permoflux Corp.	79
Pickering & Company, Inc.	23
Pilot Radio Corp.	45
Presto Recording Corporation	65
Prestoseal Mfg. Co.	102
Professional Directory	103
Radio Shack Corporation	73
Rauland-Borg Corporation	64
Reeves Equipment Corp.	74, 103
Reeves Soundcraft Corp.	11
Rek-O-Kut Company	9, 78
Rockbar Corporation	Cover 3
Shure Brothers, Inc.	10
Sonotone Corporation	6
Standard Wood Products Corp.	97
Stephens Mfg. Corp.	62
Summit Electronics, Inc.	98
Tannoy (Canada) Limited	92
Tech-Master Products Co.	94
Technical Tape Corporation	48, 49
Terminal Radio Corp.	43, 61
Triad Transformer Corp.	90
Tung-Sol Electric, Inc.	8
Turner Company, The	91
United Transformer Co.	Cover 4
University Loudspeakers, Inc.	75
U. S. Recording Co.	103
Weathers Industries, Inc.	91
Wendell Plastic Fabrics Corp.	84

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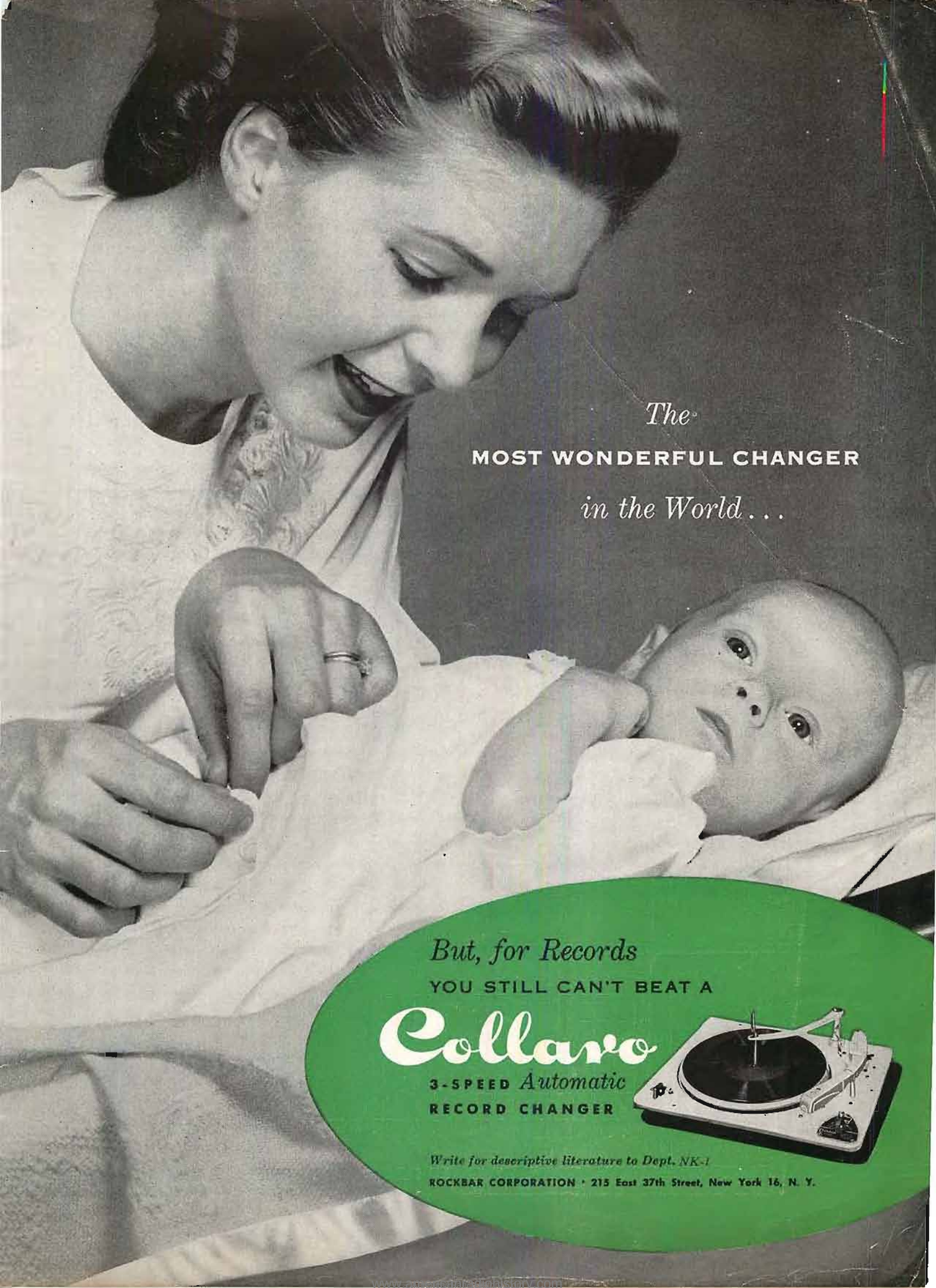
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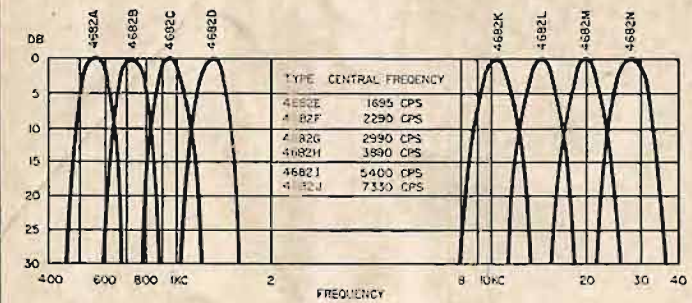

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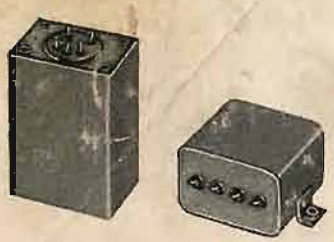
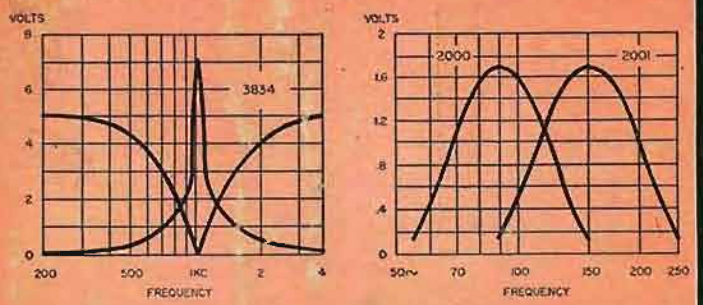
(4682A) 1½ x 2 x 4"



Dimensions:
(3834) 1¼ x 1¾ x 2-3/16".
(2000, 1) 1¼ x 1¾ x 1⅝".



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UTC has produced the bulk of filters used in aircraft equipment for over a decade. The curve at the left is that of a miniaturized (1020 cycles) range filter providing high attenuation between voice and range frequencies.

Curves at the right are that of our miniaturized 90 and 150 cycle filters for glide path systems.

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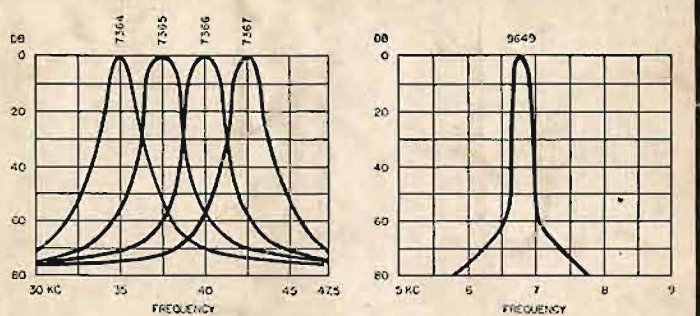

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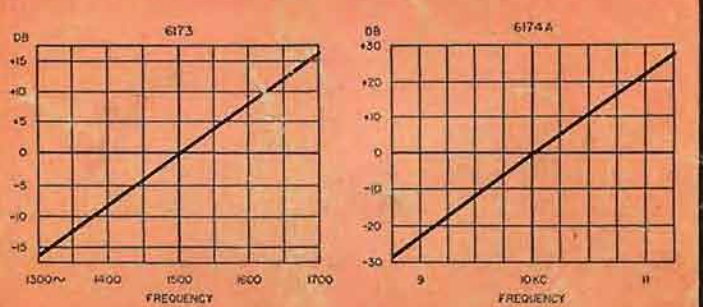

Dimensions:
(6173) 1-1/16 x 1⅜ x 3".
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