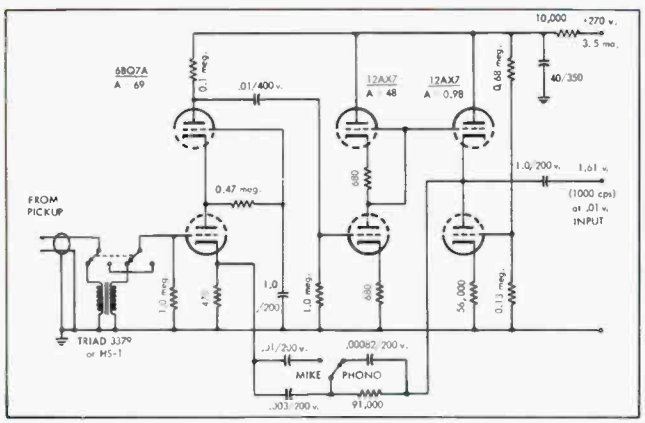
AUDIO

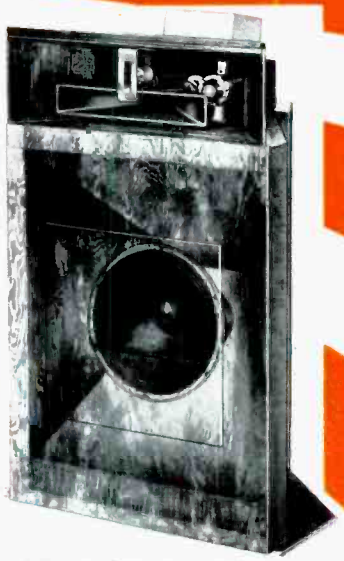
ENGINEERING MUSIC SOUND REPRODUCTION

OCTOBER, 1955

50¢



The search for low-noise preamplifiers leads into many strange channels—in this instance, the author made a complete study of noise-producing elements and evolved the simple cascode circuit shown above. *See page 23.*



Building a "Patrician" for yourself may seem a forbidding project, but data in this issue makes it easy. *See page 37.*

THE RECORD DEALER VIEWS THE STYLUS PROBLEM

BUILDING SIMPLICITY INTO THE HI-FI SYSTEM

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THE "PATRICIAN" GETS A HOME WORKOUT

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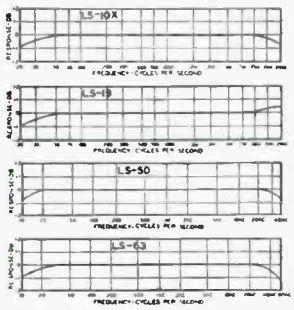
Linear Standard units represent the acme from the standpoint of uniform frequency response, low wave form distortion, thorough shielding and dependability. LS units have a guaranteed response within 1db. from 20 to 20,000 cycles.

Hum balanced coil structures and multiple alloy shielding, where required, provide extremely low inductive pickup.

These are the finest high fidelity transformers in the world. 85 stock types from milliwatts to kilowatts.



LS-10X Shielded Input
Multiple line (50, 200, 250, 500/600, etc.) to 50,000 ohms . . . multiple shielded.

LS-19 Plate to Two Grids
Primary 15,000 ohms.
Secondary 95,000 ohms C.T.

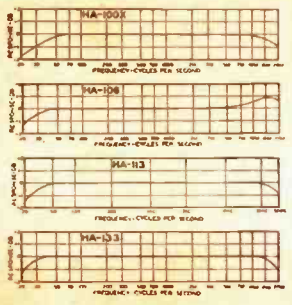
LS-50 Plate to Line
15,000 ohms to multiple line . . . +15 db. level.

LS-63 P.P. Plates to Voice Coil
Primary 10,000 C.T. and 6,000 C.T. suited to Williamson, MLF, ul.-linear circuits. Secondary 1.2, 2.5, 5, 7.5, 10, 15, 20, 30 ohms. 20 watts.

CASE	LS-1	LS-2	LS-3
Length	3⅛"	4-7/16"	5-13/16"
Width	2⅝"	3½"	5"
Height	3¼"	4-3/16"	4-11/16"
Unit Wt.	3 lbs.	7.5 lbs.	15 lbs.

HIPERMALLOY series

This series provides virtually all the characteristics of the Linear Standard group in a more compact and lighter structure. The frequency response is within 1 db. from 30 to 20,000 cycles. Hipermalloy nickel iron cores and hum balanced core structures provide minimum distortion and low hum pickup. Input transformers, maximum level +10db. Circular terminal layout and top and bottom mounting.



HA-100X Shielded Input
Multiple line to 60,000 ohm grid . . . tri-alloy shielding for low hum pickup.

HA-106 Plate to Two Grids
15,000 ohms to 135,000 ohms in two sections . . +12 db. level.

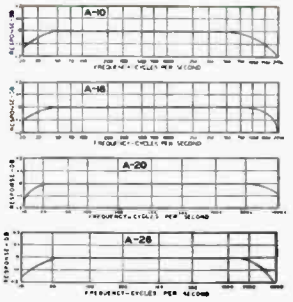
HA-113 Plate to Line
15,000 ohms to multiple line . . . +12 db. level . . . 0 DC in primary.

HA-133 Plate (DC) to Line
15,000 ohms to multiple line . . . +15 db. level . . . 8 Ma. DC in primary.

Case	H-1	H-2
Length	2⅜"	3-9/16"
Width	1-15/16"	2-13/16"
Height	3⅛"	3½"
Unit Weight	2 lbs.	5 lbs.

ULTRA COMPACT series

UTC Ultra Compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. The frequency response is within 2 db. from 30 to 20,000 cycles. Hum balanced coil structure plus high conductivity die cast case provides good inductive shielding. Maximum operating level is +7db. Top and bottom mounting as well as circular terminal layout are used in this series as well as the ones described above.



A-10 Line to Grid
Multiple line to 50,000 ohm grid.

A-18 Plate to Two Grids
15,000 ohms to 80,000 ohms, primary and secondary both split.

A-20 Mixing Transformer
Multiple line to multiple line for mixing mikes, lines, etc.

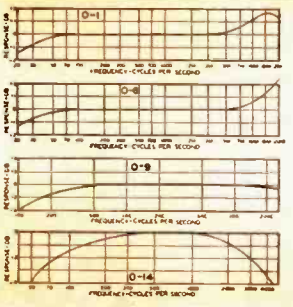
A-26 P.P. Plates to Line
30,000 ohms plate to plate, to multiple line.

A CASE

Length	1½"
Width	1½"
Height	2"
Unit Weight	½ lb.

OUNCER Series

UTC Ouncer units are ideal for portable, concealed service, and similar applications. These units are extremely compact . . . fully impregnated and sealed in a drawn housing. Most items provide frequency response within 1 db. from 30 to 20,000 cycles. Maximum operating level 0 db. These units are also available in our stock P series which provide plug-in base. The 0-16 is a new line to grid transformer using two heavy gauge hipermalloy shields for high hum shielding



0-1 Line to Grid
Primary 50, 200/250, 500/600 ohms to 50,000 ohm grid.

0-6 Plate to Two Grids
15,000 ohms to 95,000 ohms C.T.

0-9 Plate (DC) to Line
Primary 15,000 ohms, Secondary 50, 200/250, 500/600.

0-14 50: 1 Line to Grid
Primary 200 ohms, Secondary :5 megohm for mike or line to grid.

OUNCER CASE

Diameter	⅞"
Height	1-3/16"
Unit Weight	1 oz.

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OCTOBER, 1955 VOL. 39, No. 10
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

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RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.

AUDIO PATENTS

RICHARD H. DORF*

THE ACRO PRODUCTS COMPANY patent on the Ultra-Linear amplifier circuit was granted recently to David Hafler and Herbert I Keroes of Philadelphia; its number is 2,710,312. Though AUDIO readers are doubtless familiar with the subject, it is of some interest to go into it anew from the standpoint of the patent specification, which contains a more generally lucid explanation of the idea than anything this writer has seen in print. The following is, therefore, while not necessarily directly quoted, the line followed by the inventors themselves.

After pointing out that criteria for ideal sound reproduction can only be judged finally by actual listening, the inventors remind us of the two schools of amplifier thought—the one which adheres to the use of triode tubes because they produce "sweet" or "smooth" sound, and the other addicted to the tetrode or beam tube because of its "crispness" and "cleanness." Each type of tube obviously produces its own peculiar character of distortion which pleases its advocates and displeases its opponents. These distortions are elusive and unmeasurable, but are nevertheless real to the critical listener.

The conclusion which is obvious to the inventors is that the only way to reconcile the two schools and perhaps make an amplifier that will satisfy both is to invent some new type of tube, one which will provide sound acceptable to both schools and which will, in addition, have certain desirable characteristics not all presently available in either triodes or tetrodes. These are listed as follows:

1. Low internal impedance—now present in triodes but not tetrodes.

2. High power sensitivity—offered by present tetrodes but not by triodes.

3. Lower harmonic and intermodulation distortion than either the triode or the tetrode, at both high and low power levels.

4. High efficiency, so that adequate power output can be obtained without too much bulk or cost.

The first approach to realization of these aims is to point to the only significant difference between a triode and a tetrode. This is the screen grid, which gives the tetrode high efficiency, but whose absence gives the triode low plate resistance.

Next, tying up the two types by a sort of conversion-process thinking, it is noted that a tetrode can be transmuted into a triode by simply connecting the screen to the plate. This immediately gives the two boundary conditions for tetrode operation: (1) full tetrode operation in which the screen is entirely energized by d.c. and forms no active output element, and (2) full triode operation in which the screen forms as much of an active element as the plate, being energized entirely by the same dynamic current and voltage variations as the plate. Between these boundaries there must be intermediate conditions in which the screen is energized partially by a static d.c. and partially by plate-voltage variations brought about by connecting the screen across only a portion of the plate load. These intermediate conditions were investigated by the inventors and yielded surprising results.

Figures 1, 2, 3, and 4 show four methods of connecting the screen for these intermediate conditions—so that the screen is connected both to d.c. and to a part of the plate load. In *Fig.* 1, a tertiary winding on the output transformer primary couples output energy between plate and screen. In *Fig.* 2, the screen is tapped down on the output transformer for the same purpose. Both of these are single-ended outputs. *Figure* 3 shows the same scheme as *Fig.* 2, but for push-pull operation. In *Fig.* 4 the tap is made on a load inductor connected across the transformer primary. In each case except *Fig.* 1 the degree of the difference between triode and tetrode operation is determined by the position of the tap. With the tap at B-plus, there is full tetrode operation; with

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

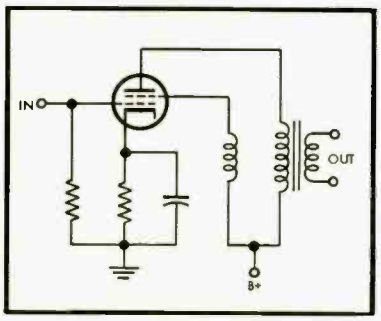

Fig. 1

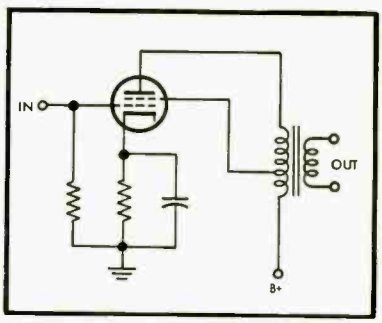

Fig. 2

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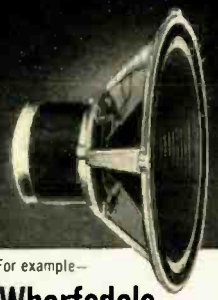

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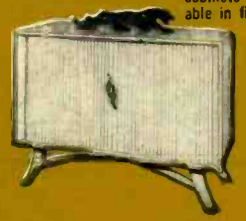

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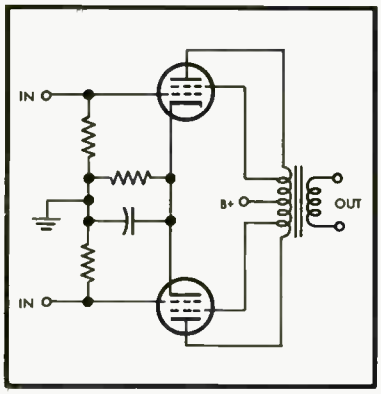


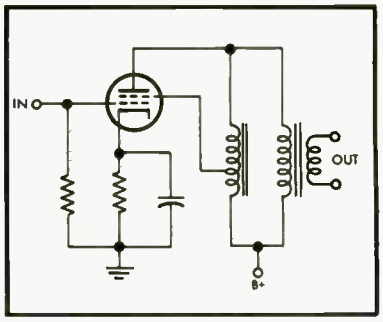


Fig. 4 (above).
Fig. 3 (left).

the tap at plate there is a full triode operation. With triode operation defined as 100 per cent screen loading and full tetrode operation as 0 per cent screen loading, the percentage of screen loading for various stages of intermediate operation is the square of the voltage ratio between signal voltage at the screen and that at the plate. Percentage of screen loading may thus be defined as the percentage of plate-circuit signal power transferred to the screen. The inventors note that power is transferred to the screen over only a part of the signal cycle, when the absolute value of plate potential falls below that of the screen. This transfer has a linearizing effect on plate characteristics.

Experiments have shown that the ideal mode of operation for a number of popular tubes—6L6, 5881, 807, KT-66, etc.—is with approximately 18 per cent screen loading. Internal impedance of the tube drops very sharply when the experimenter proceeds from 0 per cent to 18 per cent screen loading but levels off at a very low value just beyond 18 per cent. Maximum undistorted power output falls only slightly out to 18 per cent and is very high, but drops rapidly thereafter. Low-level distortion decreases rapidly from 0 to 18 per cent but far less rapidly thereafter. High-level distortion remains low out to 18 per cent but increases rapidly with higher percentages.

It follows, therefore, that the tetrode or beam tubes are actually operating as though they were tubes of a new type with the high power sensitivity characteristic of tetrodes, and the low internal impedance typical of triodes. There is very little more low-level distortion than triodes produce and a great deal less high-level distortion. This is the essence of the Ultra-Linear circuit. The 18 per cent figure for screen loading does not, of course, apply to all tubes. Tubes of the 6V6 type, for example, do best with screen loading of about 5 per cent, and for each general type there is an optimum figure.

Another advantage of ultra linear operation is the possibility of applying higher electrode potentials to the tubes, thus obtaining higher power output, without exceeding dissipation ratings. In ordinary operation a limiting factor in tetrode use is screen dissipation, which is generally listed in the manuals for static operating potentials and screen currents. Under dynamic operating conditions the allowable maxima may be exceeded and the tube damaged.[1] With Ultra-Linear circuitry the screen potential is no longer fixed but follows the potential of the plate. If, therefore, the potential on the screen does not as greatly exceed that on the plate as when the screen is unloaded, the tube can be operated safely with higher supply voltages than those normally recommended by the manufacturer.

Figure 5 shows the Ultra-Linear story in graphic form for a particular tube for which about 18 per cent is optimum screen loading. The horizontal scale is marked in percentage of screen loading from zero to 100, and there are four vertical scale markings, one for each of the graph lines. The line marked R_{int} shows effective tube internal resistance; notice how sharply it drops until the optimum 18-per-cent point. The P_o line indicates "undistorted" power output maximum. Its fall to the 18-per-cent point is negligible but more rapid thereafter. The remaining two lines show low- and high-level intermodulation.

[1] Which always reminds me—entirely irrelevantly—of a childhood German-dialect sentence, "Der cow hat ofer der fence gechumped and der cabbage gedamaged."

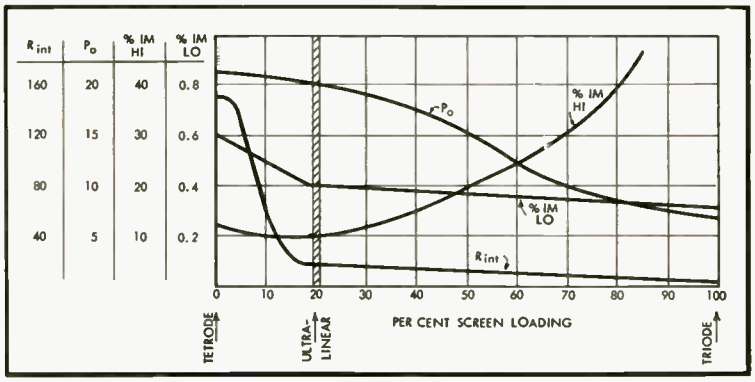


Fig. 5

NEW LITERATURE

• **Allied Radio Corporation,** 100 N. Western Ave., Chicago 80, Ill., reflects the continued growth of the industry with its new 1956 catalog which contains 324 pages, making it the biggest catalog published by any electronic distributor. Featured in an attractive rotogravure section is a selection of 34 complete music systems. Selected on the judgment of music lovers, product research organizations, and qualified publications, the systems range in price from $98.50 to $1131.50. Build-it-yourself enthusiasts will find a bigger-than-ever selection of high-fidelity amplifier kits plus expanded listings of custom cabinet kits for housing speakers and components. Copy will be mailed free on request. **P-1**

• **Permoflux Corporation,** 2835 N. Kedzie Ave., Chicago 18, Ill., has published individual product literature sheets on three of the firm's better known audio devices, namely, the HD-1 Hi-Fi headset, the new Largo Dual-8 speaker system, and the Diminuette speaker system. Each sheet is complete in the sense that it gives both technical and physical specifications as well as prices of the respective items. **P-2**

• **Instrument Division, Federal Telephone and Radio Company,** 100 Kingsland Road, Clifton, N. J., will mail on request a 4-page descriptive bulletin covering the company's new Type FT-FNA audio-frequency wave analyzer. The instrument covers a frequency range of 30 to 20,000 cps and has a length of scale which covers nearly seven feet of linear graduation. Sensitivity to signals as low as one microvolt permits use of low-output transducers, such as microphones, without preamplifier. The analyzer is also exceptionally unique in many other respects and well worthy of investigation for professional and laboratory use. **P-3**

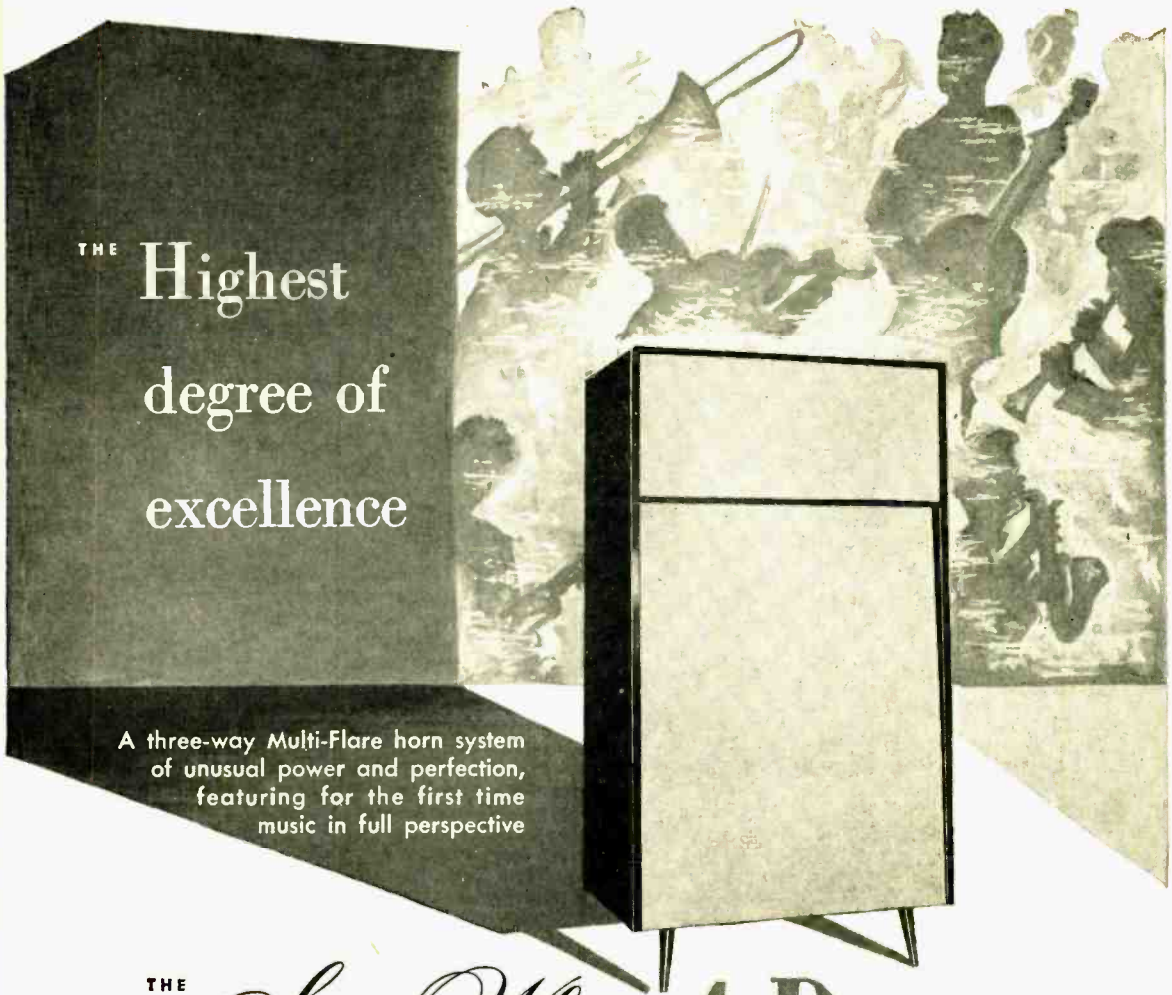
• **General Electronic Equipment Company,** P. O. Box 347, Easton, Penn., announces a new two-color brochure describing the firm's new line of kits and complete instruments that are available through jobbers and distributors. The bulletin includes oscilloscopes, tube testers, Geiger counters, and multitesters. Reasonable quantities of the folder will be supplied to distributors for use as mailing enclosures. Space is provided for distributor's imprint. **P-4**

• **RCA Tube Division,** Harrison, N. J., has just brought out a revised edition of the company's popular Power and Gas Tubes Booklet. The 24-page publication contains technical data on 178 vacuum power tubes including forced-air-cooled and water-cooled types ranging in output up to 500 kw; gas, mercury-vapor and vacuum rectifier tubes; gas and mercury-vapor thyratrons; ignitrons, magnetrons; and vacuum-guage tubes. Each tube type is covered by a text description, tabular data, and a base or envelope connection diagram. Requests for copies must be accompanied by a remittance of twenty cents for each copy desired, and should be addressed direct to: Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J. **P-5**

• **Neu Tape Center,** 2233 W. Roosevelt Drive, Milwaukee 9, Wis., a mail order company operating exclusively in the widening field of monaural and binaural recorded tapes and tape playback machines, is now issuing its 1956 catalog for tape enthusiasts. Labels represented in the catalog include Alphatape, Ameritape, Audiosphere, Connoisseur, EMC, Esoteric, Livingston, RCA Victor, Oceanic, HMV and others. **P-6**

• **All-State Welding Alloys Company, Inc.,** 249-55 Ferris Ave., White Plains, N. Y., introduces two new solders widely applicable in joining aluminum where shear strengths of 18,000 and 20,000 psi are desirable, in a new folder titled "How to Use and Apply Alloys and Fluxes for Soldering, Brazing and Welding Aluminum and Aluminum Alloys." The folder is a handy reference in the selection of the proper alloy for various types of metal bonding. Single copies of the publication are available free on request to the company or to any of its distributors. **P-7**

• **CBS-Hytron,** Danvers, Mass., is now offering the second edition of its Crystal Diode Manual. Revised and brought up-to-date, the new edition includes germanium and silicon diodes, encased in both glass and plastic. Profusely illustrated, the manual continues the down-to-earth, informative approach which made the first edition popular. Irrespective of whether your interest in semi-conductors is academic or professional, a copy of this booklet will be a valued addition to your technical library. Requests should specify Bulletin E-217. **P-8**



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LETTERS

Corrections

SIR:

I am sorry to report several errors in my article "An output-transformerless amplifier-speaker system" (July, 1955) which were not in the manuscript I sent you.

The most serious of these is the deletion of the name of the manufacturer of the special 250-ohm speaker, since this manufacturer was the only person who really went out of his way to cooperate in furnishing this special unit. I have already received seven inquiries from persons who want to know where they may obtain this speaker, and I am not looking forward to answering several hundred more letters. (*The name of the manufacturer was omitted at the request of the manufacturer himself, since he didn't look forward to having to make several hundred of these speakers, one at a time. Special voice coils can be had on order from replacement-cone houses, if sufficent urgency is indicated. However, one manufacturer, Stephens, does make a standard model with a 500-ohm voice coil.* ED.)

Electronic Transformer should have been mentioned as the supplier of the 2-Hy. 800-ma choke, their part number 152201, as this item is not readily obtainable elsewhere.

The "7 watts at 3 per cent IM" on page 13 should read "70 watts"; the baking temperature of 35 deg. on page 15 should be 350 deg.; the letters A, B, C, and D should be placed adjacent to the four arrows at the upper right of the diagram on page 14, starting from the top with A and progressing downward; a dot should appear on the lead from the lower 6337 plate where it crosses the lead from R_{19}; the value for the potentiometer between the cathodes of the 6337's should be indicated as 10 ohms, and its symbol should be listed as R_{20}.

I trust you will be able to publish these corrections in an early issue.

CURTISS R. SCHAEFER,
R. D. 2,
Clarks Summit, Pa.

(*We suggest that readers make these changes in their July issue, and we regret that errors such as these creep in occasionally.* ED.)

Optimistic (?) Claims

SIR:

As one who has been interested in "the art" for several years, I am appalled at what seems to be a current trend. Editorially, you give just deserts to those unscrupulous manufacturers who label their junk "Hi-Fi." But what seems to escape your notice, and what is fully as disturbing is the manufacturer who advertises, "Do you dare to contemplate this luxury?" or the one who bills his particular gadget as practically the greatest advance since the vacuum tube.

Granted that it is desirable to achieve a more widespread interest in (and consumption of) home audio, appealing to mass snobbery and mass poor taste seems a rather illegitimate way to achieve a mass market. Soon the tastes and desires of the nincompoop gadget collectors will be influencing makers to the point where the only difference between most makes of equipment will be the color of the leatherette covers and plastic pushbuttons which weren't needed in the first place. The parts you can't see will be uniformly poor.

If this seems an exaggeration you might check the shelves of your local camera shop. Photography went through these same growing pains twenty-five years ago. Or you might compare the life expectancy and workmanship of today's Snazzy Eight with the classic automobile of yesterday (or of Europe).

The only apparent ray of hope (and it is dim) is the fact that the audio field is dominated by many small companies. Perhaps some of them will retain the integrity of their products. Or maybe enough consumers will be acute and pass up product "A" even though it has more bouncy needles for product "B" whose manufacturer spent more on materials and labor than he did on technically uninformed copy writers. Superlative claims may be all right for the *mass* market, but the serious audiofan cannot be fooled *all* the time.

DAVID S. MAYO,
2802 Ponce Ave.,
Belmont, California.

Sensational New Advance in AM-FM Tuners

by h.h. Scott

330 AM-FM (Binaural) Tuner, $169.95*

ONLY really wide-range AM, plus super-selective FM

■ Now you can receive the full 10 kc frequency range broadcast by the better AM stations. Entirely new IF and detector circuits make this possible for the first time.

■ New AM detector insures distortionless reception even if stations modulate to 100%. Conventional detectors give distorted AM above moderate modulation percentages.

■ Three-position IF-bandwidth switch for perfect AM reception under any signal conditions.

■ New wide-band FM design gives super-selectivity to let you separate stations so close together you would ordinarily pass right over them.

■ Wide-band design insures drift-free reception.

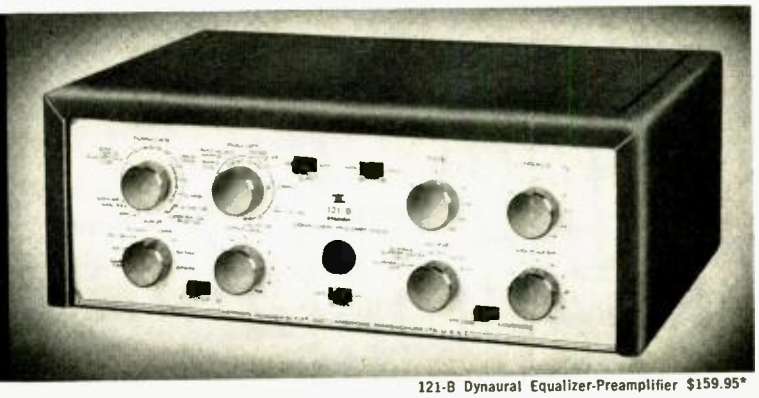
TECHNICAL SPECIFICATIONS

FM Section: 3 mv. sensitivity for 20 db quieting — 2-megacycle wideband detector — 80 db rejection of spurious cross-modulation response by strong local signals — automatic gain control — equipped for multiplex. AM Section: 1 mv. sensitivity — 10 kc whistle filter — extended frequency response to 10 kc — ferriloopstick antenna — output jacks for binaural — beautiful accessory case $9.95*

*Slightly higher west of Rockies.

New Control Unit With Every Conceivable Feature

by h.h. Scott



121-B Dynaural Equalizer-Preamplifier $159.95*

Infinite equalization for any record, plus famous DNS

■ Both bass turnover, and treble rolloff equalizers are continuously variable for precise compensation of any record, past, present or future.

■ Amazing, patented DNS (dynamic noise suppressor) eliminates record noise and rumble, but without losing audible music, as fixed filters do. Makes worn records sound new again, protects record libraries.

■ Two magnetic inputs, switched on panel, allow use of both changer and turntable.

■ Finest tape recorder facilities ever offered, including Playback-Monitor switch, and three tape inputs.

■ Special input channel for playback of pre-recorded tape through your music system.

TECHNICAL SPECIFICATIONS

Hum more than 85 db below full output — frequency response flat from 19 cps to 35 kc — record distortion filter — 5 high-level input controls — pickup load and pickup sensitivity controls — automatic loudness control with loudness-volume switch — provision for monitoring right off tape with three-head recorders — new construction for easy panel mounting — beautiful accessory case $9.95*

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A Caution—and an Opinion

SIR:

My attention has just been called to AT HOME WITH AUDIO in the June issue.

Please let me point out the error in the caption in *Fig.* 1 referring to the speaker as a "Klipschorn." The name "Klipschorn" is our registered trade mark, and the object pictured is not our product, therefore not a Klipschorn. It appears the Woofer is Electro-Voice's licensee-built Patrician. The rest of the lash up of drive components belong in a theater where the distortion and peaked response is normally overlooked since the eye, rather than the ear, is the major receptor. As for the midrange mentioned, our tests show substantially no justification for any of the claims made for it. Only direct radiators showed as much distortion.

Naturally we feel it necessary to point out the difference between the alleged "Klipschorn" and a real "Klipschorn."

PAUL W. KLIPSCH,
Klipsch & Associates,
Hope, Arkansas.

(*Our apologies for misapplying the trademarked name. As for the last three sentences in the second paragraph, we believe them to be "one man's opinion." Both the units mentioned in the article are held in high esteem by practically everyone else.* ED.)

Efficiency Again

SIR:

We have noted with much chagrin an apparent basic error made in the EDITOR'S REPORT in the September issue.

We refer specifically to the editorial which treats *in extensio* the padding of loudspeakers to match them in level during A-B audition tests. The statement was made that loud-speaker systems are designed by "chopping off the peaks and smoothing them into the valleys" and that the net result of a very smooth loudspeaker system is that it is inefficient. It followed from that that the conclusion was that low-efficiency loudspeaker systems were indeed smooth.

We disagree. . . . It is intuitively obvious that a loudspeaker system that is 100 per cent efficient can generate no distortion. It will follow from this argument, therefore, that a highly efficient loudspeaker system with smooth frequency response is relatively distortion-free when compared to one with lower efficiency. We have borne this out in laboratory tests and we find that there is no pattern of relation between efficiency and distortion.

It is our contention, therefore, that the EDITOR'S REPORT was, to a large extent, misleading, and we honestly feel based on what we consider to be, and can prove, fallacy. Since we are sure this was not the intent of the editorial, we use the term "chagrin" in our first sentence.

Please be assured that our only reason for writing this letter is that we appreciate the position of AUDIO as a leader in the field of disseminating information on things electro-acoustic. We, therefore, believe that information being disseminated should be as factually correct as possible. We feel that since editorial space was used to this end, an equal space presenting the other side of

(*Continued on page 103*)

Above, you see one example of what many discriminating people have pictured in their minds . . . but have not been able to find. It is a beautifully proportioned cabinet of fine wood, craftsmanship, and finish . . . engineered specifically for high fidelity! This cabinet is designed as scientifically as your amplifier, and, at the same time, its handsome appearance is in keeping with the finest living rooms, in place of inflexible or makeshift installations.

■ There are more than 30 River Edge models, each offering two important features: 1) Scientific design by audio experts, so that components fit properly into their areas, are correctly ventilated, and (in the case of speaker enclosures), the tone is developed according to the best engineering practices. 2) Panels factory cut to fit your choice of components, so that you or your dealer can easily and quickly make the installation.

Model 1636 (Illustrated) with tambour slide-away doors, holds many combinations of components; also available as a matching TV lowboy.

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With the help of your dealer, select from 30 basic styles and 11 finishes shown in the catalog. Then choose your hi-fi components. River Edge will supply your cabinet with all panels pre-cut.

Or

Low cost kits by River Edge

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■ *See your high fidelity dealer, or write for the complete River Edge catalog and dealers' names.*

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A quality-endorsed product of the British Industries Group: GARRARD Record Players, LEAK Amplifiers, WHARFEDALE Loudspeakers, GENALEX Tubes, R-J Enclosures, RIVER EDGE Cabinets, ERSIN Multicore Solders.

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The **New...**

Rondine* TURNTABLES

have set Quality Standards never before available for Home Music Systems

Through the complete concentration of its engineering facilities, Rek-O-Kut was able to develop a turntable design that was to set quality standards never before achieved for home installations. Two models first emerged from this design: the Rondine Deluxe and the Rondine. And then came the Rondine Jr. Model L-34 followed by the Rondine Jr. Model L-37.

These are the

In little less than one year, these Rondine Turntables have made broadcast-quality high fidelity a household experience. These remarkable turntables have succeeded in bringing to home music systems a type of quality that had been previously reserved for broadcast and professional recording studios.

Today, the Rondine is the most sought for turntable on the American market. It has been lauded by leading engineers; it has been praised by critical music analysts; and it has been acclaimed by thousands of music lovers who have had the good fortune to own and use Rondine Turntables in their high fidelity systems.

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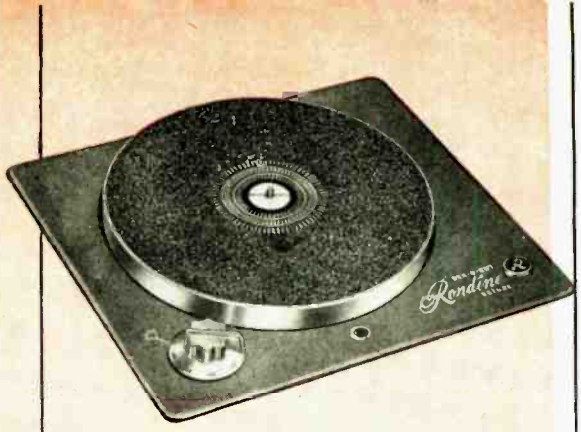
TURNTABLES

Makers of Fine Recording and Playback Equipment
Engineered for the Studio
Designed for the Home

MEMBER AUDIO INDUSTRY MANUFACTURERS INC.

the RONDINE DELUXE

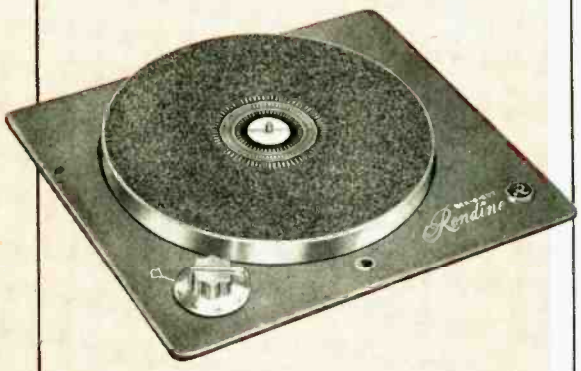


3 Speeds: 33⅓, 45 and 78 rpm

The aristocrat of turntables, the Rondine Deluxe is equipped with hysteresis-synchronous motor. Its speed is absolutely accurate and unvarying. Rumble, wow and flutter are rated better than NARTB* requirements.

$119.95

the RONDINE



3 Speeds: 33⅓, 45 and 78 rpm

Identical with the Deluxe, but equipped with a specially built 4-pole induction motor. Speeds are pre-regulated at the factory. Meets NARTB* specifications for rumble and exceeds them for wow and flutter.

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the RONDINE JR. 2-Speed 'Twins'

Model L-34
33⅓ and 45 rpm

Model L-37
33⅓ and 78 rpm

Both models operate at 2 speeds and are driven by 4-pole induction motors. These motors are the same as those used in the Rondine. These popular turntables meet all requirements specified by the NARTB*.

$49.95 each

** National Association of Radio and Television Broadcasters*

ABOUT MUSIC

A Long Look at the Long Playing Record

HAROLD LAWRENCE*

IN THE EIGHTH YEAR of the long playing record, over 200 companies are in the field, hundreds of artists have made their recording debuts, the tempo of releases is more hectic than ever, advertising claims have reached hysterical heights, and duplication of standard repertoire is proceeding at a rabbit-like pace. The plump LP catalogue seems to offer an attractive and unprecedented array of performances. Yet, after sorting the highly perishable, mediocre, and barely adequate products from the prime, does the choice remainder equal in quality or quantity the glories of the pre-LP era? To the ears of Irving Kolodin in the Prefatory Note to *The Guide to Long-Playing Records: Orchestral Music* (A. A. Knopf), "one fact is immediately discernible . . . The total of great performances now on records is substantially smaller than it was in 1941." Interpretations of Hoffmann, Weingartner, Kreisler, Mengelberg, Rachmaninoff, Chaliapin, Sir Hamilton Harty, Caruso, Hüsch, McCormack, Koussevitzky, Schnabel—a few examples of 78-rpm vintage that come to mind—seem to bear out Kolodin's statement.

Those were the days when the major companies and their international affiliates completely dominated the scene, when a recording session was generally a more thoroughgoing affair, and when the accent was on the performer, not the repertoire. Fortunately, some of these records have been transferred to LP. The most impressive re-release in recent months, for example, was the Schnabel version of the Beethoven Piano Concertos with Sir Malcolm Sargent conducting (RCA Victor, LCT 6700). Although an antiquated recording, the solo-tutti balance is well struck and the piano tone is remarkably realistic. As for the performance, Schnabel displayed a technical and artistic command throughout the cycle that failed to characterize his recordings of the 32 Sonatas. The most notable transfers are drawn from the RCA Victor, His Master's Voice, and to a lesser extent, Columbia catalogues, which for quite a while virtually monopolized the leading performers of the world. Exceptions include Mengelberg's Telefunken recordings. Conchita Supervia's Decca releases, Goldberg and Kraus in piano and violin sonatas, also on Decca, and a large quantity of pre-electrical vocal discs issued by Eterna.

Eventually, we hope, all superior pre-LP recordings will find their way into the current catalogue. Now, looking into the future, how many LP performances would stand a chance of surviving in the next era of recording, whether it be lateral/hill-and-dale, perforated card, or recorded tape on a large scale? Here are some recommendations for LP's Hall of Fame.

Trying to decide between a pair of recordings of a complete opera, each of which contains strong and weak points, would be impossible without employing the point system. The leading soprano in set A sings with perfect intonation and phrases intelligently. Her counterpart in set B, however, captures more of the spirit of the role. The tenor in set A has an unusual dramatic sense while set B's tenor is more restrained . . . etc. It is a rare event indeed when an eminently qualified cast of singers and conductor can be assembled on an operatic stage, or (a far more difficult task) in a recording studio for a fully satisfactory performance, especially when more than four principals are involved. At least eight such events have taken place on LP. Two were derived from "actual performances": Berg's *Wozzeck* (Columbia SL 118), and Wagner's *Parsifal* (London LLPA 10). The first was taken from a concert version of the opera conducted by Mitropoulos and recorded in Carnegie Hall. The second is a composite of several performances given during the Bayreuth Festival in 1951. (Both are remarkable for their well-behaved audiences; coughing and sneezing are at an absolute minimum.) The other operatic nominations are Berlioz' *The Damnation of Faust* (Munch, Victor LM 6114), Mussorgsky's *Boris Godounov* (Dobrowen, HMV 6400), Rossini's *L'Italiana in Algeri* (Giulini, Angel 3529 B), Bellini's *I Puritani* (Serafin, Angel 3502 C), Falla's *La Vida Breve* (Halffter, Victor LM 6017), Wagner's *Tristan und Isolde* (Furtwängler, Victor LM 6700), and on a smaller scale, Cimarosa's *Il Maestro di Capella* (Amaducci, London LD 9118).

In the orchestral repertoire, the LP era has employed the services of a number of conductors who have been around for some time: Toscanini, Walter, Beecham, Mitropoulos, Kleiber, Furtwängler, Monteux, etc. Unfortunately, too little of Beecham's microgroove output is happy in its choice of repertoire or quality of reproduction. By far his finest efforts are on behalf of out-of-the-way pieces such as Bantock's *Fifine at the Fair* (LHMV 1026), Lord Berner's *The Triumph of Neptune* (Columbia ML 4593), and Delius' *North Country Sketches* (Columbia ML 4637). London's ambitious recording of all Vaughan Williams' symphonies conducted by Sir Adrian Boult, under the composer's supervision, deserves high praise. So does Bartók's *Miraculous Mandarin* as con-

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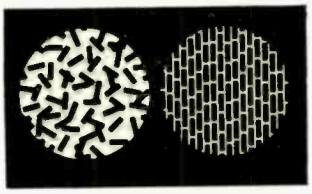

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ducted for Bartók Records by Tibor Serly. The much-abused term, "definitive performance," well describes Bruno Walter's interpretation of the Mahler First (Columbia SL 218). Other definitive performances on LP are Stravinsky's recordings of the *Octet* and *L'Histoire du Soldat* (Columbia ML 4964), and *Pulcinella* (Columbia ML 4830).

An "irreplaceable" in the LP catalogue is Backhaus' Carnegie Hall recital of 1954 (London LL 1108/9) where the German pianist displays all the mastery of his studio recordings with an added sense of concert exhilaration. In the realm of chamber music, the later volumes of Haydn's String Quartets played by the Schneider Quartet (Haydn Society), Beethoven's Quartet for Piano and Woodwinds, Op. 16 with Rudolf Serkin and members of the Philadelphia Wind Quintet (Columbia ML 4834) and Bartók's Sonata for Violin Unaccompanied, brilliantly tossed off by Robert Mann, (Bartók 916) are exceptional recording projects.

A pair of chamber orchestras have contributed some memorable discs to the LP repertoire. They are I Musici and the London Baroque Ensemble. The latter's recording of Dvořák's Serenade in D, Op. 44 (Decca DL 7533) is perfect in every way. As for the vocal literature, the following should be noted down: Lisa della Casa in an ideal interpretation of Richard Strauss' *Four Last Songs* (London LD 9072), Leslie Chabay's warm, sensitive performance of Bartók and Kodály arrangements of Hungarian folk songs, and the idiomatic feeling of the recordings of Mediaeval and Renaissance music by the Pro Musica Antiqua under Safford Cape (EMS).

The above are, of course, merely a few highlights of the long playing record era. These, and others like them, are exceptions in a catalogue where many of the best recordings display abundance of technique more often than profusion of "style," that precious ingredient that characterized the piano playing of a Hofmann, the singing of a Chaliapin, or the flair and authority of a Mengelberg.

Employment Register . . .

Positions Wanted and Positions Open are listed here at no charge to industry nor to individuals who are members of the Audio Engineering Society. Positions Wanted listings from non-members are handled at a charge of $1.00, which must accompany the request. For insertion in this column, brief announcements should be sent to AUDIO, P. O. Box 629, Mineola, N. Y. before the fifth of the month preceding the date of issue.

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$72.95*

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There are some who can look at the composer's notations and 'read' the music, and there are those who can 'visualize' the performance of a high fidelity music system from a set of plotted curves and figures.

Most of us, however, as spectators, must be content with listening. And that is as it should be. Music and high fidelity were both created for our *listening* enjoyment. And we can only enjoy the sensations of sound when we *hear* the sound.

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It is for this reason that we ask you to *listen* to the Goodmans Axiom 22 or Axiom 150 . . . housed in a suitable enclosure and connected to a high quality music system. You are due for a delightful surprise. You will *hear* high fidelity as you always imagined it would sound . . . clean, satisfying, and as realistically faithful to the original as a reproducing system is capable of providing.

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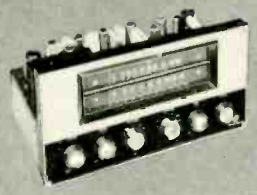
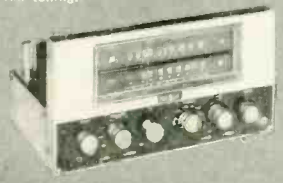


AF-825 FM-AM $129.50

Here is a tuner that offers versatility, performance and price. A sensitive armstrong circuit assures full FM reception—and you have top quality AM as well. Built-in preamp and tone controls make the AF-825 an ideal 'front end.'

AF-850 FM-AM $154.50

Truly a tuner worthy of the finest systems in use. Has a super sensitive FM section as well as broad and sharp-band AM reception. Also features the convenient Micro-Meter for precision FM and AM tuning.



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The finest FM-AM tuner ever offered. Has all the quality features of the AF-850 plus the flexibility of a professional type preamp: dual equalization and individual bass and treble tone controls.

FM-607A FM ONLY $69.50

This beautiful-to-look-at little tuner offers high fidelity performance you'd expect only in a more expensive unit . . . even AFC and Cathode Follower Output. The 'best buy' in the field.

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The AF-724 combines all the FM quality of the FM-607A with high fidelity AM reception. It is the ideal FM-AM tuner for the modest, yet discriminating budget.

TUNER CABINETS $15.95 each

For those who prefer to keep their tuners on open shelves or tables, there is a handsome, Mahogany cabinet available of each model Pilotuner. Can also be obtained in Limed Oak at slightly higher cost.

PILOT is one of the oldest and largest manufacturers of audio components . . . with more than 35 years experience in the electronics of radio and sound. It follows, quite naturally, that the Pilot name should be identified with the finest high fidelity components and component systems.

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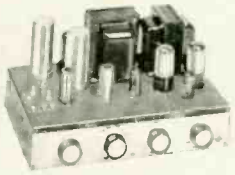
Used with the famous Pilotuners, these quality amplifiers provide matchless loudspeaker performance. Those with built-in preamps can be used directly from hi-fi phono pickups.

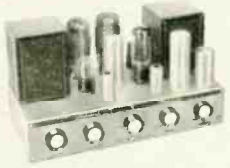
AA-410 $49.50

A Williamson-type amplifier that has gained wide acclaim. Its peak output of 20 watts is ideal for home systems. Low distortion accounts for its excellent listening quality.



AA-903 $69.50

Another wonderful Pilot hi-fi value with 10 watts of peak power and featuring a complete phono-preamplifier as well as bass and treble tone controls. The AA-903 has been selected the 'best buy' in the field.

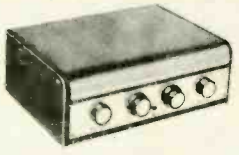


AA-905 $129.50

Represents the very ultimate in engineering skill. Combines a Williamson-type circuit and rugged KT-66 output tubes with traditional Pilot 'know-how' to achieve 45 watts peak output with low distortion. Built-in preamp has full equalization and tone controls.

AA-904 $89.50

A Williamson-type circuit using KT-66 output tubes. Provides up to 30 watts peak power with minimum distortion. There is hardly a system that would not benefit from an AA-904.



AA-420 $99.50

A masterpiece of compactness and performance, this unit provides 20 watts of peak power. Has built-in preamp-equalizer and tone controls. A favorite among those who require quality space-saving units.

AMPLIFIER COVERS $4.95 each

These perforated steel covers greatly enhance the appearance of Pilotone amplifiers. They also protect tubes and other parts. Particularly desirable where amplifier is to be kept in full view.

Prices slightly higher West of Rockies.

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HIGH FIDELITY

3-ON-1 COMPONENT CHASSIS ▼

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For the music lover who is planning a home music system, this unit eliminates virtually all of the wiring and cabinet problems. The HF-56 is 3 components in 1—sensitive FM-AM tuner (with Armstrong FM section), pre-amp-equalizer with tone controls, and Williamson-type hi-fi amplifier capable of 35 watts peak audio power. Any location—even a single shelf—will accommodate the HF-56. Only a speaker system need be added. And, if desired, a record changer or turntable to make up a complete, high quality system. Cabinet optional.

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EDITOR'S REPORT

AUDIO FAIR SEASON

Those of us who enjoy audio shows of any and all types—big ones, little ones, and those which exist throughout the year in the distributors audio showrooms—are beginning to get excited about the prospect of the next few months, for as this issue comes out there is the High Fidelity show in Chicago and simultaneously the Third Annual High Fidelity Audio Show at the Sheraton-Palace Hotel in San Francisco (the Hi-Fi Home Music Show at the Claremont Hotel in Berkeley, just across the bay from San Francisco, having closed on September 25 after its three-day run), and then comes the big Audio Fair in New York on October 13, the New England High Fidelity and Music Show at the Hotel Touraine in Boston commencing on October 21 and running for three days.

Next on the schedule is the Philadelphia High Fidelity Show at the Benjamin Franklin Hotel, November 4–6, and at the same time the First Mexican Audio Fair is being held in the Hotel Reforma in Mexico City.

Practically no one could attend all of them—though some of us try—but the more enthusiastic audio people will get to as many as possible.

The greatest of the shows so far has always been The Audio Fair, and its seventh showing starts on Thursday, October 13 at Hotel New Yorker in New York City. Even though if a manufacturer may not be able to attend all of the exhibits—he is most sure to have his wares on display at the New York show, for that is the place where *everyone* comes, or so it seems. At any rate, it is this show to which the overseas buyers flock in numbers to see what is on the market and to hear the best that the audio industry has to offer. Perhaps many of these "buyers" are actually engineers who come to see and hear what we have so that they might try to better it, but we should be willing to accept this sort of competition—we will gain in the long run, for we will have the better equipment.

No two audio shows are alike—fortunately—and there is always enough of interest and always enough variety to keep us entertained. And among the many thousands of visitors to the shows we are certain to meet many of our old friends—in our own case, we have an opportunity to talk with Audio's readers and hear first-hand what they want in their favorite magazine. So in addition to learning about the newest in equipment, we also glean some ideas which prove of value in selecting material for the magazine. We hear complaints and compliments—we try to eliminate the causes of complaints, and we try not to become complacent about the compliments. In any case, we listen to both equipment and people with open minds with the hope that what we learn from both will be reflected in a more interesting and useful magazine.

FIRST MEXICAN AUDIO FAIR

On our way back from the WESCON show in San Francisco, we "happened" to come by way of Mexico City, since we had heard there was to be an Audio Fair in that city next month. In addition to being entertained most royally, we had the opportunity of meeting most of the audio industry in Mexico, and we find them to be just as enthusiastic about good music reproduction as we are here in the States. For example, the first Audio Fair is to have some thirty five exhibitors—many of whom are displaying U. S. and British equipment, to be sure, but there is a rapidly growing list of manufacturers in Mexico, and even now much of the equipment to be shown is built below the border. We were pleasantly surprised by almost everything we saw—from the architecture to the beautiful women of that city—and while we had no intention of going back for the three days of the show itself, we were forced to change our mind. It is safe to say that the welcome extended to anyone interested in audio would make it well worth while to visit the show—even as a mild excuse to see Mexico City. We have mentioned this to several friends in the business since returning, and some of them are planning to attend. As we are.

POSTPAID REPLY CARDS

After seven months of including reply cards in the back of the magazine, we are convinced that you find this service to be of considerable value, and we thank all of our readers who have availed themselves of the opportunity to request more information with a minimum of effort. Accordingly, this service will be extended with the November issue to provide identification for the display advertising so that it will only be necessary to circle a number to get further information about any of the products that are advertised, in addition to those that are mentioned in the New Products and New Literature pages. This, we believe, will make the service even more useful to you, and will make it so much easier to obtain the desired additional information that still more of you will send in your inquiries. How do we know that you like the service? Simply by counting the inquiries received every month—just over twenty per cent of you have responded. We trust you will continue to show interest in the products of our advertisers, and that as your interest grows your inquiries will mount until one hundred per cent of you ask for more information.

The 3rd Audio Anthology

Many readers will be glad to know that the 3rd audio anthology will be off the presses by the time of the New York Audio Fair. We have been receiving requests for this volume for over a year, and we have finally gotten it put together. Same size, same number of pages, but slightly higher in price—both printing and paper are more expensive now than they were three years ago when the 2nd audio anthology was published.

BRIGGS' LECTURE DEMONSTRATION

There's still time to get tickets for the hi-fi lecture demonstration to be presented by Gilbert A. Briggs at Carnegie Hall on Sunday October 9, at 3:00 p.m. (Note that it is not Town Hall, as announced on this page last month.) Mr. Briggs will be assisted by P. J. Walker, and the music, both live and recorded, will be provided through the cooperation of Columbia Records, Inc. This is the first of these demonstrations to be presented in the United States, and no serious audiofan or music lover should miss it. Remember the date—Sunday, October the ninth, at 3:00 p.m.

THE *fluxvalve* PICKUP

the first really new pickup in a decade

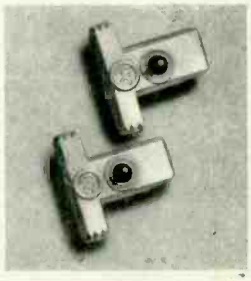
The FLUXVALVE is made by perfectionists — for perfectionists. Literally the cartridge of the future, its unique design meets the demands of all presently envisioned recording developments, *including those utilizing less than 1 mil styli.*

There is absolutely nothing like it!

The FLUXVALVE *Turnover Pickup provides the first flat frequency response beyond 20kc!* Flat response assures undistorted high frequency reproduction—and new records retain their top "sheen" indefinitely, exhibiting no increase in noise. . . . *Even a perfect sylus can't prevent a pickup with poor frequency characteristics from permanently damaging your "wide range" recordings.*

With this revolutionary new pickup, tracking distortion, record and stylus wear are reduced to new low levels.

The FLUXVALVE will last a lifetime! It is hermetically sealed, virtually impervious to humidity, shock and wear . . . with no internal moving parts.



The FLUXVALVE *has easily replaceable styli. The styli for standard and microgroove record-playing, can be inserted or removed without use of tools.*

For a new listening experience, ask your dealer to demonstrate the new FLUXVALVE ...words cannot describe the difference...but you will hear it!

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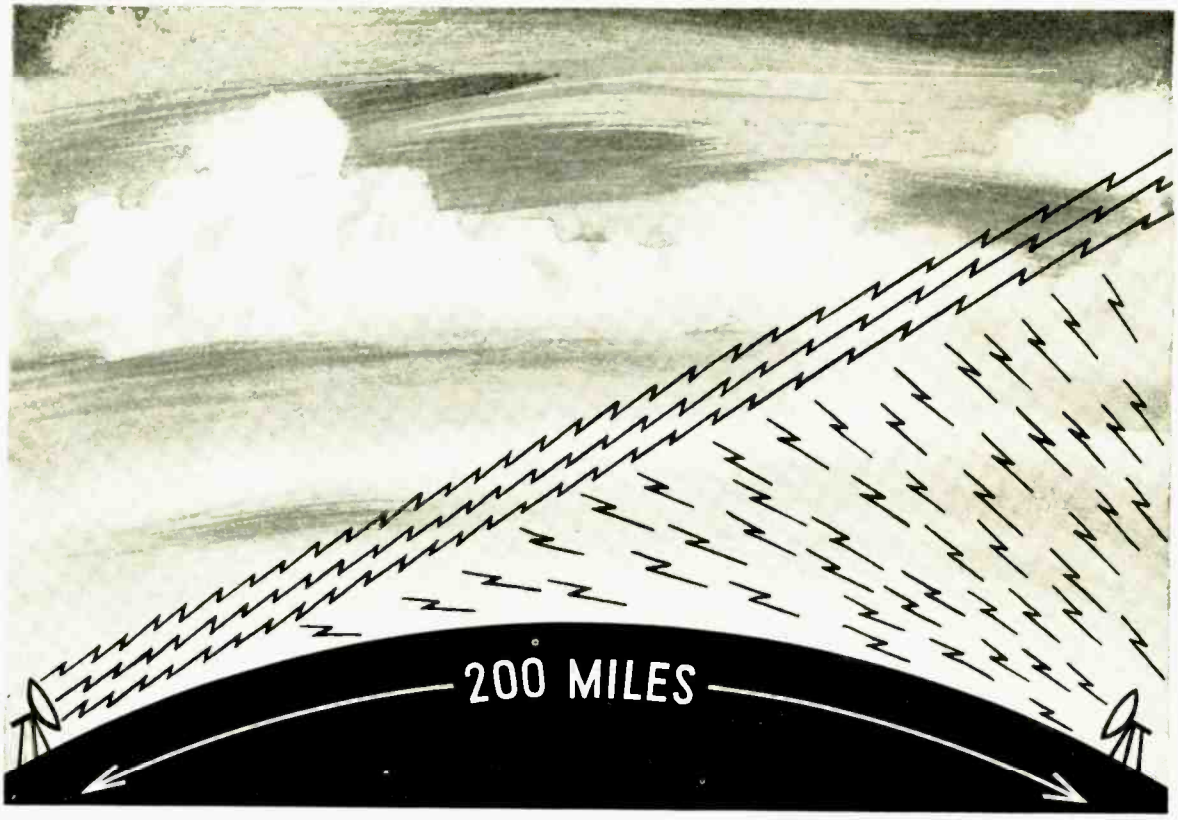
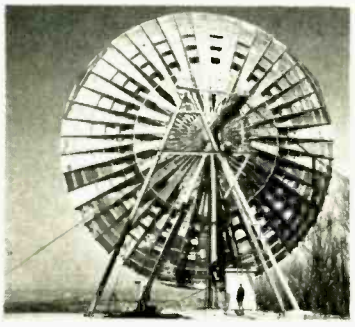


Highly schematic drawing illustrates the possible distribution of energy in ultra-high-frequency "over-the-horizon" transmission. The effect is similar to that of a powerful searchlight whose beam points into the sky. Light can be seen miles away from behind a hill even when the searchlight lens is invisible.

Something new on the telephone horizon



This experimental 60-foot antenna (rear view) photographed at Bell Laboratories in Holmdel, New Jersey, is designed for study of "over-the-horizon" phenomena.

Telephone conversations and television pictures can now travel by ultra-high-frequency radio waves far beyond the horizon. This was recently demonstrated by Bell Telephone Laboratories and Massachusetts Institute of Technology scientists using "over-the-horizon" wave propagation, an important recent development in the radio transmission field.

This technique makes possible 200-mile spans between stations, instead of the 30-mile spans used for present line-of-sight transmission. It opens the way to ultra-high frequencies across water or over rugged terrain, where relay stations would be difficult to build.

In standard microwave line-of-sight transmission, stations are so spaced that the main beam can be used. But now, with huge 60-foot antennas, and much higher power, some signals drop off this main beam as it shoots off into space. These signals reach distant points beyond the horizon after reflection or scattering by the atmosphere. The greater power and larger antennas of the "over-the-horizon" system permit recapture of some of these signals and make them useful carriers. The system will be a valuable supplement to existing radio relay links.

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Cascode Preamp Improves Signal-to-Noise Ratio

M. V. KIEBERT, JR.*

A thorough study of the causes of noise in electronic equipment points to the steps necessary to reduce unwanted disturbances to an absolute minimum.

THIS PROJECT GREW out of a design request to develop a preamplifier suitable for use with the Fairchild Type 215 moving coil pickup. The original pickups had an average maximum output of .003 volts across a nominal output impedance of 60 to 80 ohms (it is understood that with the new type 220 units, this output has now been increased to .006 volts, about half the output of the higher impedance G.E. pickup). The manufacturer also set out a requirement that the preamplifier should, if at all possible, avoid the use of an input transformer (and so necessitated a higher gain system) while being adaptable, without modification, to the use of higher level pickups.

Consideration was given to the fundamental problem of desired and required noise levels. Good discs are now available and turntables have improved to the point where a dynamic range of 50 to 60 db below maximum output, was desirable. This means that a preamplifier to be used with a pickup of .003-volt output must be so designed and constructed that equivalent grid input noise voltage level must be held to no more than 3 microvolts if a 60-db dynamic range is to be accommodated.

Noise in the input stage (aside from hum, microphonics and spurious induced voltages from the filament circuit and/or other adjacent voltages and/or from capacitive charges on the tube envelope and getter surfaces) is due to six principal causes—thermal (Johnson) noise in the grid (input) circuit, tube noise (shot effect), partition noise, flicker noise, "current" noise in the plate load resistor (and perhaps cathode resistor) of the first stage, and spurious transient plate-supply-voltage variations. Under normal circumstances and in the most generally encountered conditions of operation of well designed multistage amplifiers, the first stage noise is the limiting noise source in the system. Hence, consideration must first be given to the fundamental limitations of this stage and the engineering techniques which are under control of the design engineer and which may be employed to minimize undesirable noise sources in this stage.

Other noise problems that must be considered in the final design will, of necessity, evaluate the ballistic and microphonic characteristics of the input stage, as well as problems of stray induced hum and noise voltages. Flicker noise as results from the time-variable evaporation characteristics of electrons from a cathode surface are only under control of the designer insofar as he may select one type of tube class from another—that is, use of a 12AY7 in place of a 6AU6, for example, and then subsequent experimental selection of the minimum noise level tube (most stable cathode surface tube) from a number of tubes of the type used in this position.

"Current" noise in the plate load resistor (and perhaps the cathode resistor) may be kept to a minimum through the use of wire wound, or special, low noise resistors as previously described.[1, 2]

While the basic thermal or Johnson noise and shot-effect noise problems get into the field of quantum mechanics, this problem has been well documented in the literature although minor unresolved points of view still exist.[3, 4] However, a brief outline of the cogent factors may be in order.

Limiting Factors

In any transducer system, such as a microphone or pickup, a certain signal-to-noise ratio is intrinsic to the particular system as determined by the ratio of the transducer (microphone or pickup, for example) signal output voltage to the magnitude of the transducer thermal noise voltage as determined by

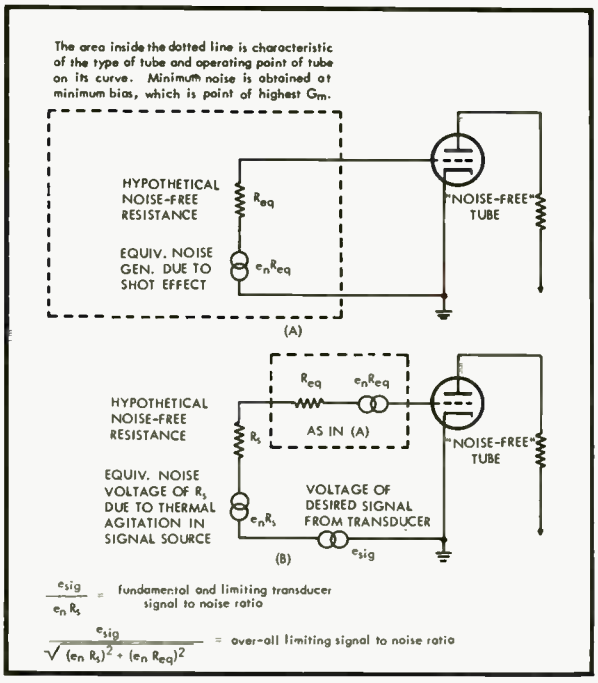


Fig. 1. Equivalent circuits for noise: (A) fundamental limiting tube noise, with zero imput impedance; (B) equivalent noise circuits considering finite input resistance and signal voltage.

[1] M. V. Kiebert, "A preamplifier switching and equalizing unit for critical listening," AUDIO ENGINEERING, Sept. 1952.

[2] M. V. Kiebert, "The Williamson-type amplifier brought up to date." AUDIO ENGINEERING, Aug. 1952.

[3] F. E. Terman, *Radio Engineers Handbook*, first edition, pp. 476–477.

[4] H. J. Woll and F. L. Putzrath, "A note on noise in audio amplifiers." *Trans. IRE PGA*, March–April 1954, Vol. AU-2 #2.

* *Applied Research, Inc., c/o Booz, Allen & Hamilton, 135 S. La Salle St., Chicago, Ill.*

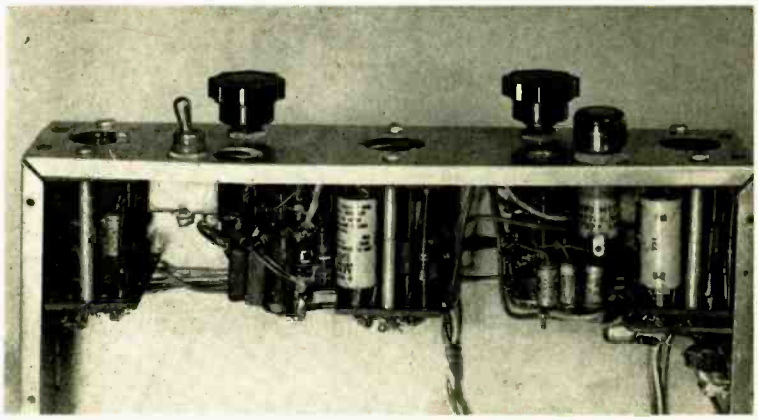


Fig. 3. Preliminary prototype of preamp of Fig. 2.

the resistive component of the signal source (transducer). Using an amplifier following such a transducer, this fundamental limiting signal-to-noise ratio can never be improved (if the bandwidth is held constant), it can only be approached. If the signal output is not large enough to be above the noise generated within the first amplifier tube, a transformer may be used to boost the signal to a sufficient level before it is impressed on the grid. A low signal device will have a small internal impedance (to give an acceptable signal-to-noise ratio) which will allow a large step-up ratio on the transformer to give a correspondingly large signal at the grid. This allows operation at a sufficiently high ratio of signal level to tube-noise level.

Noise is generated in the resistive component of any impedance by the thermal agitation of the electrons. The magnitude of thermal (Johnson) noise voltage of a resistance in temperature equilibrium is;—

$$e_n^2 = 4kTRB$$

where

k = Boltzmann's constant

T = temperature in degrees Kelvin

B = bandwidth in cps.

At nominal room temperature, 63° F. or 17° C., this may be expressed as;—

$$e_n^2 = R\Delta f \ 1.6 \times 10^{-20}$$

e_n = rms noise in microvolts.

A convenient way to express and handle the "shot-effect" noise of a tube is in terms of an equivalent noise resistance, R_{eq}, at room temperature, connected from grid to cathode of an idealized, noiseless, equivalent tube.

The value of R_{eq} for triodes (in conventional or cascode connection) is given approximately by

$$R_{eq} \approx \frac{2.5}{G_m}$$

where: R_{eq} = the equivalent noise resistance in ohms.

G_m = the mutual conductance at operating point.

The equivalent circuit for this is shown in *Fig.* 1. From the foregoing it is apparent that the highest possible mutual conductance at the operating point (a fairly high plate current and relatively low bias voltage) will reduce the shot-effect noise to a minimum. Triodes in common use have published values of G_m at the operating point of from 1000 to 5000 with resultant R_{eq}'s from 2500 to 5000 ohms.

For this particular preamplifier, or for any similar low-noise-level design application, some other generalizations may be made which will provide a guide as to the best design procedures and will give a general clue as to other potentialities which must be considered for a particular design.

Practical Considerations

Pentode input stages provide high gain (approximately $G_m R_L$) and effectively isolate the output from the input circuits but have inherently higher noise levels due to the partition noise caused by division of the cathode current between the plate and screen circuits. Triode input stages have relatively low gain (approximately $G_m R_L R_p/(R_p + R_L)$, and a fundamentally lower noise level because they avoid the partition noise found in screen grid tubes. The undesirable and unavoidable coupling between input and output circuits as resulting from the intrinsic grid-to-plate capacitance is the liability of the triode stage. The effective capacitance resulting from this is increased as the stage gain is increased by employing tubes with a higher mutual conductance and lower plate resistance. Thus it is impossible to get

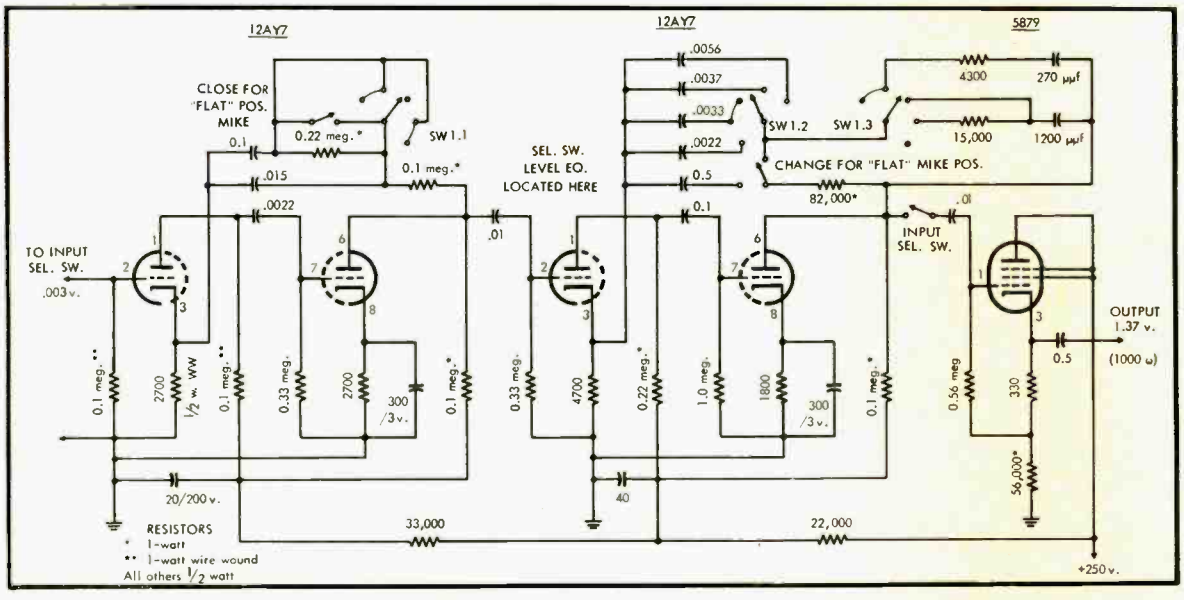


Fig. 2. Original preamp circuit, with input and interstage level equalizing circuits omitted for simplicity.

around this interelement coupling problem so the triode stage is always a low-gain stage if a wide-band frequency response is desired.

The cascode input stage is unique in that it has the general noise characteristics of a triode, provides isolation between input and output circuits comparable to a pentode, and has relatively high gain (which is comparable to that obtained with a pentode—approximately $G_m R_L$). These performance features are achieved at only the cost of another triode section which may be in the same tube envelope as the first triode section. The merits and potentialities of this type of circuit are only starting to get recognition in the audio field, although the circuit has been widely used in radar applications, television tuners, and more recently in television camera video circuits. [5, 6, 7, 8]

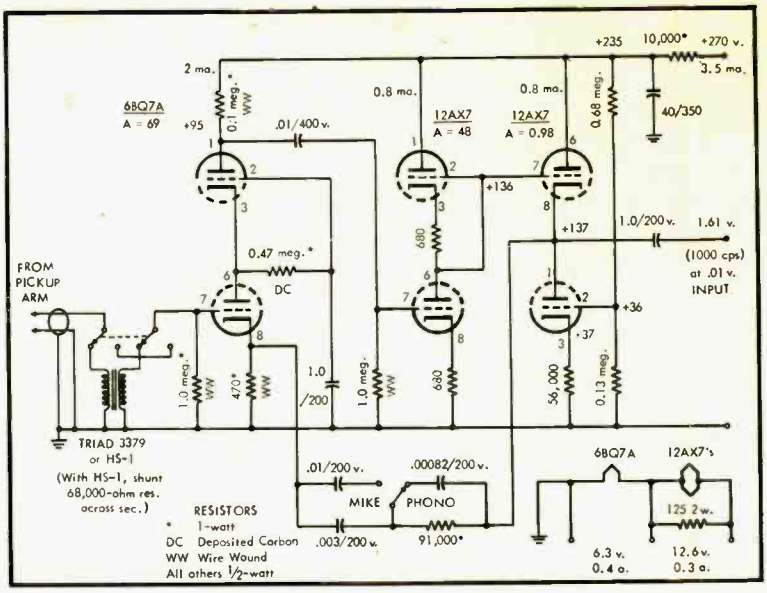


Fig. 4. Schematic of the cascode preamplifier.

Tube Choice

For preliminary consideration of an optimum, specific preamplifier to be used with a low-level, low-impedance pickup, it was assumed that d.c. was to be used on the filaments and that stray hum and spurious (a.c.) coupling was not a problem. A bandwidth of 15 kc was used as a reference and a zero grid input impedance was used in order to evaluate separately the tube "shot effect noise" (the nominal R_{eq}), and separate this phenomena from the input thermal (Johnson) noise. Under this condition of operation, pentode connected 5879's had an average of 3.6μv equivalent-grid-input tube noise (best tubes); while triode connected, they had an average of 2.2μv. The 12AY7 triode (best tube) had a 0.9μv equivalent-grid-input noise under similar conditions—a value more nearly in line with the permitted maximum of 3μv when other noise sources are considered. A cascode stage using 6BQ7A's or the GE 6386 or 5670's (basing different than 6BQ7A) has about 0.6μv,—an even more tolerable level. (The 6BQ7A however, varies quite widely from tube to tube as regards microphonic sensitivity).

Under the above conditions of operation the 5879 pentode had a gain of about 105; when connected as a triode the 5879 gain was about 14; a 12AY7 triode section had gains of about 18 to 26, while the 6BQ7A had gains of about 46 to 70. These gains were those nominally obtained under optimum operating conditions for minimum noise and the required bandwidth.

The final basic tube noise to be evaluated was the thermal noise in the grid input circuit. For a 15-kc bandwidth and a 0.1-megohm source at room temperature (63° F., 17° C.), this noise is about 4.9μv which is obviously above the maximum permissible 3μv limit if the input is .003 volt and a 60 db dynamic range is required. Under similar circumstances a 10,000-ohm source will have a noise of about 1.55μv while a 100-ohm source will have a noise of about 0.155μv. In general if tube noise (shot effect) is the principal limiting noise source, as is generally the case, the over-all system signal-to-noise ratio improves as the signal impedance resistive component increases, *provided this is accompanied by a corresponding increase in signal voltage* as available with a coupling transformer, and further provided that this signal source impedance is at least two times, and preferably four times, R_{eq}, the equivalent noise resistance due to shot effect. If this ratio is achieved, then input cir-

[5] Valley & Wallman, *Vacuum Tube Amplifiers*. McGraw-Hill, pp. 656–660, 1948.

[6] K. B. Benson, "Modified preamplifier improves movie telecasts." *Electronics*, Vol. 26, No. 12, pp. 166–169, Dec. 1953.

[7] Application Note on Type 6198 Vidicon Television Camera Tube. RCA Tube Department.

[8] R. Lee Price, "The cascode as a low-noise amplifier." *Trans. IRE PGA*, March–April 1954, Vol. AU-2, #2.

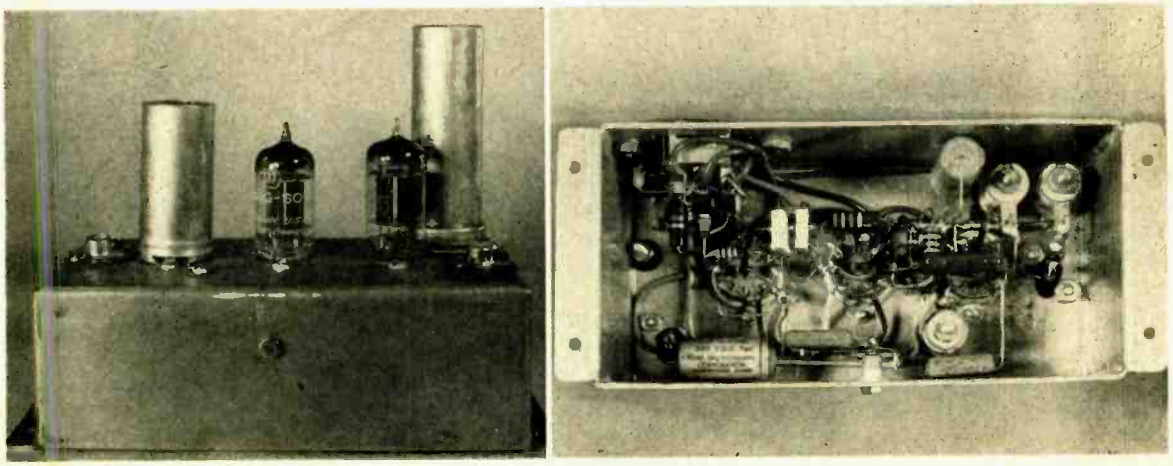


Fig. 5. External and under-chassis views of the cascode preamplifier of Fig. 4.

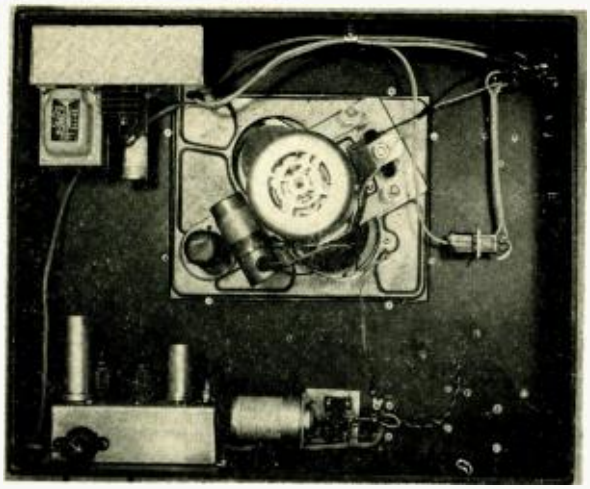


Fig. 6. Installation of preamp and associated power supply in turntable cabinet. Input transformer and switches are located just to the right of the preamp chassis.

cuit thermal noise is not a limiting factor. This, unfortunately, means that low-voltage, low-impedance input devices with the resistive component in the same order of magnitude, or less than R_{eq}, must always employ transformers in order to secure the optimum, or even satisfactory signal-to-noise ratios when feeding into a preamplifier. The use of a low-impedance, low-level signal source not provided with a suitable step-up transformer will generally result in a signal-to-noise ratio ratio limited by tube noise. A high-impedance, low-level signal source will generally result in a signal to noise ratio limited by thermal noise.

Low-impedance pickups and microphones generally have intrinsically satisfactory dynamic ranges when used properly. It is however, always preferable to use a "high impedance" (and higher signal voltage) device as the input source if the use of an input transformer is to be avoided as a means of reducing cost, reducing size and/or reducing susceptibility to transformer hum pick-up from stray magnetic fields.

From the foregoing, it is apparent that either a triode preamplifier or a cascode preamplifier will give the best (and comparable) signal-to-noise ratios on low level signals; that wirewound or special low-noise plate load resistors should be used; and then under these circumstances a residual equivalent-input-stage grid-noise level in the order of approximately 1 to 2μv may be obtained if all other noise sources due to stray hum, microphonics, flicker, line "bumps," etc., are negligible. This all adds up to the fact that a direct input, low-voltage, low-impedance signal source to the grid of a preamplifier is not good engineering design; that only under unusual circumstances and very careful design can a usable 55 to 60 db dynamic range be obtained. Either a higher impedance, higher voltage source or an input impedance-matching transformer should always be used for optimum performance under these circumstances.

For example; a 12AY7 operated under optimum conditions had an R_{eq} of 2960 ohms. When an impedance matching transformer, inserted between a 60–80 ohm pick-up and the input grid of a preamplifier was used with a nominal output impedance of 12,000 ohms, the output voltage was approximately 42 millivolts in lieu of the original 3 millivolts and a potential signal-to-noise ratio (limited by shot effect) was 82 db. When no matching transformer was used the limiting noise level was established by thermal noise and the potential signal-to-noise ratio was 69 db—an obvious marginal and difficult level to achieve when other potential circuit noise sources such as flicker, etc. must also be considered.

Aside from the three foregoing fundamental and limiting sources of input stage noise are other sources of potential noise influence which must be considered in the design of a low-noise-level, high-gain system. These secondary sources of noise which are normally encountered in the design of such a system are:—

1. Flicker effect as may result from periodic variations in cathode emission, a low-frequency phenomenon.
2. Cathode-heater leakage (ohmic) which will couple a.c. components of the filament voltage into the cathode circuit.
3. Cathode-heater capacitance which will couple a.c. components of the filament voltage into the cathode circuit.
4. Tube press or seal leakage which may couple a.c. components of the filament voltage to any tube element. This may occur either as a volume or surface phenomena.
5. Modulation of the electron stream by external magnetic fields.
6. Modulation of the tube electron fields by tube envelope surface charges, which may or may not be additionally influenced by the "getter" deposit.
7. Tube microphonic characteristics.
8. Grid current noise.

Tube selection—that is, use of tubes specifically designed for low level audio use—will practically avoid or at least minimize many of the rather formidable sources of potential secondary noise listed above. Flicker effect, seal leakage, cathode-filament ohmic leakage and grid current noise will generally not be the limiting and/or significant factors when selected tubes, or when tubes of the 1620, 12AY7, 5879, or similar classes of tubes are used. The other items must be carefully considered and a specific design provided for each particular application or installation. Shock mounting, for example, will obviously be required if the tube is operated in any appreciable acoustic, shock, and/or vibrational field.

The effect of heater-cathode capacitance, taking a 12AY7 tube as an example, is to couple approximately 4μv per volt of a.c. component of heater voltage per μμf of capacitance existing between heater and cathode. Grounding or heavy bypassing of the cathode will

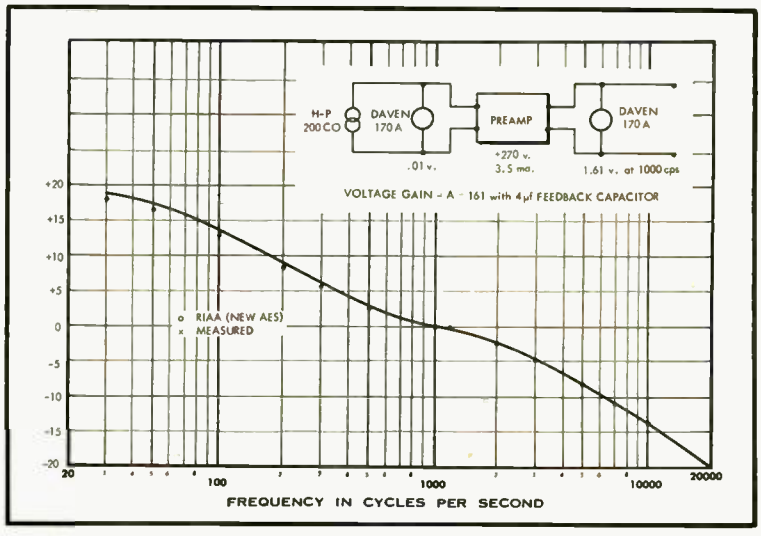


Fig. 7. Required RIAA curve compared with measured response.

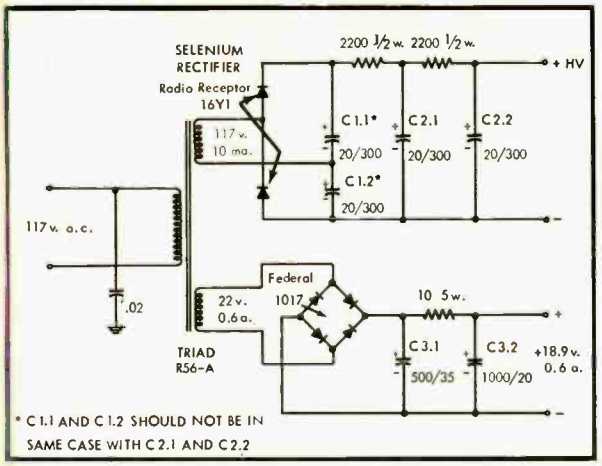


Fig. 8. Power supply for preamplifier and equalizer.

minimize this source of difficulty. The use of a rectified and filtered d.c. heater supply, even though the filtering is not too complete (a residual of 0.3 volt appears to be reasonable and satisfactory) will provide a 20 to 26 db attenuation of hum from this source and readily permit practical use of an ungrounded and unbypassed cathode circuit as may be desirable to provide for some form of feedback, reduce the number of circuit components and/or provide for miniaturization in the preamplifier unit.

Modulation of the tube electron field by tube envelope surfaces charges may be reduced to vanishingly low levels by use of a grounded metallic tube shield.

In order to secure optimum signal-to-noise ratios with low level signals it is essential to avoid "losser" type (*RC* and *RL*) equalization prior to the first-stage grid circuit. It is for this reason that both low-frequency and high-frequency compensation has generally been employed by this author in the same feedback section of the circuit (which makes it easy to use this circuit also as a "flat" microphone circuit by merely adding a 0.1-μf capacitor and a SPDT switch which inserts it across the normally lower capacitance low-frequency equalizing capacitor while simultaneously removing the high-frequency capacitor from the circuit). Feedback equalization rather than "losser" type interstage equalization serves to keep distortion to minimum levels under wide variations in input level. This readily permits use of input voltages of .003 to 0.1 volts in the cascode preamplifier to be described. Use of this type of equalization normally reduces distortion 10 to 20 db at nominal operating levels.[9]

The first preamplifier which the author designed for minimum noise and maximum performance with a triode circuit utilizing 12AY7's, is shown schematically in *Fig.* 2, and a preliminary prototype is shown in *Fig.* 3. This unit has previously been described in detail.[9]

This first preamplifier system was specifically designed for minimum noise, low-level input and for a rather wide variety of equalization curves and input levels. Due to the rather severe low-end requirement of the original AES equalization curve, equalization was divided between two sections, each of which utilized one 12AY7. Due to the use of a following loudness control there was an additional requirement which made it essential that the output level of these cascaded units be held approximately equal when switching between the various inputs of various levels. The first section of this unit has a gain of 34 (at 1000 cps), the second section had a gain of 17. The equivalent grid-input noise level (shorted input) was about 3.8 μv (neglecting the "line bumps"[9] of 10 to 12 db); the "fold-up" point was 12 volts; the design output level was 1 volt, the IM (60 and 7,000 cps, 4:1) was 0.1 per cent at 2 v. and about 0.4 per cent at 4.5 v.

A second preamplifier employing a cascode input circuit was designed and tested. The schematic diagram, showing the operating voltages and currents is shown in *Fig.* 4. The photograph in *Fig.* 5 shows the actual construction. *Figure* 6 shows an installation of this unit, with its associated power supply, in a precision turntable and pickup assembly.

The stabilized d.c. amplifier, at the expense of another triode section, provides a gain of $\frac{\mu}{2}$ and by virtue of its intrinsic stability permits d.c. coupling with attendant reduction of phase shift problems by avoidance of the usual *RC* circuits.

The triode cathode follower likewise requires another triode section but provides greatly increased linearity and improved d.c. stability which is desirable in d.c. coupled applications.

This unit is also unique as regards the low-output-impedance, low-distortion output; the use of a d.c.-stabilized, bridge-type interstage amplifier section, and a d.c.-coupled, linearized cathode-follower stage for the output. The cascode stage is resistance-capacitance coupled to the stabilized, high-gain d.c.-bridge type amplifier. The use of this type of stage permits direct coupling to a stabilized linear cathode follower which utilizes another triode section as a part of its cathode load. This configuration has a "fold-up" point of 32 volts. The over-all gain is 161 (at 1000 cps); the equivalent grid input noise

(*Continued on page 107*)

[9] M. V. Kiebert, "Design of high quality preamplifiers." *J.A.E.S.*, June 1954.

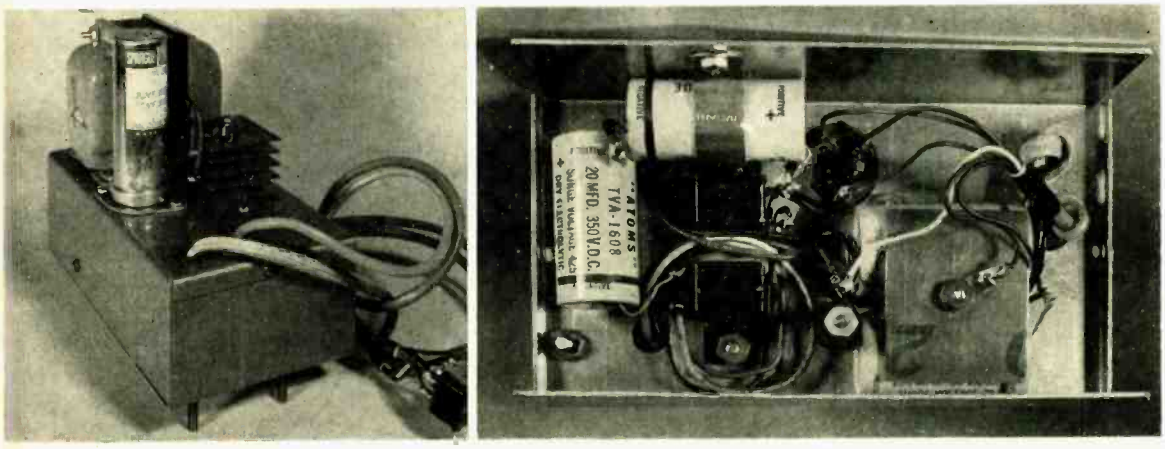


Fig. 9. External and under-chassis views of the power supply of Fig. 8.

at home with AUDIO

LEWIS C. STONE

Fig. 1. Base of audio operations is this suave "powerhouse". The Mondrianic off-center proportioning was determined by placement of hi-fi system units for most comfortable operation.

Fig. 2. The system controls are free of mechanical crowding, control knob bunching or cute disguising. They are mounted in flush furniture-finished panels, easily removable by loosening a few countersunk brass wood screws.

Hi-Fi Powerhouse

A functional cabinet adapted to house a median-cost hi-quality hi-fi system

MESSRS. DIXON AND YATES are not in on this deal, nor is the TVA. There are no kws here, but plenty mvs, dbs, and gauss in this deal. We have set it up to balance out our study, in a recent issue, of a hi-fi system housed in a sort of free association of enclosive cabinetry —"arks" they were called. And whereas that all too casually housed system boasted some of the more elegant hi-fi things (see AT HOME WITH AUDIO, June, 1955) touching the topmost brackets of cost, the subject of this month's discourse is, on the other hand, a system quite homogeneously contained in its "powerhouse" enclosure, *Fig.* 1, with parts that radiate and exude sounds, relatively, of hardly lesser virtuosity, though of more modest cost, as we shall see.

Aural Pedigrees

The actual cost at audiophile net prices is, we believe, a figure neither too high nor too low. Specifically, our man's five-hundred-buck kitty has bought him a rather delectable *smorgasbord* of last-wordish hi-fi components. But what about this "relatively," you say? Here, then, is a rundown of a few of the declared aural pedigrees of the components, which seem to add up to a collective specification of better than passing grade, to say the least.

The 15-watt power-rated 12-inch duplex speaker is the Beam Instruments' Stentorian, will response of 20 to 20,000 cps, bass resonance 35 cps, built-in crossover, two voice coils, and a magnet that weighs 11½ pounds. ($199.50)

The 40-watt amplifier is the "Coronation 100" by Interelectronics; power response ± 0.1 db from 16 to 30,000 cps at 30 watts; over 50 db feedback. Its companion consolette preamplifier-equalizer requires no transformers with all present phono cartridges; offers five input selections, 16 precision playback curves. Bass and treble compensation with over 20 db distortion-free boost and attenuation; hum inaudible with controls on full. ($179.00 for both.)

The Bogen R640 AM-FM tuner has ten tubes plus rectifier, with off-on and band selector switch plus a.f.c. defeat. FM sensitivity 5 mv for 20 db quieting. ($105.50.)

The three-speed record player is the Miracord XA-100 by Audiogersh, equipped with separate spindles for intermixed automatic and for manual operation. Push-button controls, including delay and scratch filter; interchangeable plug-in heads; ball-bearing suspended turntable and tone arm; zero wow and rumble is claimed. ($67.50.)

The General Electric RPX-052 cartridge is fitted with diamond LP and sapphire 78 styli. ($22.50.)

The Klipsch-licensed folded-horn speaker enclosure is the Rebel KR-4 by Cabinart. ($69.00.)

The tape recorder is Concertone 20/20 by Berlant; tape speeds 15 or 7½ ips., dual track; response 20 to 20,000 cps; signal to noise ratio 55 db; three heads with provision for five. Controls: microphone input, line input and playback output, meter indicators for bias current, record level and output level; VU meter, monitoring output, signal mixing variable from line and microphone. ($445.00.)

Microphone is Electro-Voice 950 Cardax crystal; hi-fi output, –57 db; wide-angle pickup at front, reduced sound at rear. Adjustable for flat response or hi-frequency boost. ($24.99.)

Tape slicer is Robins Industries TS-4DLX, semi automatic. ($8.75.)

The cost of the basic hi-fi system (before tape recorder, etc.) comes to around $543.00. A look-ahead additive contributing to the juicier workings of the system, in this case the Concertone tape recorder, adds $445.00, for a total outside figure of $988.00. Putting pencil to paper at this juncture for a bit of camparative reckoning and to see where the economics of the deal is trending, the figures show that our basic system costs barely more than one of the better tape recorders alone. Also, that combined with such a recorder the total cost of the system (as above) is, in turn, equal to the cost of one of those tape recorders approaching broadcast standards (meaning that such a machine would have a separate mixing unit with its own power supply). Total catalog price for that kind of equipment is just over nine hundred dollars for one brand, and about two–three hundred dollars more for another. Compared as to equivalent value, our base cost would seem to be pegged in a median or middle ground—a territory certainly attractive economically but one in which a lot of hi-fi errors of commission and omission are all too frequent. We like to believe (rather than not) that the items we have included in our hi-fi system of the month are a most representative sampling and a fair guide to what is available today offering optimum quality at, as we set out to demonstrate, a middle or median cost.

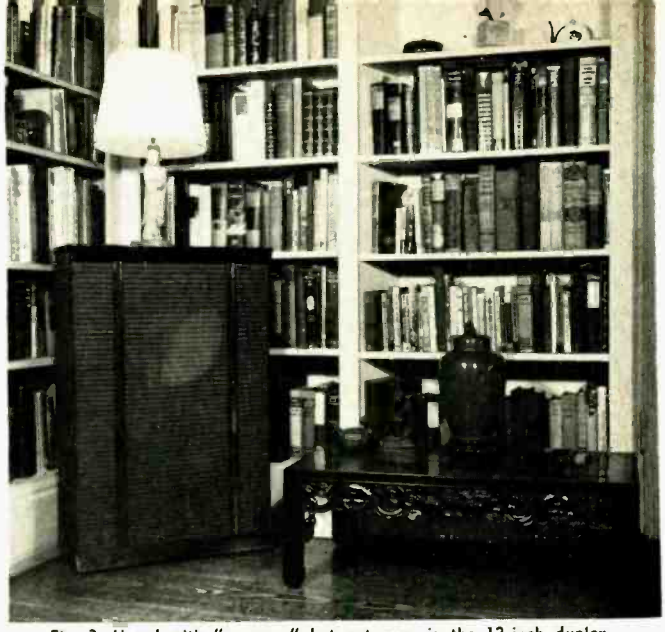


Fig. 3. Heard with "presence" but not seen is the 12-inch duplex Stentorian speaker with 11½ pound magnet. Plenty of excursion for clean lows through Cabinart's KR-4 Klipsh-designed folded horn, and tweetered to highs with separate coaxial-mounted voice coil. (The camera "saw" the speaker, but we are *not* a camera!)

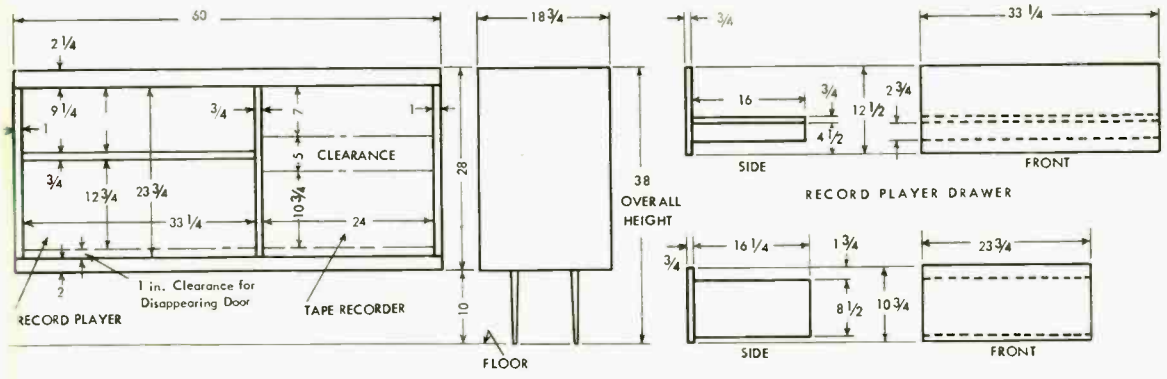
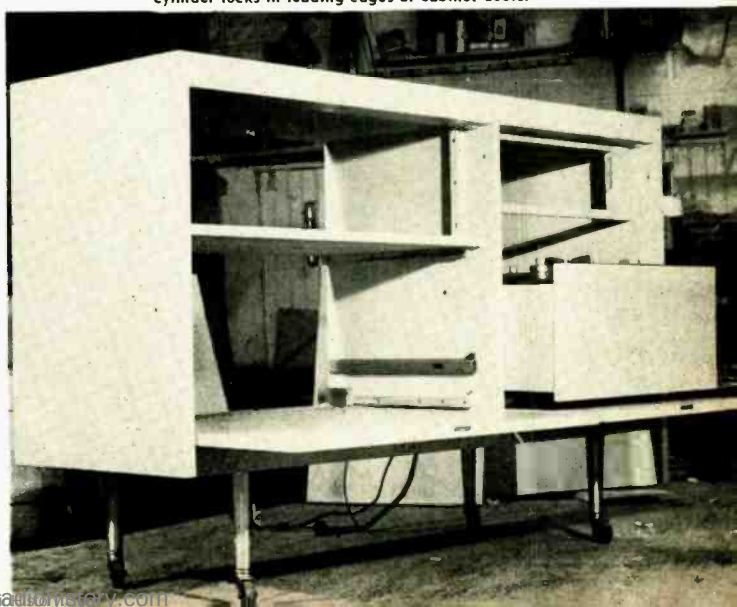


Fig. 4. Doing it yourself with a purpose: The dimensions give the proportions. Working in wood according to sizes shown yields an esthetic of form for the eye and, more subtly, for the ear as well. (Design of Powerhouse Cabinet copyright 1955, Lewis C. Stone)

Fig. 5. Full-size wall cabinet with convenience of chair-side operation. Near compartment shows framing for panels to house tuner, amplifier and preamplifier (top) and below, space for the record player platform. Note side-mounted track for latter, also below it, guide for sliding door. Draw-out with tape recorder in place, in far compartment, with framing and panel set in above it for amplifier. All parts are glued and secured with brass wood screws; joints are mitred, reinforced with corner blocks. Brass legs are caster-mounted for mobility. Note flush-mounted cylinder locks in leading edges of cabinet doors.



Going Places with Hi-Fi Placements

Exactly why your dedicated hi-fier is so willing to take a flier in audio "futures" we do not claim to know for certain. But we can try guessing at a few possible reasons. For one, there's his (and our) fascination with mechanical and electronic devices. Love of gadgets and novelties enters the lists too, alerted as that makes us to the *yonder* newest thing even as we decide on using the *hither* one, for who can guess how long. It is a healthy climate of change. Many a new product, like as not, comes on the market with an abruptness that often belies its slowly evolving origins in abstract and basic research. It takes years and years of search and research—for that is essentially the process—to come up with something new and acceptable. And there's no telling how many audio engineers may now have on their boards the embryo of that new concept in amplifiers, or

speakers, or means of recording sound and of "picking it up."

No wonder, then, that in a fast-moving field like audio, your hi-fier is like a fire-engine buff who must ride fast to every ringing of the bells of change and innovation. He is the worshipper in the temples of, as our economist friends term it, superinduced obsolescence. He is the hardy perennial buyer of "change;" he is the one that gives that newer thing its chance by proving it in use as he hi-fis at home with audio. In the devising of our basic cabinet we have given this phenomenon due weight. The instrument mounting panels are removable without in any way affecting the cabinet's format or finish. (*Fig.* 2.) It can readily accept that different front end, power source, tape or record player, tuner, etc., if and when these have been improved enough to justify the change, and are available at an affordable price.

Anatomy of Hi-Fi

It is our pleasant, though somewhat reluctant, speculation that the anatomy of hi-fi is an object of inventive evolution, and no amount of "frozen" components can consistently be satisfactory as, regrettably, the frozen ones cannot for long be equal to the progressive offerings of an industry that is fairly boiling with the creation and re-creation of hi-fi media for spirit-lifting home entertainment. It seems that the hi-fi "conscience" can brook no stoppages of the free flow of ideas that ceaselessly shape the better, out of today's perhaps merely adequately good, for the buyer of hi-fi component equipment. Hence, the structure of our cabinet has this virtue of adaptability.

Our guess is that the incidence of certain makes of equipment in a good hi-fi system seems to run a gamut of comparative quality not much greater than that from A to B or maybe C. There are numerous worthy makes, many individual preferences. But the young "turks" as well as the elders of hi-fi are generally as one in subscribing to the stylish offerings of the currently many-time winners among the thoroughbreds of home audio instrumentation. For some of us the changeovers in brand loyalties—if any—come about slowly if at all, inspired as they usually are by either a friend's later installation, or exposure to other brands seen at successive Audio Fairs, in audio merchants' salons, or described in a publication, or by our own sharpened *critique*, and the like. At any rate your hi-fi stalwart moves along from his original basic four- or five-unit system to acquisition of "better" and more units for, up to a point, what he considers his ultimate destination in star-studded earfuls of joyous perception. For the likes of him (and aren't we all?) a good hi-fi system, a well-rounded system, is like a little colossus poised astride radio broadcast reception on the one leg, and home music generation on the other. This "creature" offers in the compress of record or tape or broadcast band, the substance of whole orchestras of instuments, ensembles of voices. And these recordings, only inches-big are played on or through mechanisms also measured in inches; in turn they are mounted and interconnected within that inch-dimensioned Music Hall in miniature—the well-devised hi-fi cabinet, with speaker separate, but far from aloof. (*Fig.* 3.)

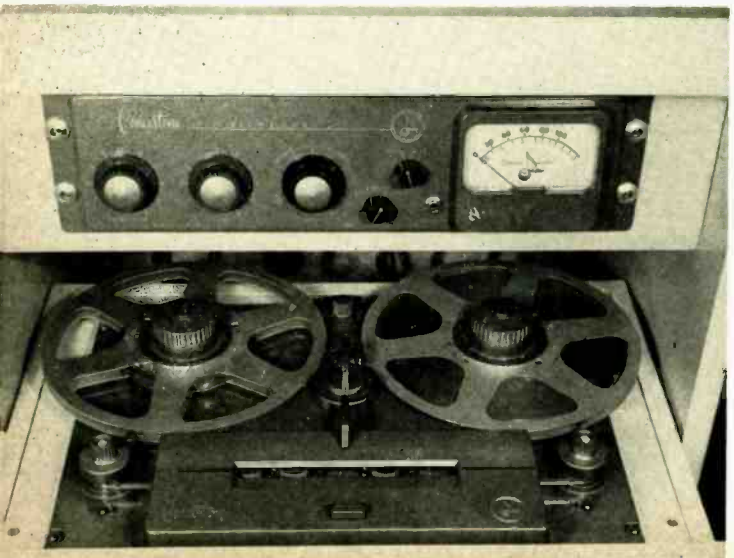
Fig. 6. No Tin Pan Alley is this vista of audio instrumentation, but rather a *Rue de la Hi-Fi*. Space alongside automatic record player is provided for addition of heavy-duty turntable in future. Control panel is recessed for knobs to clear doors when closed. Note spring catch in near edge of door.

Re-creation, and Recreation Too

But, we say, measured in inches *generously*. As given in the sketches, *Fig.* 4, the dimensions of the "powerhouse" are 60 inches long, 18¾ inches deep, and 28 inches high. Plus 10-inch supports, the total height is 38 inches which, for the average person, places the top of the cabinet just about below the bent elbow. The top is a fixed flat surface, not a lift-aid. On it we have seen the comfortable handling of records or tape reels or tape splicer; the selected ones finally being placed on the projecting ends of the "platform" sliding doors, which serve as shelf or side table, being always level and firm because of the solid way they have been mounted to slide freely in and out. From full "out" position they swing upward on full-length brass piano hinges, closing to with small spring catches set flush into their side edges, to cover and conceal the hi-fi controls. When these doors are locked (with cylinder locks) they protect the system from undesirable handling or tampering, whether by grown-ups or children. Like a precious car is said to keep best if it is one-man driven consistently, so it appears to be with what is in its way and on its scale, the similarly precious hi-fi equipment.

The housing is a wall cabinet in build and stature, but in addition is a comfortably workable chairside hi-fi system. In fact the placement and disposal of the equipment and the components were planned for this kind of flexibility in operation, and the comfort levels were determined with the aid of a person seated on a plain kitchen chair (seat 17 inches above floor) alongside of the first framing-out of the cabinet and before all the innards were placed. (*Fig.* 5.) The same factor influenced the final height of the legs of the cabinet. They could be not longer than 10 inches over-all, including sizable heavy-duty ball-bearing casters for mobility. In a small city apartment heaven only knows what the "layout" might turn out to be as a growing family twists and turns in its confines, hedging to gain an inch of space here, another there—and where, it is only fair to ask, would

Fig. 7. Operation of tape recorder from seated or standing position has been designed into this placement of its components. Panel for amplifier is removable by taking out screws blind-mounted from the rear. Transport unit board comes out when four wood screws (two shown) are removed. Note round venting holes in back panel, just behind the 10½-inch reels.



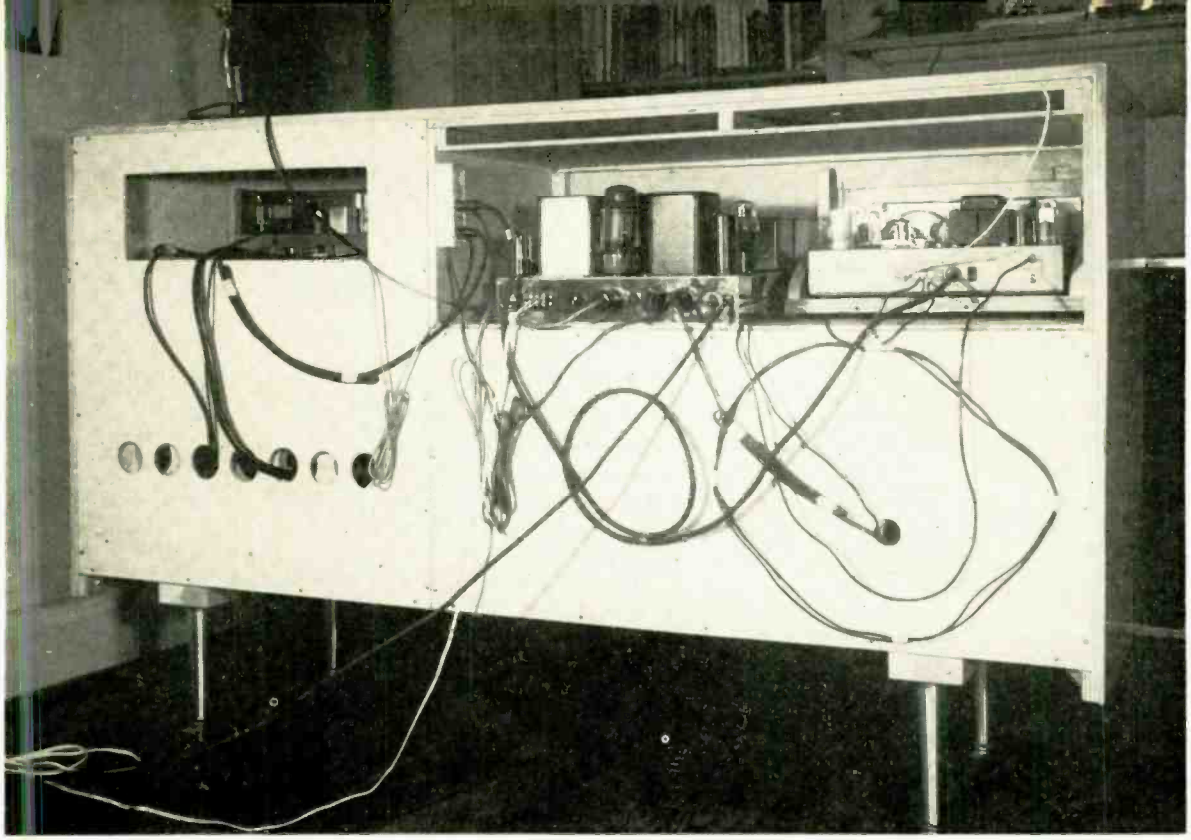


Fig. 8. Rear of "powerhouse" is finished in Korina veneer same as the front and sides. Only two leads trail to floor—the power cable to house-outlet and twin leads to speaker. Large coil at right is AM antenna; FM antenna is carried up from tuner and stapled to framing above air-vent compartment. Round holes at left bottom are for ventilation; port at top gives desirable flue effect, also access to tape recorder amplifier. Note wood screws catercornered showing placement of corner blocks beneath for rigid framing.

that get them if *all* the furniture were not free-swinging, *a la* a Calder mobile (confined to quarters, but in motion) —at least? The two pairs of legs were fashioned from stock 12-inch ones, brass-plated over cast aluminum with integrally-cast mounting plates. They were cut down at the narrow end of their taper to a length of 7½ inches, wood blocks then being wedged inside through the top down to the now larger opening at the bottom, wide enough to accommodate and fix solidly the ferrules of the heavy casters, which in themselves measured the necessary 2½ inches high to bring the total height of the supports back to the required 10 inches. All of this has contributed to the final dimensions and determined the final operating levels or positions for the various components of the system. The controls for the tuner, main amplifier and the tape recorder amplifier are all aligned in tandem just about below shoulder height of a seated person. Both the tape recorder transport and the automatic record player are, on the other hand, just below the level of the bent elbow of the seated figure —which is something this department has been advocating as a desirable tiring-proof working level for most operating steps around audio at home.

The Versatile Powerhouse

Preplanned specifically to house hi-fi equipment, it is also adaptable to change. Like one of these ranch-type homes so popular today, it has its equivalent of an expansion attic, in the sense that voids have been built into the design for the accommodation of future arrivals and additions to this hi-fi family. (The tape recorder is one such "future," but has been included here to demonstrate the validity of the basic cabinet design.) Note in *Fig.* 6 the unbroken area provided alongside of the automatic record player—some 19 by 20 inches of space—which is plenty and to spare for the future addition of one of those stable, heavy-duty turntables of this man's choice, plus a choice of any one of a number of fine quality pickup arms and their proper cartridges. Not that the roles of automatic or manual turntables are not interchangeable in this particular hi-fi *menage*. "Serious" listening can be enjoyed with either

(*Continued on page 100*)

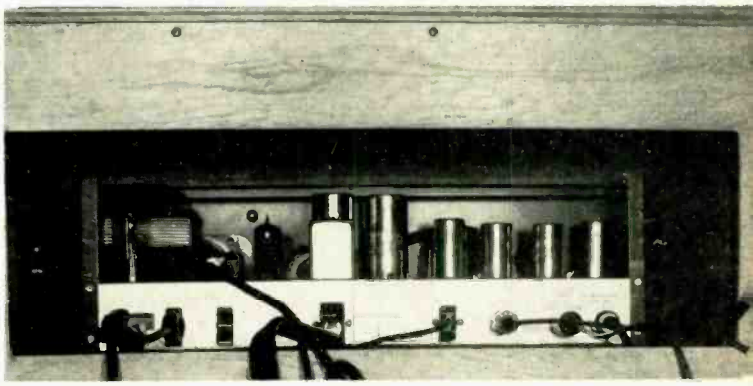
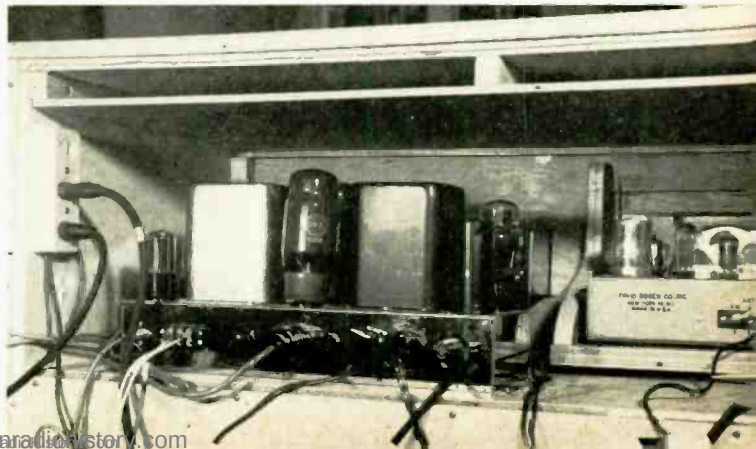


Fig. 9. Rear skirt of tape recorder amplifier shows output, live microphone input and bridging input, enabling variable signal mixing from line and microphone.

Fig. 10. Heat from tuner and power amplifier is carried off in air space near top. Note that all parts are secured with screws. Three-outlet receptacle at left is "sub-station" powered from outlet in main amplifier, accommodates leads from record player and tape recorder, avoiding jungle of wires around house-outlet. Tuner is cradled on bracketed shelf for stability and better ventilation. Note one of the two KT66 tubes in power amplifier.



The Record Dealer Views the Stylus Problem

SAM GOODY*

The grass isn't always greener on the other side of the fence—the dealer has some arguments in his favor. The author—who undoubtedly sells more phonograph records per year than any other dealer in the country—tells his side of the story.

THE ADVENT of the long-playing record has proven a boon both to the record buyer and to the phonograph record dealer because of certain unique advantages this speed has to offer. We know that the long-playing record has musical continuity, consumes considerably less space, has the advantage of safe portability and, most important for the purchaser today, gives excellent sound reproduction. This last factor has been the most widely publicized and the most eagerly accepted, until record sales on LP's have amassed figures which have reached an all-time high. But with the fantastic number of records sold and the publicity about LP records, one negative factor stands out like a sore thumb, yet it has been consistently and continually overlooked by the entire record and equipment industry. This is the problem of the *alleged* defective record. This problem has grown to the proportions of a plague which has descended upon the record retailer and in some measure upon the manufacturer and which by the inevitability of the customers' ignorance has destroyed a large share of the good will created by this remarkable product, the long playing record.

* *235 W. 49th St., New York 19, N. Y.*

I, myself, realize and will concede that there are defects on some records and, concomitantly, that all records are not perfect. However, a record which is defective can be proven to be such beyond a shadow of a doubt. In the early days of LP production (circa 1949/50) there were a number of pressings made with deficient stampers. However, with the inspection systems now employed by the record companies, it is virtually impossible for a run of defective records to escape the sharp eyes and ears of the inspectors. Every fiftieth or so record coming off the press is subjected to a complete examination in a search for defect. So rare are these actual deficiencies that many of the record manufacturers now refuse to accept merchandise returned as defective hy the record dealers.

In using the word *defect* I am not dealing with the obvious, easily detected blemish generally caused by mishandling or created by abrasive substances found in the record sleeve, but mainly with deficiencies which are caused by faulty or badly worn phonograph needles. One of the positive aspects of my company's business policy and one which attracted an unlimited number of record buyers to the new speed was our policy of permitting the customers to exchange any LP record without question. It was not until I had totaled the sales for one day, and examined our defective record returns (which were always sent back to the factory under the manufacturer's guarantee) that I noticed that the total of returns for that day nearly equalled the entire day's sales. You do not have to be a particularly shrewd businessman nor inordinately suspicious to realize that this large quantity of returns could not all be defective. Either our customers or the records were at fault and I decided to attempt to unravel this knotty problem.

It has always been prime policy in our shop never to permit the auditioning of records on the premises. To further this aim we made sure that no phonograph was ever available which might be used for this purpose. My feeling is that only one playing of a record is sufficient to convert a brand new record into a used commodity. Permitting the records to be played on the premises would invalidate my policy of selling only factory new merchandise. In order to check more closely on records being returned with purported defects, we installed a high-fidelity phonograph. Customers returning these records were politely asked to point out the nature of the fault and the approximate area on the record where such claimed blemish existed.

Needless to remark, many of my customers were taken by surprise, and some even struck an indignant pose when this new policy was instituted. However, the majority agreed that we were justified in checking the record to discover the defect in order that they might procure a satisfactory replacement. Both customer and ourselves were continually amazed, after checking, to find that there was nothing wrong with many of the records; that they tracked perfectly, neither sticking nor jumping grooves. The customer had, perforce, no alternative but to reclaim his original record. But still they kept coming in with other records that did not play properly and no matter how often replaced were still not satisfactory to the customer on *his* machine. Logic indicated that since the only portion of the phonograph that came in contact with the record was the needle, then this tiny object must be the culprit. And so we set to work to try to evolve

(*Continued on page 95*)

"Ten watts at least."

Reprinted from AUDIO—August, 1954

Equipment Report

C. G. McPROUD

MIRACORD "MAGIC WAND" RECORD CHANGER

It is probable that the designer of a record changer considers that amplifiers are "Rube Goldbergs" compared to his simple products, but most of us who profess to understand amplifiers are amazed by almost any record changer. The new Miracord XA-100 has a number of features which are new to the changer field, but which result in an interesting and efficient unit.

Foremost of the features is the "Magic Wand"—a device which handles 78's and LP's in the same manner as 45's are handled—from the center hole entirely. And it works, too—consistently and reliably. This device, which readily lifts out from the hole in the center of the turntable, takes a stack of ten to twelve ordinary records, holds them carefully balanced on its small spindle, and drops them as required—one at a time. And when there are no more to drop, the pickup arm returns to its rest and shuts the motor off. The Wand is actuated from below, and is held in place only during a change cycle; any other time it can be removed to facilitate taking a played stack off the turntable. It takes 10- or 12-inch records, intermixed as desired, and plays them all properly—the one requirement being that all are of the same speed and stylus type.

If, however, you should not want it to operate as a changer, you simply remove the Magic Wand and replace it with a short spindle, conveniently held in a clip which you mount on the motor board. Then your Miracord becomes a single-play turntable to all intents and purposes, for you can move the pickup arm at will, yet the motor still shuts off and the arm returns when the record has finished playing.

When you want to repeat a 10-inch record a number of times, you turn the short spindle over and replace it in the hole; then the device plays the record over and over as long as you leave it turned on. And while it does not say so in the instructions, a toothpick judiciously placed in the slot alongside the record scanning lever will cause the changer to repeat 12-inch records indefinitely.

For 45's, a large center spindle works in the conventional manner, the arm dropping at the 7-in. diameter so long as the speed control knob is set at 45 r.p.m.

Push Button Controls

The operation is controlled by four push buttons—START, FILTER, PAUSE, and REPEAT, for repetitive operation. The START button commences the operations once you have placed the records on the spindle and set the speed control knob to the correct r.p.m. The REPEAT button inaugurates a change cycle without causing the record to change. The FILTER button places a load resistor across the pickup to lower high-frequency response. If the unit is being used with a modern amplifier with adequate controls except for the absence of a sharp cutoff the resistor could be replaced with a capacitor and resistor in shunt to provide a cutoff at any desired frequency. Another possible use would be to cut in a different load resistor if two different types of pickups were used interchangeably; or by adding some series resistance in the pickup shell from a new type ceramic pickup and a different shunt resistor for level-adjusting applications. In short, another single-pole single-throw switch is available for whatever use the owner might wish to put it.

But the PAUSE button—that's another story. As you depress this one, the number in a small hole back of the buttons changes. In the "0" position, the changer operates with its normal cycling time—5 seconds for 78's, 9 for 45's, and 12 for LP's. If you depress the PAUSE button once, the number "1" appears in the opening and the cycling time is multiplied by seven, approximately. Depress it again and the number "2" appears in the hole and the cycling time is multiplied by two times seven, still approximately. In the "4" position, the pause between successive playings is 328 seconds for LP's, 140 for 78's. Thus you can adjust the interval between records to as much as 5½ minutes with LP's, which many people find a great convenience when using the phonograph for background music.

The turntable runs on a ball suspension, and rumble was measured at less than 3 db higher than a comparison single-play unit. No wow was detectable on 78-r.p.m. piano records played at 33⅓—a test which appears to be quite indicative of any wow whatever in a turntable.

The pickup is carried in a plug-in head, and stylus force can be adjusted by means of a knurled nut under the arm and just behind the pickup head. Pickup output is shorted during the change cycle, and a resistance-capacitance filter eliminates pops from motor starts and stops. With stylus force set at 6 grams on a single record on the turntable, it was again measured with ten 10-in. records on the turntable, and was found to be within one gram of the original setting. Electrical connections are so arranged that a shielded pair can be used to connect to the pickup, if desired, to reduce hum pickup in the leads over that single shielded wire.

The changer is attractively finished in maroon enamel with contrasting white push buttons, speed control knob, and turntable mat, which is of molded rubber with projections on the under side to engage holes in the platter, and with concentric grooves on top to give a firm grip to the records. Also molded into the mat are three gear-like projections which make positive engagement with the bottom of the 45 spindle to prevent slippage.

The four-pole motor is located well away from the pickup arc to avoid induced hum, and is effectively shock mounted to reduce rumble to a minimum. The motor is started and stopped by a switch in the pickup arm rest, and a spring clip holds the arm against the rest to protect the pickup from accidentally being pushed off and damaged.

A Precision Instrument for BOTH Manual

MIRACORD XA-100

with PUSHBUTTON CONTROL and the "MAGIC WAND" SPINDLE

2 Precision Instruments in ONE:

(1) PUSHBUTTON AUTOMATIC RECORD CHANGER

(2) PUSHBUTTON MANUAL RECORD PLAYER

Here is a truly magnificent accomplishment in the high fidelity field — the two-in-one Miracord XA-100. Tested and enthusiastically approved in laboratory and home, the Miracord XA-100 is unequalled in both quality and performance.

Every element desired by the critical listener was considered: simplicity of operation, made possible by Pushbutton Control; unhampered record reproduction; the heavy duty 4-pole motor in hum-free mounting means no wow, rumble or hum; gentle treatment of your records with the exclusive "Magic Wand" Spindle; and finally, beauty of design in an extraordinarily compact unit.

That is why it is not surprising that the Miracord XA-100 is the world's most preferred record changer.

EASY OPERATION — 4 PUSHBUTTON CONTROL

The touch of a button starts the smooth, silent action. The "Magic Wand" Spindle releases records gently — not a pusher arm or stabilizing plate in sight! Now you can enjoy hours of continuous music — with the *pause* YOU want between records. Or insert the single-play Spindle — your MIRACORD becomes a manual player! Muting switch eliminates "plop". At the end of record play, the arm returns to rest and sets down.

SPECIFICATIONS: For AC current, 110 or 220 volts, 60 cycles. 50 cycles can be furnished if specified. Chassis, 12½" x 10¼". Height above mounting plate 2½", below mounting plate 2¼". Clearance above mounting plate 4⅛", below mounting plate 2¾". Net weight approximately 11 lbs. Gross weight approximately 14 lbs.

SHIPPED COMPLETELY ASSEMBLED WITH ALL PLUGS AND LEADS ATTACHED READY FOR OPERATION

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Audiophile Net **$67.50**

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COMPARE THESE UNEQUALLED OUTSTANDING FEATURES:

The

"MAGIC WAND"

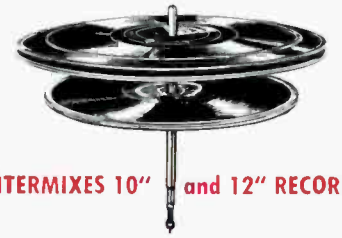
Gently Releases Records Horizontally and Safely

- NO PUSHER ARMS
- NO STABILIZING PLATES
- INTERMIXES 10" and 12" records regardless of how stacked.

Undue load on the record stack and pusher arm friction are eliminated. Prevents enlarged center hole and the distortion that results. PROLONGS THE LIFE OF YOUR PRECIOUS RECORDS.

THE SINGLE PLAY SPINDLE

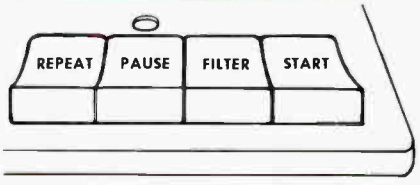
comes with puck for 45 rpm play. A spindle for automatic 45 rpm play is available as an accessory. By inverting the Single Play Spindle you have continuous record repeat on a 10" record!



INTERMIXES 10" and 12" RECORDS

"MAGIC WAND" allows 10" and 12" records to be intermixed. Changes 10 or 12 inch records in a single record stack. Extremely simple to load. Records can be replenished at any time — even during playing.

CAPACITY . . . Holds eight 12" records; ten 10" records (or a corresponding mixture of both) or ten 7" records.



EASY PUSHBUTTON CONTROL

4 Pushbuttons Control All Operations:

- REPEAT: Allows record to finish, then repeats without dropping new record, or any portion of record can be repeated.
- PAUSE: Adjusts wait period between records.
- FILTER: Screens out surface noises caused by old records — only the music comes through.
- START: Starts operating. Push START button to reject . . . permits record change at any time.

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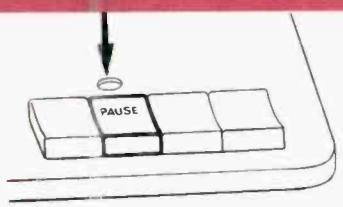
and Automatic Reproduction of ALL Records

Perfection

FITS PERFECTLY INTO YOUR VARYING MUSIC PICTURE



"PAUSAMATIC" INTERVAL CONTROL

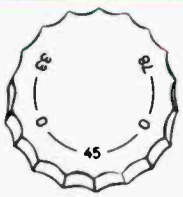
Automatically regulates wait period between records. Adjustable as follows: 78 rpm adjusts from 5 seconds to 2⅓ minutes; 45 rpm from 9 seconds to 4 minutes; 33⅓ rpm from 12 seconds to 5½ minutes. The interval selector is located directly above the PAUSE button.

Heavy Duty 4 POLE MOTOR

With constant turntable speed insures correct pitch.

- NO WOW
- NO RUMBLE

Mounted in vibration-free ball bearings, totally screened to prevent outside interference.



ONE KNOB CONTROLS ALL THREE SPEEDS

A simple turn of the setting knob sets the speed desired. No other adjustments or settings necessary.

NOISE REDUCING TONE ARM

The Tone Arm is constructed of special noise-reducing plastic and suspended in ball bearings. Eliminates stylus displacement and guarantees equal stylus pressure.

INTERCHANGEABLE PLUG-IN HEAD

Allows use of all standard and turnover cartridges. Simple thumbscrew easily adjusted to compensate for any change in cartridge weight.

BEAUTY! COMPACTNESS! EFFICIENCY! VERSATILITY!

Miracord's base measures only 12½" x 10½". Comes in rich, gleaming Burgundy with white trim, white rubber-matted turntable.

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MIRAPHON XM-110 ..... *Manual Player*

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A specially designed four pole motor with a high constant speed factor is mounted in vibration free ball bearings totally screened to prevent outside interference.

The tone arm is constructed of damped plastic and is suspended in ball bearings thus eliminating displacement of stylus and guaranteeing equal stylus pressure. Beautifully finished in rich Burgundy with white trim. White rubber matted turntable. Chassis 12½" x 10¼".

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OUTSTANDING FEATURES

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- ★ Plug-in head to accommodate users choice of cartridge
- ★ Minimum needle pressure with adjustment screw to compensate for cartridge weight
- ★ Tone arm of specially developed noise reducing plastic
- ★ Three-speed drive for 33⅓, 45 or 78 rpm
- ★ Specially constructed 4 pole motor with hum free mounting, absolutely free of outside interference
- ★ Specially balanced turntable — white rubber matted
- ★ Silent Automatic stopping

SPECIFICATIONS

For AC current, 110 or 220 volts, 60 cycles. 50 cycles can also be furnished if specified. Chassis, 12½" x 10¼". Clearance above mounting plate 4⅛", below mounting plate 2¾". Height above mounting plate 2½", below mounting plate 2¼". Net weight approximately 7 lbs. Gross weight approximately 10 lbs.

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AUTOMATIC SPINDLE

Automatic spindle for 45 rpm use. Holds ten records. Constructed of durable plastic, finished in maroon. Supplied complete with clips for attaching spindle to base when not in use. For MIRACORD XA-100 ONLY.

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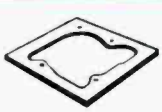

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Kiln dried and sanded ready for staining. All holes drilled. Specify XA-100 or XM-110.

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The "Patrician" Gets a Home Workout

How to build the folded horn; what to do with the components; how to wire them internally and into your hi-fi audio system.

CULLEN H. MACPHERSON* and ROY C. CARLSON*

SOCIALLY SPEAKING, the patrician and the manual worker have, traditionally, little in common. But a home constructor worker of sorts can build a 'Patrician," providing he follows certain instructions laid forth here. For we are peaking not of "talkers" with windpipes, ut of speakers with voice-coils—hi-fi ones. Economically speaking, the assumption is that one unit of work by a do-it-yourselfer audioist is pretty sure to get him a half-dozen tangible and intangible units of value. In other words, *do* something yourself, *save* something of your substance, and besides (another "gain") *lose* that creeping flabbiness in your muscle-flexor areas.

Hi-fi-ly speaking, "Patrician," *Fig.* 1, identifiies a certain folded-horn speaker system. It contains a woofer, mid-bass driver, treble unit, and tweeters, with the proper crossovers at the proper frequencies. The interior horn assembly we are about to dissect and analyze—for you, in turn, to synthesize—is housed in a finished furniture cabinet 60 inches high over-all, 41 inches wide and 30 inches deep. It is not a simple one to build, but build you shall (as the saying goes) for the simple reason that, like many of us, your itch to get is not blessed with enough "scratch." Hie yourself then to the woodshop and get dimension lumber and sheets in sizes and quantities sufficient to make the necessary parts, subassemblies and assemblies, as will be shown further on.

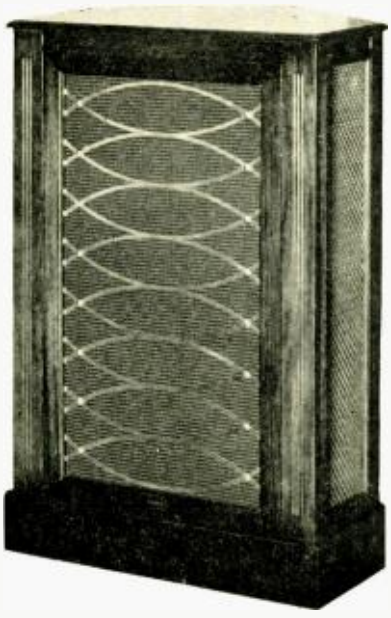

Fig. 1. The completed Patrician loudspeaker—a four-way system of excellent performance—which may be built by following the plans given in this article.

The Horn Assembly

The construction of this speaker enclosure has been boiled down to seven steps. We suggest you follow them, as they are basic to the successful completion of what, for want of these steps, could be a most confusing and perhaps frustrating undertaking. The interior horn assembly consists of the complete wooden acoustic structure necessary for the satisfactory operation of a 4-way corner type loudspeaker system. The sequence of procedure outlined here for the wood assembly duplicates the working parts of the Electro-Voice Patrician IV.

The horn assembly can be had in either of three ways: (1) The complete Patrician cabinet, which is supplied with furniture exterior, all the internal horn construction, and the speaker system mounted and connected ready to operate on delivery by hooking up to the proper terminals on your proper power amplifier. (2) The internal horn assembly only, in kit form, which you proceed to put together as shown in the step-by-step isometrics, numbers 1 to 7 inclusive. This horn assembly is without the outer furniture casing. (3) The complete working drawings only, for this internal horn assembly construction, with the size, quantity and kind of lumber of wood needed for each of the parts. The dimensioned lumber specified ranges from ¼-inch to ¾-inch fir plywood B–D grade or better, to a solid dimensioned lumber like poplar of 1⅛-inches to 1¾-inches thickness. Such is the province of this article.

Parts and Patterns

The speaker units that come with the complete Patrician IV cabinet, and for which the kit or properly home-built horn are equally suitable, provide you with a system identified as the Electro-Voice Model 103-C Driver Components Package, consisting of some ten items:

1—18WK very-low-frequency (Lo-Lo) driver
2—A8419 low-frequency phenolic horn sections (complete set)
2—828 high-frequency drivers (complete set).
1—T25A treble driver
1—6HD 600-cps diffraction horn
1—T35 very-high-frequency driver
1—X2635 four-way crossover network
1—8675 cable harness, including three AT37 level controls

The construction of the parts that make up the front section of the model 115 K horn assembly, shown in step 1 is detailed in drawings 12, 13, 14, 17, 18, and 22.

The construction of parts leading to step 2 is shown in details 5, 6, 7, 19, 20, and 21.

Step 3 construction is shown in details 3, 8, 10, and 11.

Step 4 is an interior assembly job, indicating where details 10 and 11 fit (as in step 3) and introducing detail 4.

Step 5 is the erected assembly of the 115 K low-frequency driver horn, complete at this point but for the addition of the diffraction horn assembly which fits over the top of the K horn. All of the foregoing five steps are shown in *Fig.* 2.

Step 6 is the mid-bass diffraction horn assembly, with its parts shown in details 1, 2, 3, 9, 15, and 25, *Fig.* 3.

Step 7 shown in *Fig.* 4, is the completed erection of the Patrician horn assembly with mid-bass diffraction horn housing added, and details 16, 23, 24, and 26. (Note detail 26, an acceptable alternate serving the purpose as well as the curvilinear detail 25 indicated in step 6, and easier for most of us to make, unless blessed with special tools for routing the top of part 3, shown in step 6).

Working Out the Steps

What you do to get step 1 done, (*Fig.* 2): Place part 22 face down on a workbench or saw-horses. The face should be the better side of the fir plywood panel, which typically is a "wild" grained wood; you would choose the more restrained or cleaner appearing grain for the front. Four strips 12 and two 17's which abut the perimeter of the 21-inch square opening in the center, should be secured as shown, with glue and nails. Use enough glue ("Weldwood" or "Woodlock," for example) so that it oozes out from the joints as the pieces are butted together for nailing. All contacting edges, in fact, should be sanded before gluing and nailing, which will guarantee a tight fit and prevent air leaks throughout the completed horn, especially in the two cavities leading to the

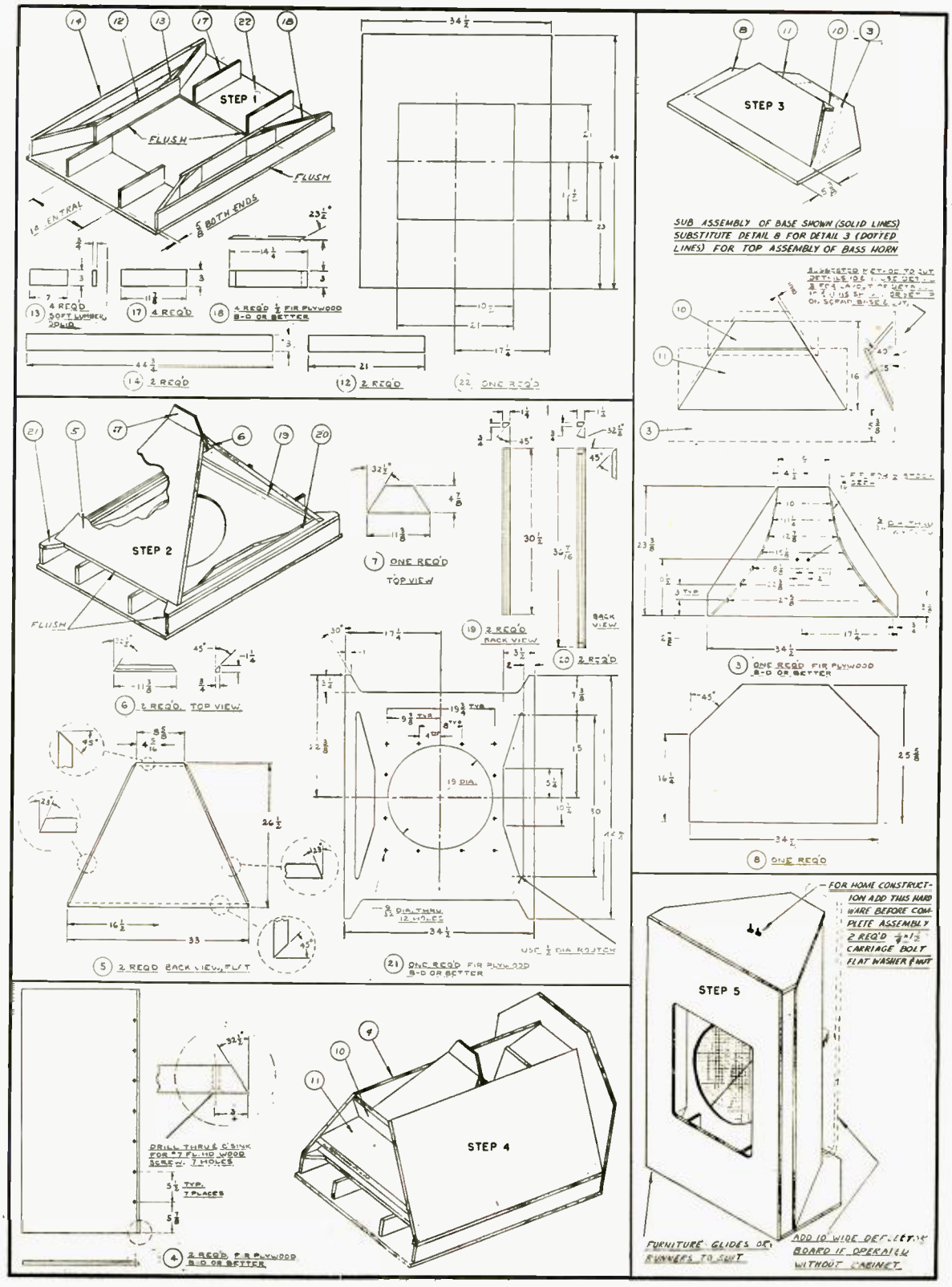

Fig. 2. Basic wood parts for the K-horn enclosure, illustrated in the first five steps of construction.

back of the driver cone. Now tack or clamp part two 14's in position, flush on the outside of face board 22, but shorter than it by 5/8 in. at both ends. You've now laid in all the parallel pieces. Then place four strips 18 across strips 12 and 14, scribing guide lines for the mitre cut, as that is the way they will have to be set in for an airtight fit. Cut the mitres in the four 18's, then temporarily tack and clamp in place. Do the same with four parts 13, first laying them across 12 and 18 to determine the mitre. Cut it then; holding part 13 in place by hand scribe a line on part 22 around the insides of 12, 13, 14 and 18. Loosen temporary fastenings and glue and nail 13, 14 and 18, guided by the scribe lines. For added rigidity use 3/4-inch square cleats at the points where 12, 14 and 18 are butted to 22.

Step 2

The strips you have just mounted and secured are the base for parts that will be laid flat across them, and should all be evenly level. This you can (and should) check by laying a straight-edge across the assembly, using the 14's as a guide for correcting any high or low spots among the sixteen (count them) pieces. Satisfied that they are uniformly level, you can now lay down part 21, which is the board with the round speaker opening in it. Glue and nail it in place, using an excess of glue to assure an airtight fit for all vertical members.

Erection of the cone is facilitated by temporarily tacking two pieces of scrap wood 1 in. thick across the 17's and tight against 21. Tap your hammer lightly to tack parts 5 temporarily at their intersection with 21. Use another piece of scrap plywood to stick up from board 21 all the way to the place to be occupied by part 7, at the apex of the cone-to-be. Holding a 19 with one hand, scribe location guide lines on 21; then scribe another guide line for parts 20. Be sure to mark the pieces correspondingly so that you can secure them where they belong without mismatching. Remove parts 5 (you have tacked them temporarily) to enable you to glue copiously and then nail the two 19's and the two 20's to panel 21. Now you are free to secure parts 5 (the two sides of the cone), by gluing and nailing to the 21's; and at the apex where parts 6 (cleat details inside the apex) and the lower end of part 7 meet. With 5 as a guide, check for absolute level with a straight-edge laid across 6 and 7.

Step 3

This shows the assembly of the ramps —there are two, one at the top, the other at the base of the horn assembly.

The lower one is made up of parts 8, 10, and 11, glued and nailed together; the top unit uses parts 3, 10, and 11. To do this properly, tack a cleat or piece of wood scrap 5 3/8 in. from the edge of part 8 (which is the "base") and fit part 11 against it. Then, 16 in. away towards the narrow end of "base" 8, place another cleat or block to hold part 10. Now glue and nail 10 and 11 to 8. Do the same with 3, 10 and 11, gluing throughout

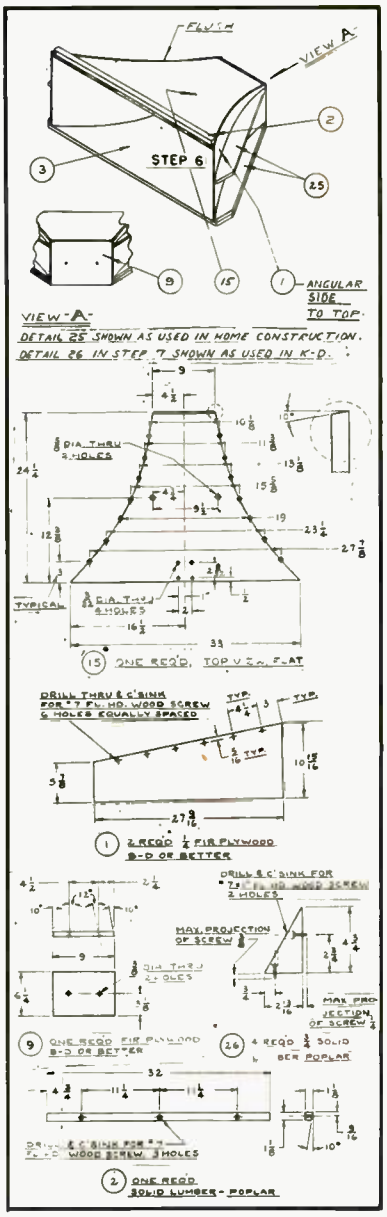

Fig. 3. Wood parts and assembly for the diffraction horn assembly which tops the low-frequency section.

thus providing the ramp for the base sub-assembly of the bass horn.

Step 4

Now mount the encompassing side wings, the two parts 4. Glue and nail the 4's to panel 21. If needed, you may use wood screws to secure 4 tightly to 21. Add dummy spacers across the back of the assembly to hold 4 parallel. Now try the fit of the base sub-assembly (built as in step 3). Do not force it to fit. If sides 4 spring out, then trim parts 10 and 11. Glue and nail 8 and 4 only.

Step 5

Follow the same procedure as to fitting the top sub-assembly. Do not force the fit, but follow through as in step 4. Glue and nail 3 and 4, then complete gluing and nailing 4, 10 and 11 on both assemblies.

Step 6

To ready the mid-bass diffraction horn sub-assembly for its place atop the 115 K horn housing, assemble parts 1, 2, 9, and 15 as in *Fig.* 3. Scribe a line on the angular side of 1, about 5/8-inch in from the narrow end. Glue and nail 2 and 15, then glue and nail 1 and 15, with the scribed line flush with the narrow end of 15. And when you have glued and nailed 9, this assembly is complete.

Step 7

Glue and nail cleats 16 to 3, *Fig.* 4, which is the top of the folded horn; keeping 1 at right angles to 3, glue and nail gussets to suit. And make sure that an airtight seal exists where the diffraction horn sub-assembly sits atop the K horn. Do this by adding adhesive-backed, airtight sponge rubber weatherstripping, 1/8 by 3/4 in. along the inner outline of 24. Do the same around the exterior of the front loading panel opening in 23.

Airtightness is an absolute requirement and we suggest that this can be further assured by gluing with the types of glue mentioned above, 2 1/2-in. strips of muslin or broadcloth over all joints in the interior of the cavity. Or you may use wood filler or plastic wood instead. Careful application of either should give the desired degree of airtightness.

Note that it is necessary to install a 14-inch wide deflector board at the rear, and for the full height, of the K horn (step 5 dotted lines) if you intend to operate it without an enclosing cabinet.

The Electronic Assembly

The wood construction described above is based on the Klipsch principle of folded corner-horn loading. It has been designed to house the model 18 WK low-frequency driver in a K type reproducer, but scaled up 16-2/3 per cent. When the Patrician IV or its properly self-made facsimile is placed in a corner, the folded throat of the bass horn becomes part of the entire room, allowing the large wavelengths of the second and the upper parts of the first audible octave to be formed properly. The low-bass driving section reproduces the first three octaves, to the first crossover point at 200 cps.

Taking over for only the next one-and-a-half octave range to 600 cps is a separate horn, used as an indirect radiator, with two 828HF driver units, for the mid-bass section. The horn load is fabricated of wood and phenolic tubes, one of which is shown in *Fig.* 5, and reproduction down to 200 cps is handled much more satisfactorily than a horn assembly made of metal.

The treble range, from 600 to 3,500 cps, is reproduced through the Electro-Voice Model T25A driver exhausting into a 600-cps 6HD diffraction horn. *Fig* 6. Other frequencies not a part of this range are excluded, but are reproduced by the T35 Super-Sonax very-high-frequency driver, using an integral diffraction horn.

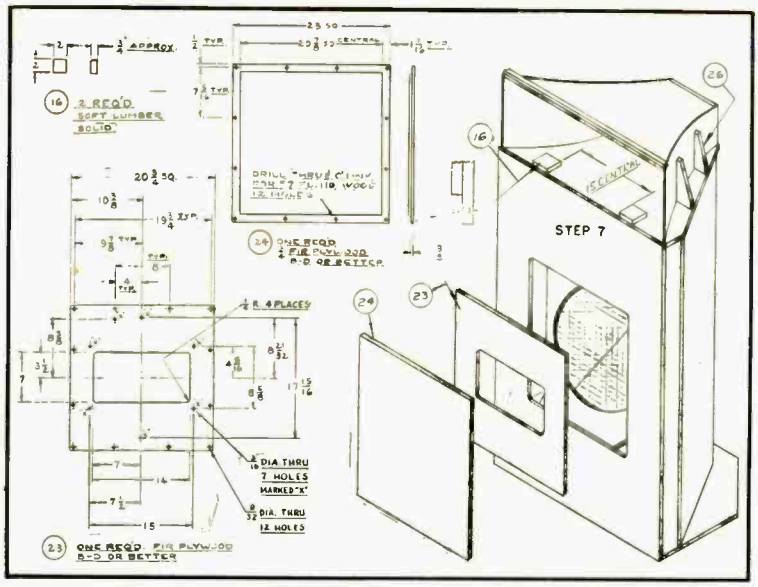

Fig. 4. Steps for assemblying the diffraction horn to the low-frequency section.

With this unit the remaining octaves in the audible register above 3,500 cps are accomplished with practically unmeasurable distortion. The proper allocation of this spectral energy is controlled by the X2635 crossover network. It divides the amplifier power into four separate portions, eliminating upper harmonic and intermodulation distortion from one driver in the region covered by the next.

See (as in *Fig.* 7 A, B, C, D) how these components are interconnected for optimum reproduction efficiency. The electronic schematic has also been translated into placement-perspectives of these parts. These, in addition to the step-by-step drawings for building the wooden acoustic structure, have been prepared to clarify the entire procedure for the hi-fi enthusiast who might prefer to add his manual efforts to the integration of a 4-way speaker system for a fuller enjoyment of his signal-source hi-fi equipment.

Step 1

Begin the installation of the driver components in the acoustic structure by laying the horn on its back and removing the front cover and the speaker mounting boards, at the same time marking the tops for proper re-assembly after the 18 WK low-frequency driver has been placed on the center of the mounting board.

Step 2

Drill holes in it for mounting by placing the speaker with two opposing rim holes on a vertical center line, with the speaker terminals showing on either side of the top hole. Your guide to drilling the necessary holes for the bolts is a sure one if you now make markings on the mounting board through the bolt holes on the rim of the speaker shell. Then drill six ¼ in. holes in the mounting board in these locations; also drill one 3/16 in. hole near the terminals just outside the speaker frame.

Step 3

Use 3/16 inch carriage bolts, 1¾ inches long, with both flat (under the bolt head) and lock washers (at the nut end) to bolt the woofer into place. Tighten the carriage bolts just snug enough to hold the loudspeaker firmly in position. If you draw the bolts too tightly at this stage you may warp the speaker frame and cause the voice coil to rub. Now take up the wiring harness kit which comes packed with the speaker, and run the long single red and black pair from the speaker through the 3/16 inch hole. A knot tied on the speaker side will prevent the cable being pulled out. Attach the wires to the terminals of the 18 WK as follows: *red wire* goes to *black terminal* and the *black wire* to the *red terminal*—and you will enjoy proper phasing when operating the system later. ("A" in *Fig.* 7).

Replace the baffle board with its speaker, taking care to seal the board tightly against the sponge rubber gasket material. Draw the speaker leads through the top opening of the horn and out to the back. Close the throat of the large horn by screwing the front cover back into place, and be sure that it makes a tight seal with the gasket.

Step 4

The foregoing three steps in the process of fitting the speaker system components together were handled with the K horn on its back. Now return the assembly to an upright position. And here we invoke, again, (see AT HOME WITH AUDIO April, 1954) the thought that to do this kind of job comfortably, the working top of bench or table should be at about the height of your bent elbow, standing erect. Whether you work with parts held horizontal or vertical, the use of a surface at or very close to the suggested height should land you in that area of comfort which means greater efficiency, surer results.

Returning the assembly to an upright position, guide the bolts projecting from the ends of the low-frequency horns (A8419) through the holes in the back plate of the smaller wood horn, using the rubber spacers provided to insure an airtight fit. Run large cap screws and washers through the top of the horn into the brackets of the phenolic tubes, and tighten by hand only. Neither should you use force to push the two wood shim blocks under the brackets, where they rest on top of the K horn. Start the wood screws through these brackets and into the shims only, stopping short of going into the top panel of the large horn. Play the shims until the brackets of the phenolic tubes have been lifted so that the bolt moves freely through the hole at the back of the board. Secure the wood shims with a brad, then turn the wood screws through into the top of the K horn board. Tighten the cap screws just snugly enough so that the tube bolt is free through the back hole. The final move at this stage is placing the washers and nuts on the bolts through the back and tighten snugly, but not too, to avoid strain on the phenolic horn tube.

The photograph (*Fig.* 8) of a phantom wash drawing of the K horn with woofer in position and the inset of the midrange high-frequency and very-high-frequency units above, shows that the installation of these units is basically simple, despite

Fig. 5. One of the two mid-bass driver units assembled to its phenolic three-pass folded horn. Two of these units "exhaust" into the large diffraction horn of Fig. 3.

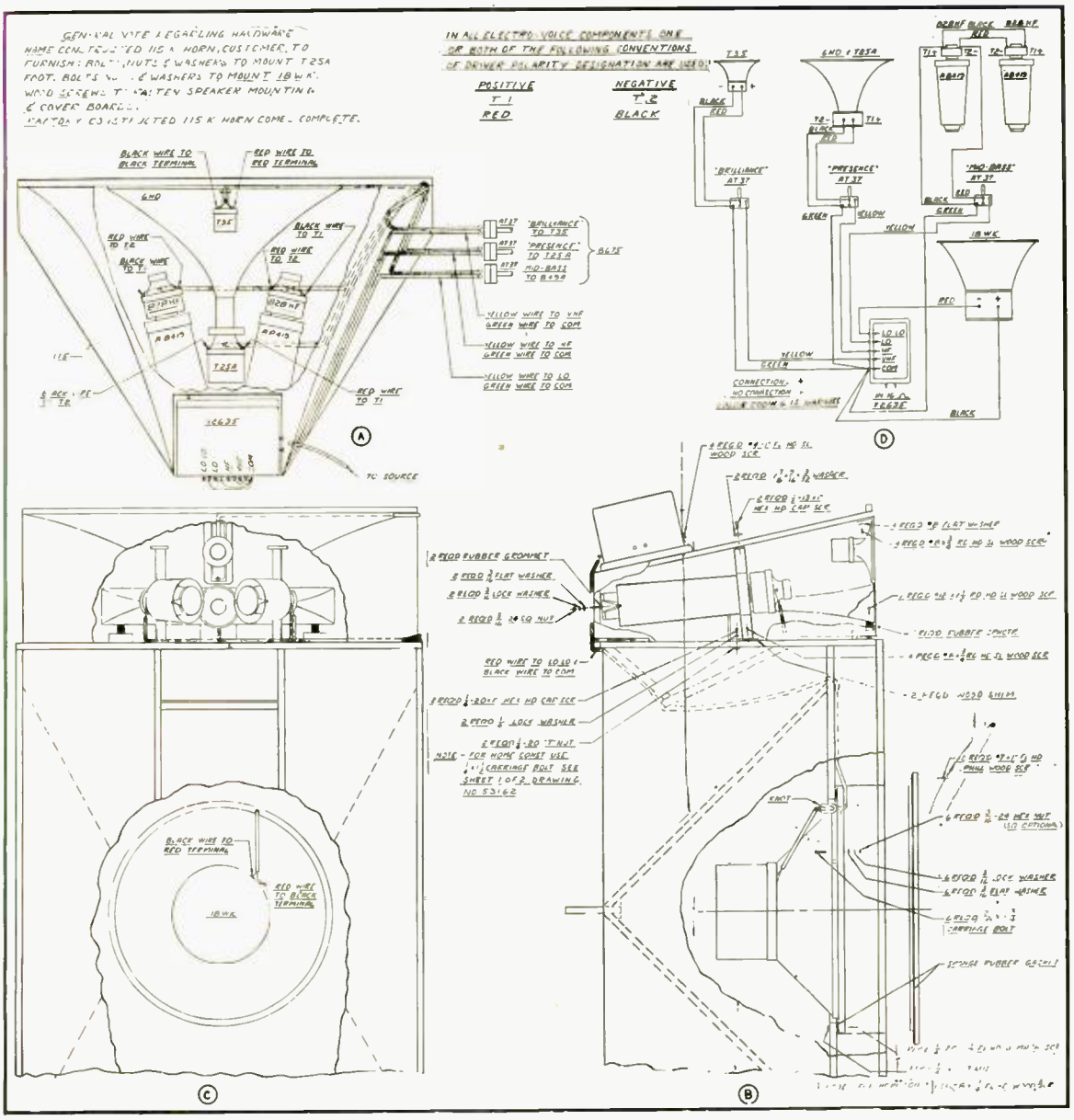

Fig. Electrical connections and placement of the elements of the complete loudspeaker system.

the fact that step-by-step instructions may appear to describe a rather complicated procedure. Our photograph brings to plain view the brackets, shims and supports that you are required to secure with the flat, round, hex and Phillips wood screws; the carriage bolts, nuts, washers, as well as a machine screw here and there, as and where indicated in the cross section (see "B" in *Fig.* 7).

Fig. 6. The treble range driver and horn, which radiate the frequency range from 600 to 3500 cps.

Step 5

Install the pair of 828HF drivers with terminals facing toward the front ("A" in *Fig.* 5). Screw these into place on the re-entrant horns. Connect the T1 terminals of the two drivers together, and do likewise with the T2 terminals. Connect a black wire to the T1 terminal of the left unit, and a red wire to the T2 terminal, and bring these wires out past the left front edge of the 200-cps horn assembly, stapling to the bottom board. Finally, mount the crossover network with output terminals toward the back, and centered (as in "A", *Fig.* 5), which also

Fig. 8. Phantom view of low-frequency section topped by the diffraction horn and its three sections—each of which covers a specific frequency range.

shows the placement of the T35 very-high-frequency driver.

Step 6

To install this T35 driver and horn—and now is the time—mount its bracket in the pre-drilled holes, on the top section of the 200-cps horn. Align the driver vertically by bending the bracket slightly after it is in place. Follow the schematic ("D" *Fig. 7*) which indicates black wire going to black terminal, and red wiring to red terminal. "A" in *Fig. 7* indicates the AT37 level controls which may be mounted on a board where shown, or in any other convenient spot, for up to ten feet more wiring may be added to the cable harness. (*Figure 9* shows the recommended location of the controls) Incidentally, this harness and other necessary hardware are packed with the driver components in a wooden crate. This is not so in the case of the K horn. The home constructor will need to get bolts, nuts, and washers to mount the T25A foot, and for mounting the 18 WK speaker, and wood screws to fasten the speaker mounting and cover boards. These are as specified in the notes on drawing "B" *Fig. 7*.

Step 7

The 6HD horn and treble driver T25A can be mounted in place, and full instructions for this are packed with the unit. One point more—attach the threaded adapter plate to the bracket and horn and bolt it in place, using the flat gasket supplied with the driver. Having thus pre-assembled the entire unit you can now place it in position as shown ("A" and "B", *Fig. 7*). Wire the T25A driver as shown in the schematic, the T2 terminal to the black wire and the T1 terminal to the red wire. Run the wires parallel to those from the 828HF drivers installed earlier, and staple in place. Not only a neat thing to do, but easier to identify and handle when testing or servicing the equipment.

Step 8

Having assured proper phasing of the drivers by connecting them as described above, you are ready to bring the crossover network into the picture. Connect the output terminals on the X2635 unit as follows:

1) Splice the black wire from the 18 WK with the three green wires from the high-frequency drivers; connect these to the terminal marked COM.

2) Connect the yellow wire from the T35 *brilliance* control to the terminal marked VHF.

3) Connect the yellow wire from the T25A *presence* control to the terminal marked HF.

4) Connect the fourth yellow wire from the 828HF *mid-bass* control to the terminal marked LO.

5) Connect the red wire from the 18WK to the terminal marked LO-LO.

6) Connect the crossover terminals marked IN to the 16-ohm output of the amplifier. For this purpose use #18 fixture wire for the leads from the speaker system to the amplifier if they are no further apart than 20 or 30 feet; for longer lengths, #16 two-conductor cable is better.

As for the decorative housing of this highly utilitarian horn assembly—generally speaking, the side ports on the housing should measure 9 by 49 inches, to allow proper coupling of the K horn to the walls of the room. Exact positioning is not critical. The 200-cps horn may be masked to some extent without affecting radiation characteristics, but the minimum opening of such a mask must be 10 by 24 inches. Use expanded metal "Shelf X" for the grille, painted or plated; this can be had from any metal supply house, cut to size. The grille cloth, available at your parts distributor, should be 60-40 open mesh weave to allow maximum transmission of the high frequencies. *Figure 9* shows a composite plan view of the speaker and suggested dimensions for the furniture housing.

Some Hints on Operation

From its corner location this system will yield excellent radiation of all tones. Furniture is better kept two or three feet away from the sides of the unit. In fact, only if furniture is very large so that it forms an appreciable portion of the low-frequency tones being emitted,

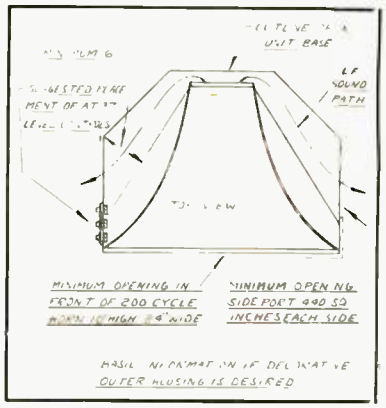

Fig. 9. Combined plan view of the complete speaker and recommended dimensions for the furniture enclosure.

will radiation be affected. For instance, the wavelength of a 30-cps tone is 111 inches, and an object three or four feet square must be actually blocking the side ports to affect radiation at this frequency. Neither will an open window or door, several feet away, cause any noticeable degradation of response.

There are three continously variable level-controls, allowing complete balancing to any acoustical environment. For a musical selection played by a full-size orchestra set the *mid-bass* control to maximum, and the *presence* and *brilliance* control to one-half rotation. This will be a pleasing setting for a large living room with hard walls and few drapes and rugs. Should the room be of average size—about 14 by 20 feet—advance the *presence* control to about three-fourths rotation. This will require a readjustment of the *brilliance* control for good musical balance, so it is just as well to advance this control slightly while listening to various passages in the music. If the source material is clean and wide range, the point of balance will be definite; the higher tones then fall into place automatically, and there will be little aural doubt that the proper setting has been achieved. In heavily draped rooms the setting may be as high as 9 or 0, but only in extreme cases.

Ordinarily the *mid-bass* control is operated fully clockwise, at a setting of 0. But it is up to the user, who should set this control to conform to his own listening preferences, but probably never lower than a setting of 5. Once these settings have been made, the controls need hardly ever be touched again. In short, you now have an audio system capable of handling any hi-fi situation.

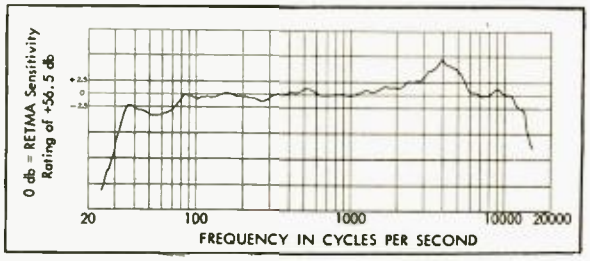

Fig. 10. Frequency response curve for the completed Patrician loudspeaker.

The Acoustic Earset—a New Approach to Conference Applications

D. D. JONES*

Simple, efficient, sanitary "earphone" solves many problems at once—one of the principal advantages is the reduced maintenance required by this type of installation.

SOUND DISTRIBUTION within conference rooms permanently equipped with facilities for simultaneous interpretation is usually accomplished by means of a wired audio system. Several such installations are described in the articles referenced in the bibliography.

These conference rooms, which are primarily used in the field of international diplomacy, may have capacities ranging from a few hundred to several thousand seats to accommodate delegates, spectators, and members of the press. To provide a full interpretation service, each seat must be equipped with terminal apparatus which includes headphones, channel selector switches and, in some instances, individual headphone volume controls.

Experience with many installations has shown that unless special care is exercised in the design of these terminal facilities, the acoustical operating conditions may not prove satisfactory and the physical shocks and stress to which publicly used equipment is ordinarily exposed will result in excessive repair and replacement costs and quite possibly an inferior service.

Practically every contemporary simultaneous interpretation installation utilizes headphones of conventional design as listening equipment. But conventional headphones are not well adapted to this class of service. For example, they cannot be easily integrated into the architectural scheme, which may include several types of auditorium chairs and many shapes and kinds of conference tables. Conventional headphones have too many parts which are vulnerable to loss, breakage or abuse.

As a rule, they are too heavy and the side pressures exerted by the spring steel headbands are too great, causing discomfort and early fatigue to the wearer. In addition, the relatively large unstretched and resonant diaphragm in most headphones is effectively loaded by air at frequencies above 800 cps, and the resulting air coupling from unused but energized headphones leads to annoying acoustic residuals, air-borne crossstalk, and an unfavorable acoustical environment.

A fresh approach to this problem has been needed, and the acoustic earset which is shown in the diagram in *Fig.* 1 has been found to have very interesting possibilities.

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The Acoustic Earset

It will be seen by reference to (B) and (D) in *Fig.* 1 that this earset is in effect an acoustic waveguide coupler which connects a remotely located electromagnetic driver to the ear through a flexible tube.

The acoustical transmission of sound through tubes is a very old principle. Among early applications were the first mechanical phonograph reproducers and clinical stethoscopes. At least one contemporary manufacturer[1] has adopted the acoustic headset principle for industrial applications, and very acceptable properties are claimed for it.

The principal advantages of an acoustic listening device for conference or auditorium applications are: (1) the total weight can be held to about two ounces, which is one third to one eighth that of permanent magnet headphones; (2) a moderate degree of automatic self-sealing may be incorporated and headband eliminated; (3) the electromagnetic driving mechanism can be fully protected from breakage in functionally designed chairs or tables; and (4) the acoustic residual from unused earsets can be dissipated in simple acoustical energy absorbers built into furniture.

The main disadvantage is the relatively high energy loss per unit length of transmission tubing. This results in low over-all efficiency as compared to conventional permanent magnet headsets. This loss, which increases with frequency and varies inversely with tubing diameter, is in the order 1.6 db per foot at 1,000 cps for 0.120 in. (ID) tubing, which is probably the maximum practicable diameter.

The curves in *Fig.* 2 from Massa[8] give the attenuation loss in db per foot for tubings of various inside diameters over an extended audio-frequency range. An experimental model of the acoustic earset was equipped with 0.120 in. (ID) tubing 30 in long. The insertion loss characteristic for this section of tubing was derived from the curves of *Fig.* 2 and is given in *Fig.* 3. For the transmission of speech a band width from 100 to 6,000 cps is desired. This requirement is easily met by incorporating some high-frequency boost in the driving amplifier circuits.

[1] Telex Inc., St. Paul, Minnesota. (Dynamic Earset.)

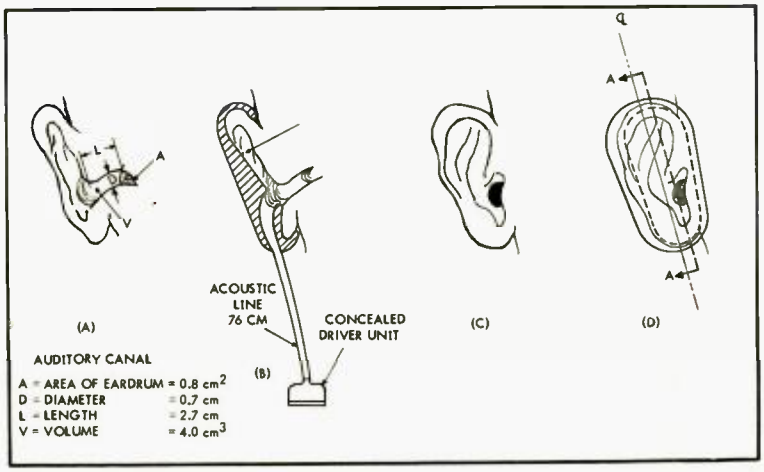

Fig. 1. Diagrammatic sketch of acoustic earset. (A), the ear as seen in cross-section; (B) Developed shape of molded earset through offset sect. a-a; (C) right ear, side view; (D) developed shape of molded earset in place over ear.

Some Criteria

To design an acoustic earset for public usage, there are three points which must receive careful attention:

1. For hygenic reasons, the transmission tubing must be coupled effectively to the external auditory meatus (ear cavity) without making physical contact to the inner walls.
2. The air leak between the shell of the earset and the head must be kept to minimum for good coupling at low frequencies.
3. Being supported by the cartilaginous connecting tissues between the head and pinna of the ear alone, the total weight must be low and the mass of the supporting lip well distributed over the supporting area.

The Acoustical Problem

To establish efficient coupling between the transmission tubing and the ear cavity without physical contact is a difficult matter. Good results may be obtained, however, by utilizing the directivity effect of a flared horn section. The mouth diameter is dimensioned to be approximately the same as the ear cavity (about 0.7 cm).

The horn mouth may touch the pinna or outer parts of the ear, but because it cannot be permitted to extend into the external auditory meatus, the cross section of the mold through the horn is slightly bulged as shown at (B) in *Fig.* 1.

Also, because the physical dimensions of the earset must conform to the size of a "statistical" ear, in a practical mold there is a small enclosed volume of air S_V in the region directly above the horn section which may exhibit a Helmholtz resonance effect.

At the frequency of resonance, which it is desirable to know, the volume velocity U_s to the ear will be zero and this frequency and its neighboring regions will be cut off.

Theoretically, it would probably be desirable to make the flared horn section act as an acoustic impedance transducer by giving it an exponential rate of taper. However, an exponential horn can behave as an impedance transducer only when its length L is greater than one-half wave length. To effect transformation at say 200 cps, the total length of the exponential section would have to be:

$$L_{200} = \frac{\lambda}{2} = \frac{c/f}{2} = 2.8 \text{ feet}$$

A horn section of this length cannot be obtained unless a long external flexible matching section is used. For this application, such a section would be an undesirable mechanical feature, and a very short section was used as a practical compromise.

Moreover, an exponential horn coupled to free air will behave differently from one coupled to the ear. The ear is believed to exhibit properties similar to an acoustic compliance[2], but the acoustical constants are not yet well known.

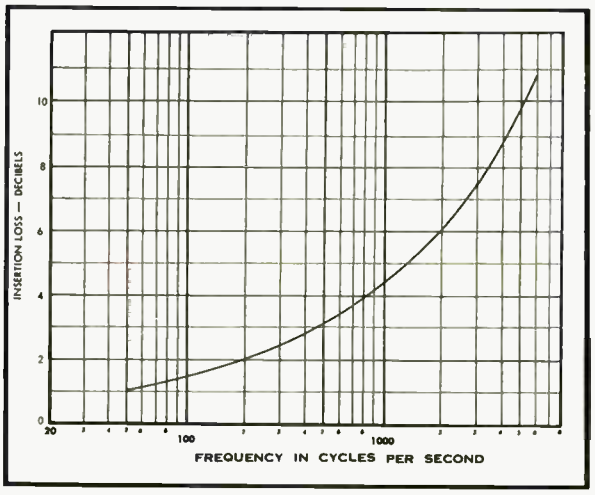

Fig. 3. Insertion loss characteristics for 30-in. section of tubing used.

The Acoustical Circuit and its Analogous Impedances

The diagram of (A) in *Fig.* 4 shows the elements of an acoustical system which approximate those of the acoustic earset closely coupled to the ear.

G is a constant-force generator driving piston P. L_T is the transmission tubing connecting the piston to the earset. L_s is the small cavity of the ear terminating in membrane M. The volume S_V is in shunt with the line, and L_s is the constricted neck of the air path leading to volume S_V.

If the earset is not held closely to the head, an air leak will occur around the pinna of the ear and the pressure response at frequencies below approximately 300 cps will drop. To minimize the air leak, a static balance, which will be explained, is employed to maintain a small but constant horizontal component of force (F_T) by the earset against the head.

The impedance type analogous circuit is shown at (B) in *Fig.* 4.

The tentative physical dimensions which were chosen for the experimental earset and acoustic line shown in *Fig.* 6 were substantially as follows and were used to compute the sizes of acoustic mass for elements M_{A1}, M_{A2}, M_{A3}, acoustic compliance C_{A3} and the frequency ω at which the volume velocity U_s is zero.[3] The mks system of units is used.

T_s (cross section of tube T) = $3.14 \times 0.060^2 = 0.011$ cm^2 = 0.011×10^{-4} m^2

T_L (length of tube) = $30 \times 2.54 = 76$ cm = 0.76 m

E_s (cross section of ear) = 0.3815 cm^2 = 0.3815×10^{-4} m^2

E_L (length of ear cavity) = 2.7 cm = 0.027 m

S_L (length of constricted air path leading into earset) = 1 cm = 0.01 m

S_V (volume of cavity in earset) = 5 cm^3 = 5×10^{-6} m^3

(*Continued on page 104*)

[2] The method recommended by the American Standards Association in Bulletin Z24.9 (1949) for measuring the performance of earphones which rest upon the pinna, utilizes a 6-cc cavity terminating in a standard condenser microphone to simulate approximately the acoustic compliance of the ear.

[3] For a rigorous treatment of acoustical circuits see *Acoustics*, by L. L. Berenek, Chapters 7 and 13, McGraw-Hill Book Co., New York.

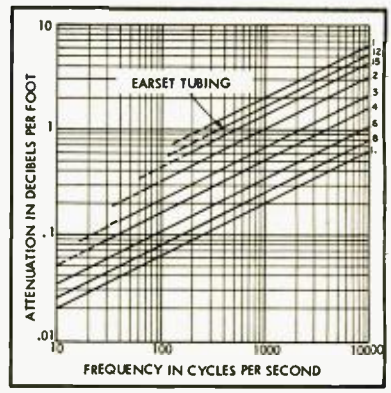

Fig. 2. Attenuation characteristics for tubing of various diameters. (After Massa, "Acoustic Design Charts")

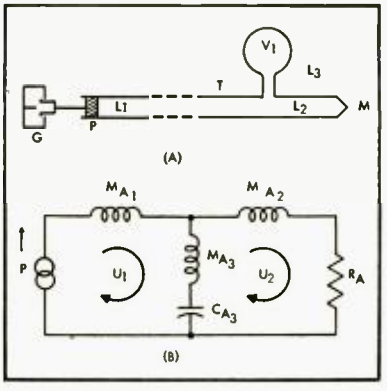

Fig. 4. (A) Elements of the acoustic system, and (B) the equivalent circuit.

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EXTRAS: Wider Frequency Range • Heavy Magnet (compare with any 12" or 15" speaker) • Longer Magnetic Path • Smaller Air Gap • Larger Voice Coil • Heavy Duty Non-resonant Cast Aluminum Frame • Multi-Parameter Cone.

These and other features of the LP312 result in increased efficiency, lower distortion, improve internal resonance damping and transient response, give even distribution of sound and a tonal quality free from "metallic" effects.

SPECIFICATIONS:

Impedance at 800 cps.: 16 ohms. Frequency Range: below 20 to above 14,000 cps. Power rating: 25 watts average — 35 watts peak. Magnet wgt.: 61.5 ozs. Voice Coil Diam.: 1.5". Overall Diam.: 12¼". Baffle Opening: 10⅝". Depth: 6¾". Heavy Duty Cast Aluminum Girder-constructed-Frame.

AUDIOPHILE NET: **$49.50**

NEW LORENZ LP208

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This new 8" Speaker has enormous flexibility. It can be used as a wide-range speaker, alone or in groups, as the high or low end of a 2-way system, or as a mid-range speaker in a 3-way system. Will fit any 8" cabinet, will load most 12" cabinets.

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SPECIFICATIONS:

Impedance at 800 cps.: 8 ohms. Frequency range: 35 to 14,000 cps. Power Rating: 15 watts average, 21 watts peak. Magnet wgt.: 28.5 ozs. of high efficiency ALNI. Voice Coil Diam.: 1.0". Overall Diam.: 8.5". Baffle opening: 7.25". Depth: 4.0" Heavy Duty Cast Aluminum Girder-constructed Frame to eliminate frame resonances.

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LORENZ LP-65 HORN-TYPE TWEETER

The Lorenz LP-65 has many unusual features. For example, the soft plastic cone, round in shape for even sound dispersion, insures smooth, sweet sound rather than the often-heard shrill, harsh, metallic overtones of other tweeters . . . and because of its solid back, it can be placed in any enclosure with any speaker, without the usual interaction.

SPECIFICATIONS:

Impedance at 800 cps.: 5.5 ohms. Frequency range with High Pass Filter HP-1: 2,000 to 17,000 cps. Sound dispersion: 120 degrees in all directions (achieved by round design). Power Rating: 2 watts. Outside Diam.: 2½". Cone Diam.: 2¼". Mounting hole in baffle: 2⅛" flared to 2½" or more.

AUDIOPHILE NET: **$8.50**

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By adding the Lorenz TB-2 or TB-1 to the standard Lorenz 12" wide-range speaker, you have the advantage of a diaxial or coaxial speaker with extended high frequency output, the range extending from 20 to over 17,000 cps. (This is the Lorenz "Growth" approach in action.)

SPECIFICATIONS:	LP 312-1	LP 312-2
Impedance at 800 cps:	16 ohms	16 ohms
Frequency Range:	20-17,000	20-17,000
Power Rating:	27 watts	29 watts
Overall diameter:	12 1/8"	12 1/8"
Baffle Opening:	10 3/8"	10 3/8"
Depth:	6 3/4"	7 1/8"
AUDIOPHILE NET:	$61.95	$71.79

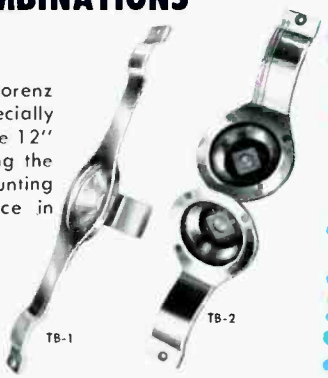
LORENZ TB-1 and TB-2 TWEETER COMBINATIONS

FOR ALL 12" LOUDSPEAKERS

If you desire to extend the range of your 12" speaker, a Lorenz Tweeter Combination will fulfill all your expectations. A specially designed, rigidly constructed steel bracket which fits across the 12" speaker supports 2 Lorenz LP-65 Tweeters coaxially, clearing the cone, but not projecting beyond the front of the speaker mounting baffle. The rigid metal construction discourages resonance in speaker or tweeter. Modernize your own 12" Speaker!

TB-1 – Bracket and single tweeter completely assembled and ready for installation) AUDIOPHILE NET: **$11.85**

TB-2 – Bracket and two tweeters completely assembled and ready for installation) AUDIOPHILE NET: **$21.69**



The LORENZ HP-1 HIGH PASS FILTER

The HP-1 with a nominal crossover at 5,000 cps. introduces highs into the tweeter at the rate of 3 db per octave starting at 2,000 cps. Its effect increases smoothly with frequency, extending the range of the system to the limit of audibility. It may be used with any tweeter. Assembly and construction is such that the unit may be placed within the speaker enclosure.

SPECIFICATIONS: Mounting Dimensions (Square Base): 1½" between hole centers. Over-all height: 2¾". AUDIOPHILE NET: **$4.95**

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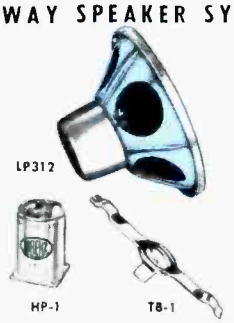
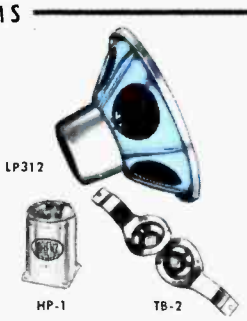
System range: 40-17,000 cps.
Power rating: 17 watts.



System range: 20-17,000 cps.
Power rating: 27 watts.



System range: 20-17,000 cps.
Power rating: 29 watts.
Greater High Frequency Sound Dispersion.

3-WAY SPEAKER SYSTEMS

System range: 20-17,000. Power rating: 42 watts.

MULTIPLE SPEAKER SYSTEM

Use multiples of each of the speaker types to any desired total power output.

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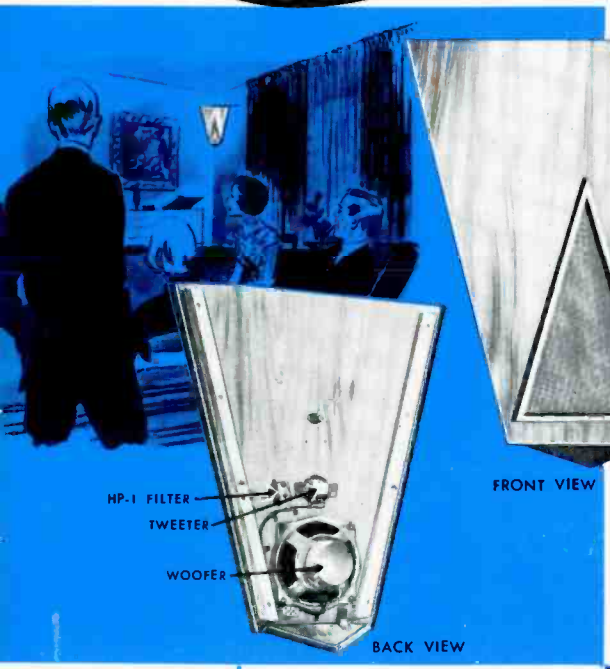

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Truly a high fidelity Speaker System that is Heard . . . not Seen

Ingenious, modern, the triangular cross section horn design uses the walls of your room and the speaker baffle as rigid boundaries.

The Sound Corner consists of the LP-215 Woofer, LP-65 Tweeter, HP-1 High Pass Filter. Frequency response: 40 to 17,000 cps. Impedance: 8 ohms. Power rating: 14 watts. Comes ready to use . . . requires no additional cabinet. Size: 31" x 27½" x 11¾". Blonde finish.

AUDIOPHILE NET: **$59.50**

Here is the compact corner wall 2-way speaker system that utilizes the horn principle — recognized as basic by sound engineers and enthusiastic listeners for the reproduction of smooth, resonance-free bass. Since the Lorenz Sound Corner uses no floor space and is as easy to install as hanging a picture, it has gained wide acceptance by music lovers everywhere.

Use it everywhere — in playroom, kitchen, patio — any room in the house. Use it as your primary sound system or as an extension system to your main equipment. It can be painted or wall-papered to match the decor of your home.

KAL Audette Shelf-Size 2-WAY SPEAKER SYSTEM

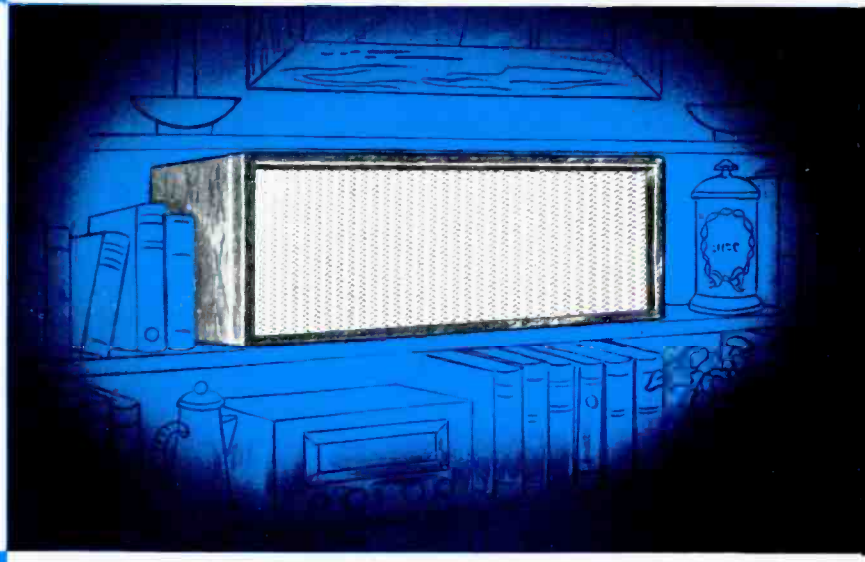
Here is listening pleasure packaged in attractive convenience! Imagine a speaker system small enough to put on the shelf of your bookcase, with all the high fidelity features of systems many times its size. Employing the principles of the Helmholz resonator and phase inversion techniques, the KAL Audette gives you wide frequency range (45-17,000 cps.) and astounding balance of natural sound.

The low price enables you to have an excellent binaural system by using them in pairs.

SPECIFICATIONS:

LP215 Woofer, LP-65 Tweeter, HP-1 High Pass Filter. Power rating: 14 watts max. Dimensions: 11" H., 23¾" W., 10" D. Finish: Richly grained maroon leatherette covered case with contrasting buff and gold beading trim.

AUDIOPHILE NET: **$49.50**



LORENZ SKL-100 ELECTROSTATIC HIGH FREQUENCY LOUDSPEAKER

The SKL-100 was developed by Lorenz to meet the need for a low-cost, high frequency reproducer of the "tweeter" class. It is an electro-static unit, using [illegible]ectrical forces developed between the two plates of a condenser as the source c[illegible]dio output.

Unlike other tw[illegible] SKL-100 has been equipped with a louvered deflection plate which dis[illegible]gh frequency sound, ordinorily very directionol, over a wide angle. It is also possible to connect two SKL-100s to the same filter network and mount them on either side of the "woofer", minimizing even more the directional effect of high frequency sound.

AUDIOPHILE NET: **$4.95**

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ROSS H. SNYDER*

Interconnection of the many elements of a hi-fi system demands some clear thinking if complete satisfaction is to be obtained. In particular, the method of connecting a tape recorder in the system for most convenient operation is outlined clearly by the author.

HIGH-FIDELITY COMPONENTS for home entertainment systems have been developed in such numbers and variety that rigorous application of good over-all systems' design has been almost impossible. The popularity of high-fidelity equipment has increased at such a pace that designers of components of all kinds have been faced with the necessity of building in a sort of makeshift universality which made it possible, in general, for the purchaser of an assemblage of these components to plug together a system which would function, but usually at something less than optimum.

Too Many Knobs

The commonest defect of an assembled system is multiplicity of controls, many of which perform duplicate functions. The likelihood of imperfect performance is great when such systems are operated by people whose interest is mainly in the music, not in the equipment upon which it is played. Typically, a radio tuner will have on its face a control for the selection of FM, AM, Phonograph, Tape, TV, etc. It will also have a volume control. Frequently such a tuner is selected especially because it has *relatively* few controls, and is connected into an elaborate audio control box, which will possess phonograph inputs, phonograph equalizer controls, power switch, volume or loudness control (or both), and separate bass and treble tone controls. These control boxes are usually connected to power amplifiers which have, themselves, at least a gain control, and sometimes another set of tone controls and selectors. These are happily rare now that the basic "flat" amplifier is the norm. With a basic flat amplifier, adjustment of the main amplifier gain control is required only at the time of installation, and it is supposed to be set by the installer so as to provide correct gain for the audio control box with which it is used. There is a tendency for many users to adjust the power amplifier gain so that the control box volume control is rotated about one-third at comfortable room level. Those control boxes which contain loudness controls are usually contributing considerable "bass boost" at this rotation, and this effect is removed only when thunderous volume is being delivered into the living quarters by the equipment. The function of the loudness control should be to remove all artificial bass boost at a sound level equal to that which would be heard if the listener were in the room where the recording was made. Complete instructions on this adjustment are more and more being included in the Instruction Manuals which accompany high-quality equipment, and if the listener is so minded, the facility for proper functioning of his loudness control is at hand.

* *Ampex Corporation, 934 Charter St., Redwood City, Calif.*

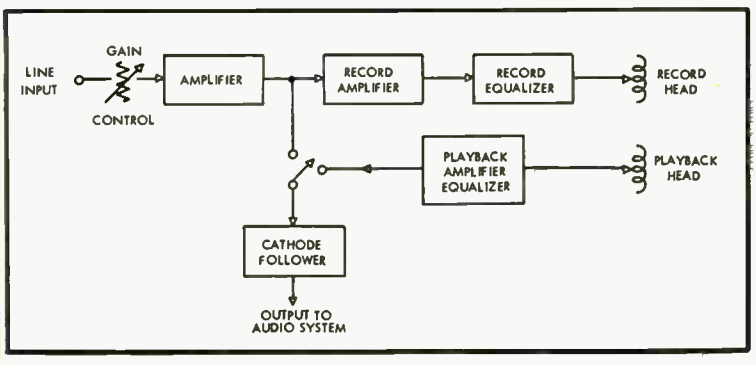

Fig. 1. Block diagram of a typical high-quality tape recorder designed for home use.

The Maximum Hum Control

But the handling of cascaded volume controls, one on the tuner and one on the control box, for example, is not so simple. The way is always open, if not for the high-fidelity enthusiast in the family who is responsible for the purchase and installation of the equipment, at least for other members of the family to adjust the equipment for maximum hum, or for maximum distortion. A tendency will be found, for example, to operate the volume control on the tuner at a medium setting, and then, upon interruption, for the listener to turn the volume down temporarily *at the audio control box*. Following the interruption, the listener may find it most convenient to raise the volume level again, *this time using the tuner control*. Thus, those amplifier tubes which follow the tuner volume control, may well be driven far into distortion, while the volume level of sound in the room is not particularly high, having been reduced by the control box knob. If the knob on the control box is a loudness control, this function will also be disturbed. On the other hand, if the procedure is reversed, and the level of sound reduced at the tuner, then later raised at the audio control box, the "maximum hum" situation will exist. The level of sound through those amplifier stages which exist after the tuner volume control, but before the audio control box volume control, may be sufficiently reduced as to be comparable to the internal hum level, and raising the amplification *with the control box knob* after *the unnecessary reduction* will result only in an *increase* of hum and unpleasantness. The remedy is, of course, to eliminate one of the volume controls, or at least to remove it to a screwdriver adjustment at the back of one of the components, and to leave in the hands of the listener only a single knob for the control of level. In this manner, adequate level in lines between components may be set at the time of installation, for the best compromise between low distortion and good signal-to-noise ratio. The difficulty of predicting what amplifier will be used with a tuner of given design is, of course, the reason for incorporating the control into the tuner in the first place. The thought was that it's better

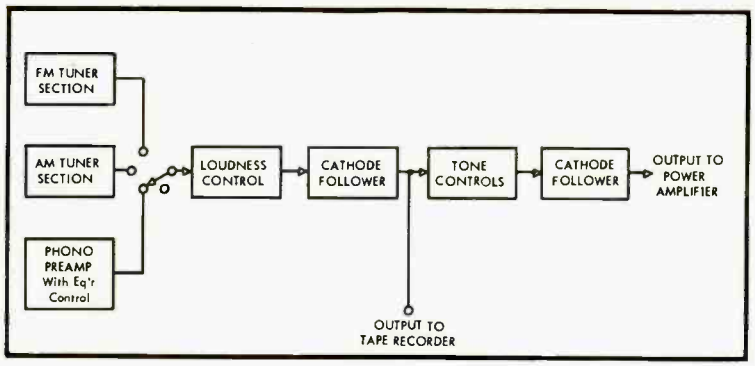

Fig. 2. Block schematic of one model of deluxe FM-AM tuner with magnetic phono preamplifier and tone controls.

to provide more controls than necessary, rather than to eliminate one which may be needed. But it was a bad thought.

Volume controls, as an industry practice, probably should be left off radio tuners, unless these tuners also incorporate phonograph preamplifiers and tone controls, and are intended to serve as complete control centers as well as tuners. If unnecessary controls are provided, the installer ought to remove them. More than one manufacturer follows good practice in this, and others should, for the greater convenience of users and for less opportunity for unpleasant sound in the home. Only those few listeners who wish to eliminate all functions from their systems excepting radio, and who wish no tone controls of any kind will need gain control on the basic tuner. Those may be of sufficient technical skill to devise a convenient volume control for themselves.

"How Many Selectors?"

The duplication of selector controls appears to be a harder problem. On those radio tuners which are designed as an adjunct to an audio control box, there is no justification for the provision of anything other than an AM-FM control, possibly with broad and sharp positions on AM, and AFC or no-AFC positions. Incorporation of selector positions for phonograph, tape, TV, and other sound sources may appropriately be provided only on tuners which also possess magnetic phonograph pickup preamplifiers, and are designed to function as combined tuners and audio control boxes. The ultimate simplification in control is probably provided by those tuners which have been designed for two-channel stereophonic service, and bring each of the two outputs, AM and FM, to separate jacks, for delivery to the audio control box. Such tuners may readily be connected into audio control boxes so that selection of phonograph, AM, FM, tape, etc., may be made on one knob on the audio control box, and there only. Realistically, no selector controls other than those for AM or FM should be incorporated into tuners which are designed as adjuncts to audio control boxes, but only into the tuners which are designed as combined audio control centers and tuners. The very least which we should ask is that the knobs on the front panel of these tuners should be arranged so that if the a.c. switch and volume control are removed, the panel remains balanced and symmetrical. Many home high-fidelity system owners insist that all knobs be left on the panel, even though some are superfluous or rendered functionless, in order to preserve balanced appearance; it should be made possible to preserve both good appearance and good operation.

The Underfed Tape Recorder

As the high-quality magnetic tape recorder becomes a staple in the list of components in a high-fidelity home system, a provision for its incorporation in simple plug-in form becomes a necessity. The logical place for the incorporation of plugs which are intended to connect to the tape recorder input and output is in the audio control box, or into the tuner which is intended to function as an audio control center.

A block diagram of a typical high-quality magnetic tape recorder is shown in *Fig.* 1. In those recorders which use a common magnetic head as both record and playback, the selector switch is so ganged as to perform essentially the same function as that shown. Typically, the line input of the recorder presents a high-impedance load, which may be bridged across a number of available points inside the audio control system, and requires no more than 0.5 volts rms to drive the recorder to maximum record level. This is a simple requirement to meet, although consideration for it has often been omitted from commercial components. The output from a typical magnetic recorder is of low internal source impedance, and relatively high level, which will adequately drive any of many possible points in the audio control system.

There are several typical arrangements for tape recorder connection. *Fig.* 2 illustrates a widely sold deluxe FM/AM tuner with magnetic phonograph preamplifier and tone control, designed to function not only as a tuner, but also as an audio control center. At least four input jacks are provided, one of which is intended for tape. An output is also designated for connection to the tape recorder. The signal which is delivered for recording to the tape recorder is, unfortunately, unsatisfactory. The user may reasonably be supposed to be listening, over his loudspeaker, at the same time he is producing a tape recording. The tuner selector may, then, be set for FM, for example, the loudness control adjusted to comfortable level. The output to the tape recorder, then, located *after* the gain control, is extremely low in level, and is exaggerated in bass, because of the effect of the loudness control at these low listening levels. Typical peak voltages obtained from this array will measure around 50 millivolts. Not only does this provide inadequate drive for the recorder, but it also produces a tape which is artificially heavy in bass. The output to the tape recorder could hardly have been located at a worse position. So far as proper level and proper equalization for the production of a flat tape recording are concerned, the tape recorder jack might better be connected between the loudness control and the selector switch. A cathode follower would be advisable, of course, as isolation, and in order to assure that the load of the tape recorder and the capacitance of the interconnecting cable would not affect the over-all performance of the system, or of the recorder.

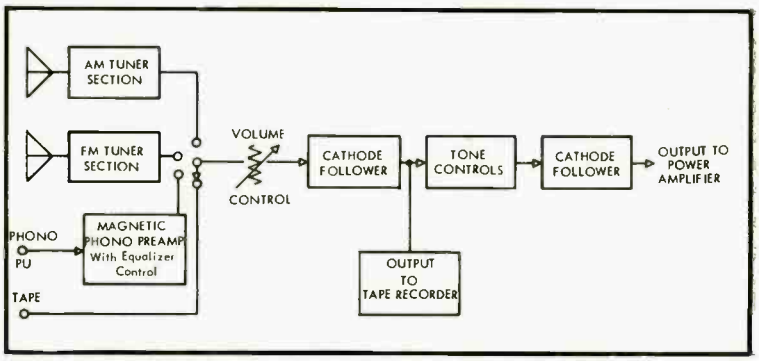

Fig. 3. Arrangement of popular-priced FM/AM tuner with phono preamp and tone controls.

The Case Of The Howling Tape Recorder

With the configuration of *Fig.* 2, however, still another source of unpleasantness for the listener is offered. Assuming that a recording has been made, the listener may now switch the selector control on his tuner to the fourth position, into which the output of the tape recorder has been plugged. Referring to *Fig.* 1, if the tape recorder selector switch has been left in the "record" position, a feed-back path is created from loudness control through cathode-follower to tape recorder input, to tape recorder output, to selector switch, to loudness control. The result is usually a loud howl. This effect can be avoided, of course, if the listener is careful always to turn his tape recorder switch to "playback" *before* he changes the position of his tuner selector control, but it would surely be good design to prevent so likely a cause for unpleasantness.

Figure 3 is of a lower cost tuner than that in *Fig.* 2. This unit does not have the fault of presenting to the tape recorder an artificially unbalanced signal, since the volume control is not a loudness control, but it does have the same fault as the tuner of *Fig.* 2 in being likely to be so used as to present a very small signal to the input of the tape recorder, due to the listener's having set his volume control for comfortable listening, rather than for adequate level for recording. This configuration also possesses, still, the possibility of feedback "howl."

Figure 4 outlines the configuration of a popular deluxe one-piece power amplifier and audio control box. In this case, the output to the tape recorder is of adequate *level*, but has been subjected to "tone control" whose purpose is primarily that of adjusting the sound for most comfortable listening, rather than for flatness. There is good reason for tone controls, of course. But a flat signal should nevertheless be presented to the tape recorder. Tone controls are for playback, and not for recording. It should be assumed that the listener will wish to adjust his tone controls, every time he listens, for conditions which exist at the moment, and which may not always be the same. To feed a signal through the same set of tone controls twice is to "double" the effect of the tone controls upon playback. On only one generation, with such a process, a 12 db-per-octave bass boost slope may be obtained, or a very sharp high-frequency cut-off be introduced.

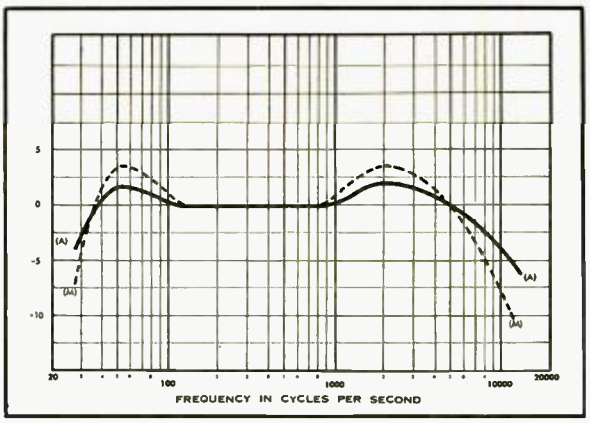

Fig. 5. Curves showing additive effect when signal passes twice through an amplifier which is not perfectly flat.

Double Dipped Tone Controls

Even if the "tone controls" are set at the "flat" position, which often is not marked accurately on the control panel, this position usually is a little off true flatness. Typical of the "flat" position on tone control systems is the curve shown at (A) in *Fig.* 5. This curve, it is true, is "± 2 decibels from 50 cycles to 8,000 cycles." But, suppose the tape, which has been recorded to this degree of "flatness," is now played back, through the system shown in *Fig.* 4. Even though the tone controls be left *unaltered*, the playback curve differs from flatness by twice the amount of Curve A, forming Curve M. This, flat now only by ± 4 decibels from 50 to 8,000 cycles, is sharply rolling off at both low and high frequencies, with severe "bumps" in response. Small deviations from flatness in the tone control system, which are entirely negligible so far as the original function of the controls is concerned, now become major sources of unpleasantness, which may be blamed upon the tape recorder, even though, in this example, the tape recorder was assumed to be perfectly flat in frequency response. If the tone controls had been set for only a little departure from the nominally "flat" position, the results would have been even worse.

Figure 6 illustrates a high-quality commercial audio control box which provides the tape recorder with a flat signal of adequate level. With this control box, the possibility remains for feedback, if the listener chances to select "tape" on the control box before switching the recorder to "playback," but all other considerations of good practice are observed. The general configuration of the commercial system in *Fig.* 6 is shown in *Fig.* 7. Great flexibility in the arrangement of loudness or volume controls, tone controls, sharp high or low cut-off filters, and so forth, may easily be designed without essentially changing this arrangement. Only the feedback problem remains.

High Fidelity Unlimited

Figure 8 shows an ideal configuration for incorporating a tape recorder into a high-quality home music system. Whether the arrangement for this connection is made in a tuner which is designed also as an audio control center, or in a deluxe audio control box is unimportant. The provision for placing the tape recorder in *series* with the circuit is the key to the removal of any possibility of feedback "howl." A low impedance-source signal to the tape recorder line should be provided—cathode followers work well. A jack should be provided for this output. If, then, *no connection* were normally provided between this and the jack which is to bring back the output of the tape recorder, the possibility for series insertion of the recorder exists. A simple jumper may be provided as standard equipment, to be removed when the tape recorder is installed. With this connection the tape recorder is either left on at all times when the system is being used, or the tape recorder may be provided with a means of automatically connecting its input to its output, directly, when the recorder is turned off. Such an arrangement is offered as standard equipment on some tape recorders which have been designed for home use, and is available as a factory modification on others.

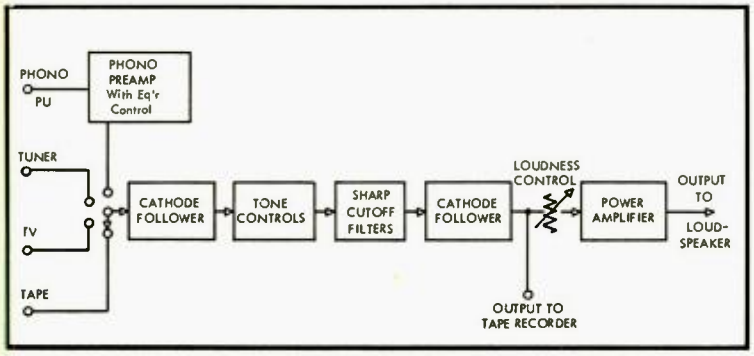

Fig. 4. Block diagram of deluxe one-piece power amplifier and audio control unit.

Hi-Fi Surgery

When the owner of a high fidelity system, on which he may have spent many hundreds of dollars, buys his tape recorder, it is too late for corrective action by the manufacturer of his tuner or of his audio control box. If the machine is to function well as a unit, some sort of "corrective surgery" is going to be needed. This may range from simply unsoldering one connection from its present location, and soldering it to a new one, all the way up to the incorporation of an additional tube, and the changing of several wires. None of these procedures is beyond the skill of a typical hi-fi technical enthusiast, but probably ought to be undertaken only by his serviceman if the listener is one of the many thousands of newcomers to the field whose interest lies mainly in the music and not in the knobs and gadgets.

A tuner like that illustrated in *Fig. 2* might be modified in either of two ways. A single wire will be found which leads from the jack marked "output to tape recorder" to a certain pin on one of the tubes. This wire may be unsoldered from the tube, and transferred to the selector switch, being soldered to that lug on the switch which represents the "rotor" or, if more convenient, to the "top end" of the loudness control. A more elegant solution would be to cut the chassis at a convenient point, to mount a new tube, such as a 6C4, in a tube socket, and to connect this newly added tube as a cathode-follower. The wire leading to the "output to tape recorder" jack would, then, be connected to the output of the cathode-follower, while the grid of the newly added cathode-follower would be connected to the rotor of the selector switch. Appropriate values for such a cathode-follower are shown in *Fig. 9*. Connection of the follower to the tuner's filament supply will probably present little problem, but the selection of an appropriate connection for the plate should be done most carefully. A point on the schematic diagram of the tuner should be found at which considerable "decoupling" has already been provided, and at which a large capacitor is already connected. The plate of any cathode-follower should be connected to a high-voltage d.c. source which is effectively "grounded" for audio signals. In most cases, it will be found that the follower will function well if its plate is connected to the same point as the high-voltage end of one of the plate resistors in a low-level audio amplifier stage.

If, in the case of a tuner like that in *Fig. 3*, no attempt is made to install a cathode-follower, care must be taken that the wire which carries the signal to the tape recorder is of the "low-capacitance" shielded type, and that the input impedance of the tape recorder is not so low as to "load" the volume control unduly. Otherwise, some distortion could occur, and if the wire were of high capacitance, the high-frequency response of the system could be impaired.

The audio control box illustrated in *Fig. 6* offers the possibility of simple wiring changes in order to effect the "series" configuration of *Fig. 8*. It is possible to lift the connection between the cathode-follower and the loudness

(*Continued on page 99*)

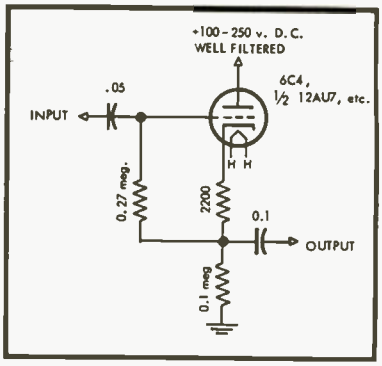

Fig. 9. Schematic of cathode follower stage which can be added to a tuner or control unit to provide suitable coupling to a tape recorder input.

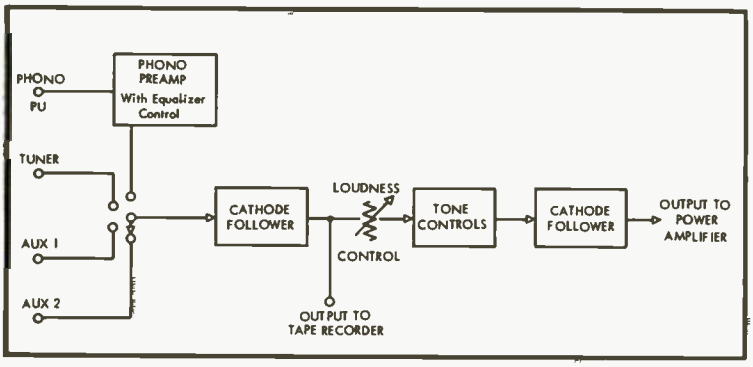

Fig. 6. Block schematic of high-quality commercial audio control unit.

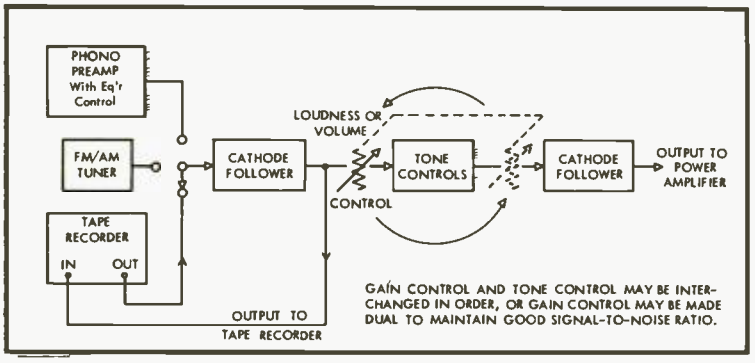

Fig. 7. General configuration for control box or tuner control system. Possibility of feedback is still present even with this arrangement.

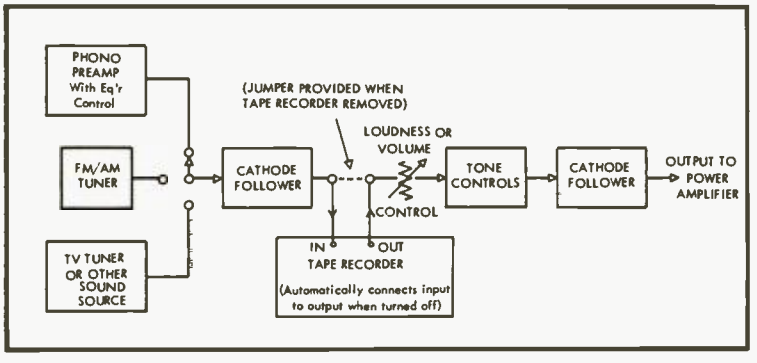

Fig. 8. Ideal configuration for incorporating a tape recorder into a high-quality home music system.

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The key-switch circuitry of the new models is much changed from the old system, both electrically and mechanically. The high impedances of the old generator outputs made shunt keying mandatory; that is, switches were normally closed, grounding undesired tones. Not only did this require more components and more labor, increasing the cost, but a switch with nonfunctioning contacts would cause a "cipher," a continuous sounding of the tone. Inevitably any switch will once in a while fail to work, but it is far less disturbing to have a failure of a tone than to have it sound continuously.

The new system, drawn in part in *Fig.* 10, employs the series keying method, with normally open switches, Each tone is brought to the appropriate switch through a 0.1 megohm isolating resistor. When a key is played the switch closes, passing the tone to output busses which run the length of the assembly. The switches are actually three-circuit ones, so that when a key is played tones of 4-, 8-, and 16-foot pitches are brought to the respective busses. The resistor-capacitor networks to which the busses are connected are key-click filters, tailored in values to the specific ranges which they cover, so that clicks are almost eliminated but minimum harmonic structure of the tone is affected.

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

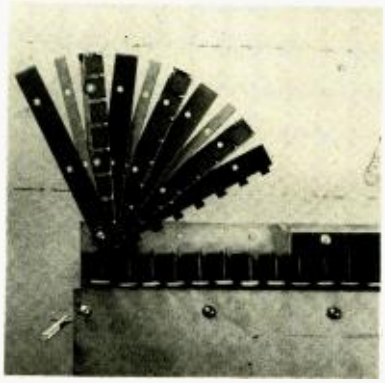

Fig. 11. One end of a key-switch assembly, showing the switch blocks, printed-circuit output busses, and separators.

The key switches themselves are no longer the flat blade type. When used for series switching these units have too large a capacitance between the opened blades, and there is leakage of unkeyed tone into the rest of the system; the result is an annoying whine in the background. Part of a key-switch assembly, opened and fanned for view, appears in *Fig.* 11. The switches themselves are blocks of phenolic in which three silver-alloy fingers are set. A small phenolic actuator is placed over the fingers and when the key comes down it hits the actuator, which forces the fingers down. Each finger strikes a gold bus wire running at right angles to it. Because the entire switch consists only of two thin crossed wires capacitance across an open switch is negligible and there is no audible leakage whatever. The combination of materials results in trouble-free contacting over a long period.

Pedal Tone Generator

The main tone generators provide only five octaves of tones equivalent to the

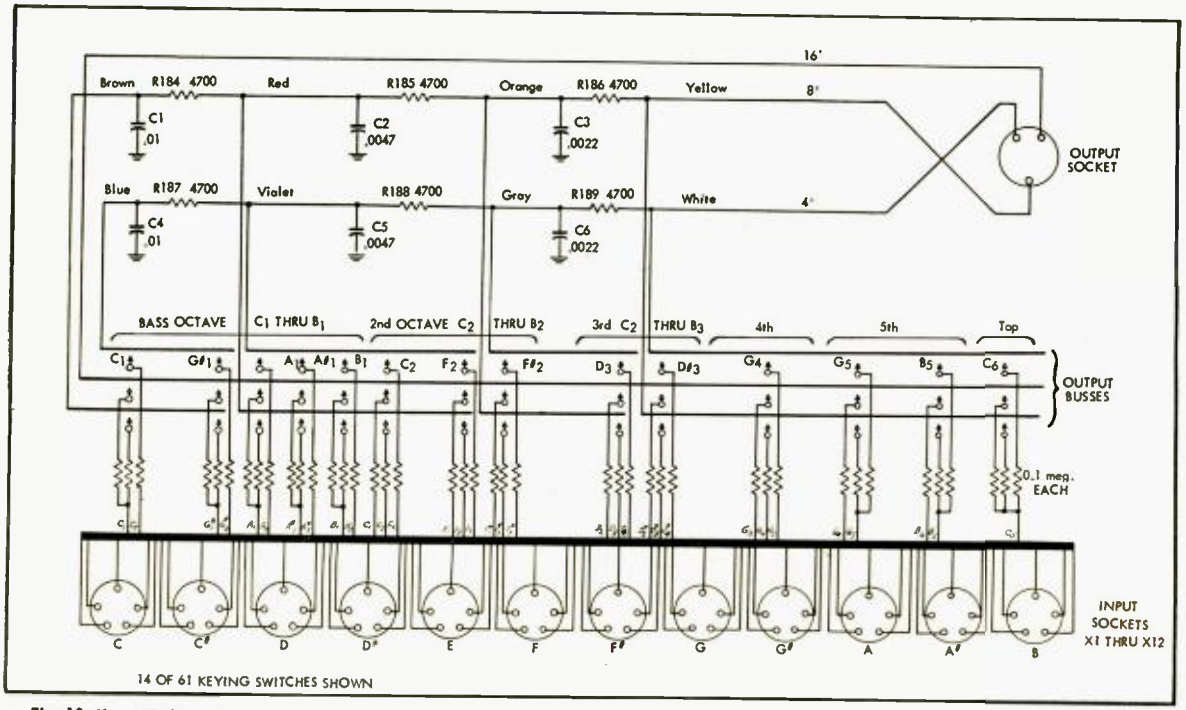

Fig. 10. Key-switching diagram for the swell manual. Great wiring is the same, with addition of plugs and cables to carry tone up to swell.

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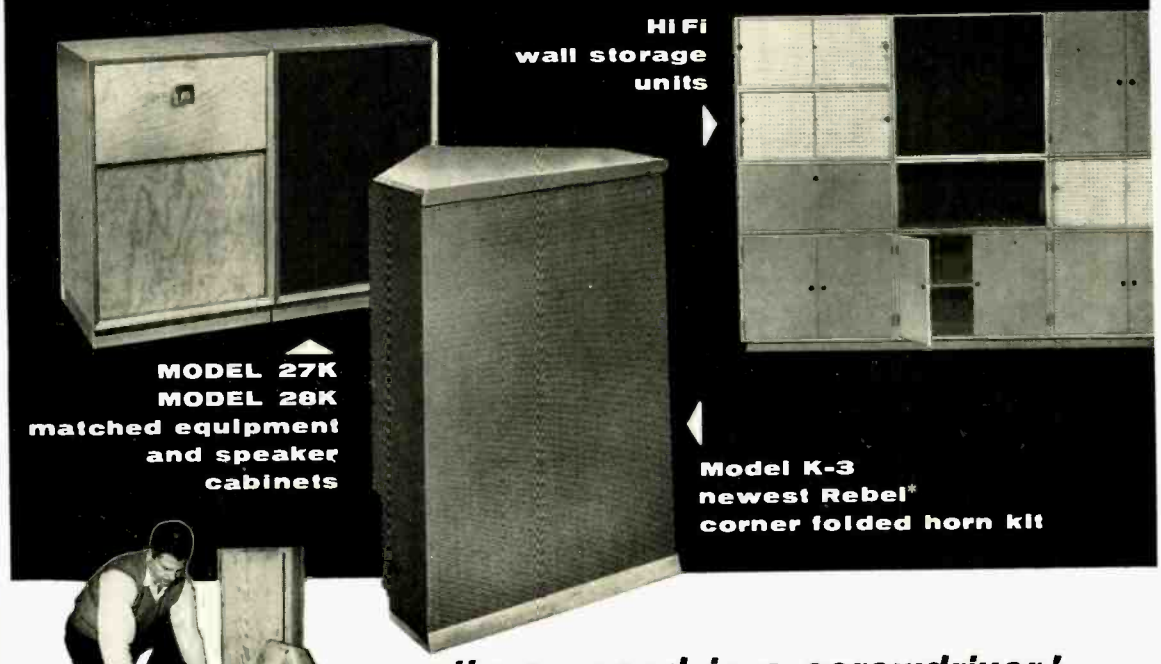

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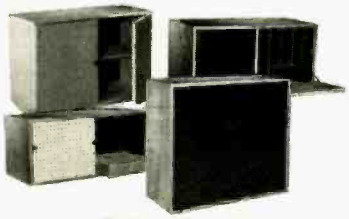

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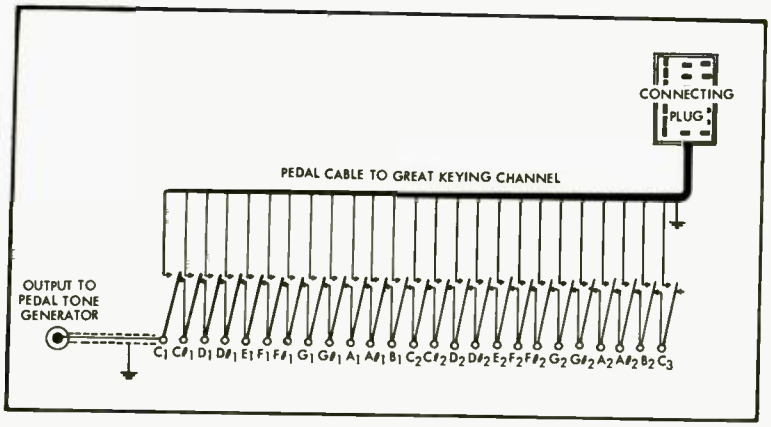

Fig. 12. Diagram of the pedal-switch assembly. Tones from the main generators are fed through the large connector to the switches.

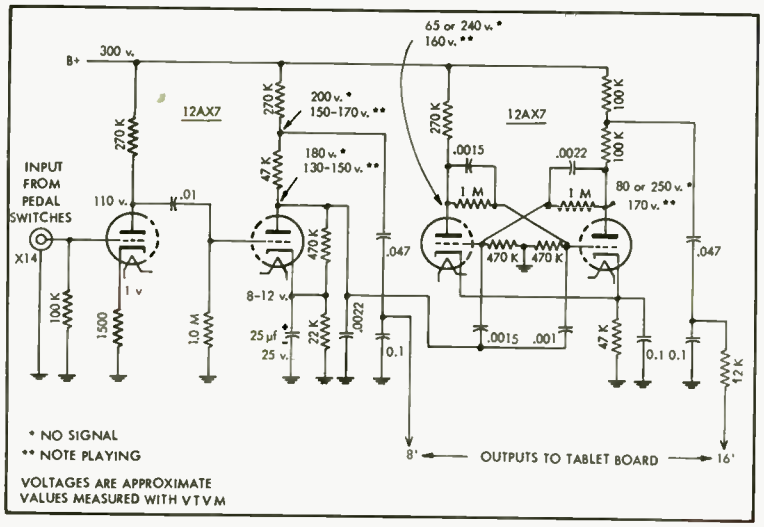

Fig. 13. The pedal generator, consisting of amplifier, wave shaper, and flip-flop.

8-foot range of the standard 61-note manuals. The 4-foot tones for the upper manual octave are repeats of the upper-octave 8-foot tones and the lower-octave 16-foot tones are repeats of the 8-foot lower-octave tones. In the earlier models 16-foot pedal tone was derived from a "resultant bass"* arrangement which mixed the lowest 8-foot tone with its musical fifth and produced a beat note an octave below the fundamental. The actual 16-foot component of this system was small and the idea unsatisfactory from every angle but cost.

In the new models actual 16-foot tone is derived from a special pedal generator which requires only two tubes for the entire pedal section. It is actually not a generator at all but a wide-range frequency divider.

Figure 12 is a schematic diagram of the pedal keying switches. Each switch is a single-pole double-throw unit and the diagram shows the switches in normal (unkeyed) position. Eight-foot tone from the main generators is fed through the connector and cable to each of the switch contacts as shown. When any pedal is pushed, its switch changes positions and the corresponding 8-foot note is brought to the output. Because of the switching arrangement, only one tone at a time can appear at the output, the lowest of any number played simultaneously.

The pedal generator is shown schematically in *Fig.* 13. The 8-foot tone from the main generators through the pedal switches goes to the first grid of a 12AX7 amplifier and from its plate to the second half of the tube which is a wave shaper giving the tone the proper shape to trigger the following flip-flop circuit. The second 12AX7 is an aperiodic flip-flop which is nonfrequency-sensitive over a wide range. The 16-foot output is taken from one plate circuit so that for every two input cycles there is one output cycle. The 8-foot output is taken from the second plate circuit of the first tube. Both are fed to the tone-color section. This is an extremely neat, inexpensive, and effective method of deriving real 16-foot tone.

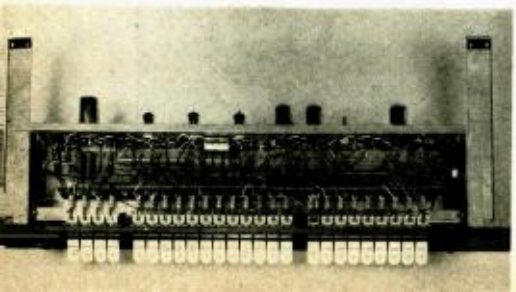

Fig. 14. The tablet board holds the tab switches and the chassis containing bus amplifiers, tone filters, and preamplifiers.

Tablet Board Circuitry

The stop filters, bus amplifiers, and preamplifier are all located on the tablet board assembly, which consists of the wood board above the swell manual on which the stop tablets and other controls are mounted, to which is attached a metal channel containing the circuitry. This is shown in the photograph of *Fig.* 14. *Figure* 15 is the schematic diagram of the bus amplifiers, whose function is to amplify preliminarily the voltage appearing on each of the manual keying output busses before it is applied to tone filters.

Each of the triode voltage amplifier grids is fed signal from one keying bus, the bus being terminated by a 12,000-ohm resistor. The 16-foot tones from both manuals go through to the grids without isolating resistors, but the others have resistors between bus and grid. Each triode has voltage feedback, a capacitor and resistor from plate to grid; the purpose of this is to give an effectively low output impedance.

There is one coupler on the organ, a Swell to Great. This means that when the coupler switch is closed, as it is in the diagram, 8-foot and 4-foot tones keyed on the great manual will pass through the 8-foot and 4-foot filters associated with the swell manual. This means, of course, that they must be mixed into the swell busses. Note how the 4-foot great tones are handled for this purpose. Tone from the keying bus is fed to its tube through a resistor and to the coupler switch which, when closed, injects 4′ great tone into the grid circuit of the 4′ swell amplifier tube. An important point in this process is that the 4-foot swell output from its amplifier and the 4-foot great output from its amplifier must not change in level with operation of the coupler switch. Effects on the 4-foot great amplifier are prevented by taking the coupling line directly from the bus ahead of the isolation resistor and making sure that when the switch is closed this point is shunted by nothing which would be comparable to 12,000 ohms.

Preventing some effect on the 4-foot swell tone is not so easy, but it is done here in a very neat way. The output of the 4-foot swell amplifier depends on the magnitude of the feedback. This depends on the total value of resistance between grid and ground, since this resistance is the shunt leg of a voltage divider for feedback. The value of the 4-foot swell voltage reaching its grid is also dependent on the total value of the series resistors since these are the shunt leg of a signal voltage divider. When the coupler switch is closed, the 4-foot swell voltage

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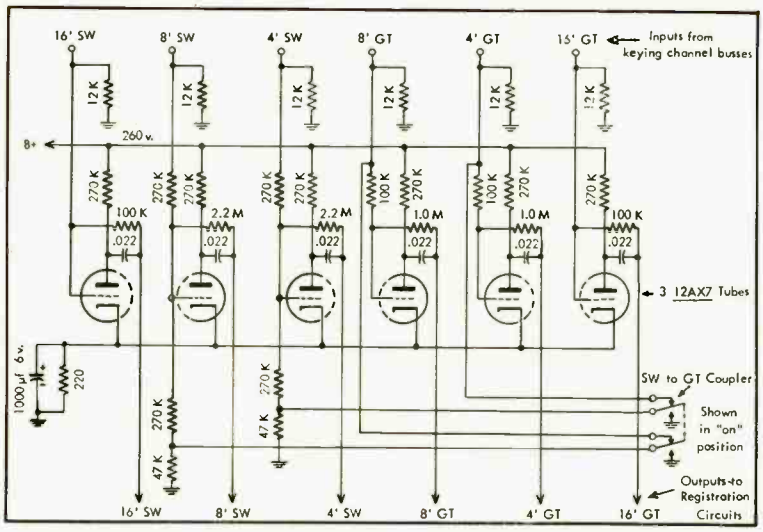

Fig. 15. Bus amplifiers and coupler system.

at its grid is decreased because of the lessening of the total resistance between the grid and ground. However, this decreases the feedback voltage fed around the 4-foot swell tube, so that its gain rises just enough to restore the former output level, now with the addition of the 4-foot great tone. The same process applies to the 8-foot coupling.

Figure 16 shows the tone filters for the great stops, of which there are eight. The idea here is the same as in the Baldwin and the Schober organs—formant filters which simulate the acoustical effects of the various spectrum characteristics of different instruments or types of organ pipes. These filters are less complex than those in the Baldwin and Schober because the initial tone is not so complex and not as much filtering can be or need be done.

The swell registration is shown in *Fig.* 17, and again the principle is the same. Here, however, two little tricks have been used. Among the 12 stops there is a 2-foot salicet, which seems surprising in view of the fact that there is no 2-foot keying bus. The salicet is actually operated from the 4-foot line, but it is a very stringy tone (note the high-pass filter) almost devoid of fundamental content. Because of the lack of 4-foot fundamental it actually sounds an octave higher than, say, the 4-foot flute.

The second trick is in the clarinet filter. The normal clarinet tone is almost devoid of even harmonics. In the Baldwin organ the symmetrical tone without even harmonics is obtained for this purpose by an outphasing circuit, which is patented. In the Minshall the same effect is achieved (over a limited range) by so designing the tuned circuit that its phase shift with respect to the tone fed directly through tends to cancel even harmonics. The resulting tone is not quite authentic but is improved. *Figure* 18 shows the pedal registration schematic with its four stops.

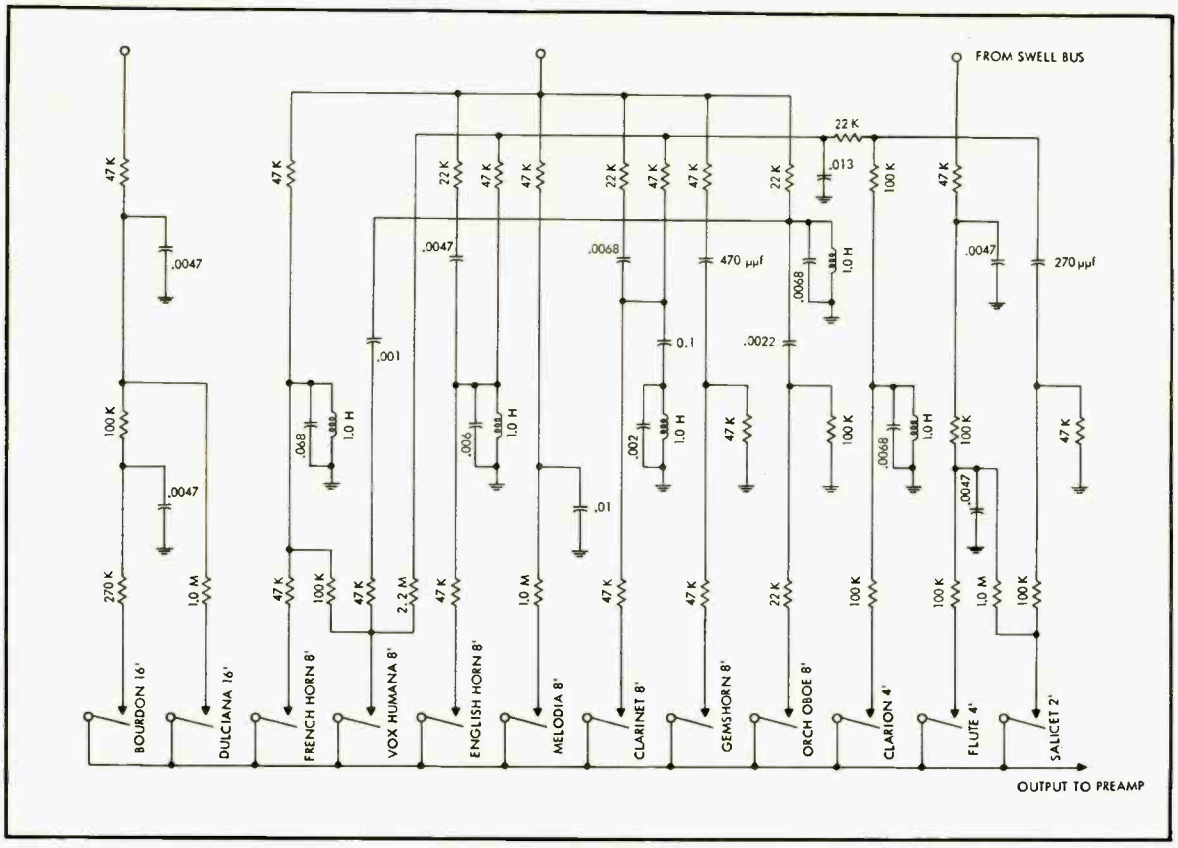

Fig. 17. The swell registration circuit.

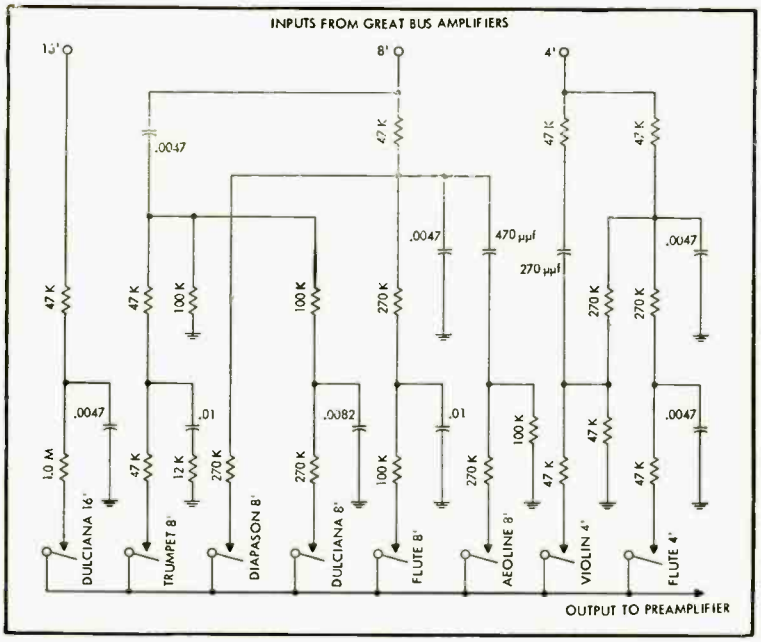

Fig. 16. Tone filters and tab switches for the great.

The preamplifier, also located on the tablet board, is diagrammed in *Fig.* 19. Outputs from the swell and great registration sections go to the grid of the first tube. The pedal output passes through a "balancing" section so that the pedal level can be adjusted for any set of auditorium conditions with respect to the manual levels. This first triode has feedback around it. Volume of the organ is controlled between the first two stages by a swell-shoe control which varies the impedance of the shunt leg by a voltage divider, being compensated for loudness by the capacitor network which raises the comparative level of the bass as volume decreases. A brilliance control in the plate circuit of the second stage is simply an old-fashioned tone control. The third stage is a cathode-coupled phase splitter and the preamplifier output stage is push-pull with feedback around each half. The "chimes" input is to be used with any of the commercial electronic chime devices, most of which consist of struck bars whose vibrations are picked up electrically and amplified.

Figure 20 is a schematic of the amplifier and supply sections. The amplifier, rated at 15 watts output, consists of a pair of 6L6's with cathode feedback from

(Continued on page 73)

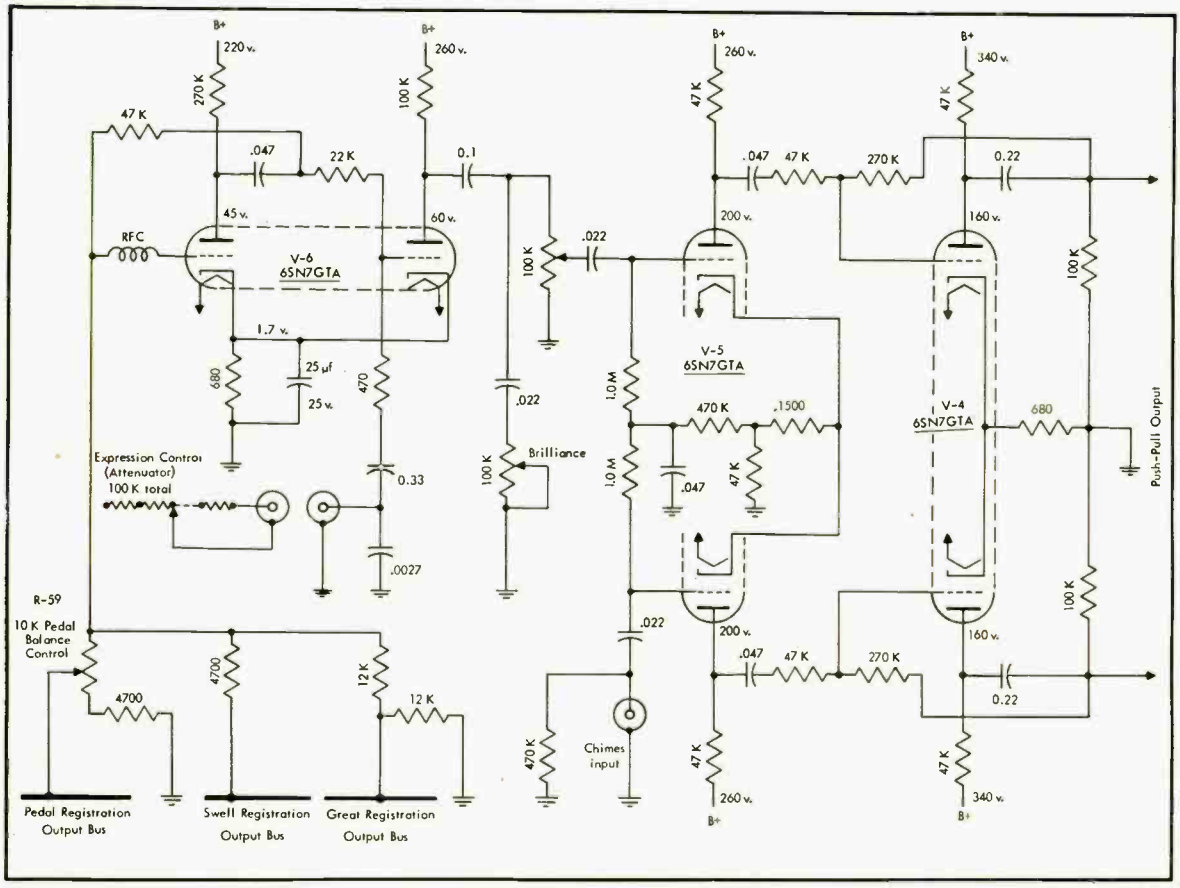

Fig. 19. The preamplifier circuit, with swell-shoe and brilliance controls and push-pull output.

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Unique Relationships

NORMAN H. CROWHURST*

Sugar-coated only slightly, but basic audio engineering mathematics which facilitates determining phase shift when attenuation is known, and vice versa.

THE WRITING of this kind of article presents somewhat of a problem. If all the mathematics necessary to prove the various statements made are put into the article, the reader who would really benefit from the article would probably shy away from it after one look at the formulas scattered around. On the other hand, if the mathematical proof is not furnished, the article will lead to endless controversy among the people who require rigid mathematical proof before they will believe anything. To try and overcome this difficulty, the discussion is presented first and the necessary mathematical formulas are reserved to the end of the article. This will serve two purposes: it will avoid frightening the reader who would not understand the mathematics anyway away from reading the article at all; and it will also serve to force the writer into expressing himself without being entirely dependent upon the mathematics, which would make his presentation incomprehensible to the reader who cannot follow the mathematics.

Let us start by being a little historical. In the early days of amplifier design, before Doctor Bode and various other people wrote on the subject, the question of mathematical prediction of circuit behavior was regarded as being so complicated that even the best mathematicians would leave it alone, and so amplifiers were designed on the principle of trial and error. Later on amplifiers were required for such specialized purposes that a degree of perfection became necessary that could not be achieved by trial and error methods. This situation gave rise to the approaches adopted by the mathematical geniuses.

In view of the fact that the mathematical approach was recognized to be extremely difficult, it was only natural that the professors of mathematics, to encourage others to follow along and make use of the techniques that they had developed, should stress the simplification which their various approaches introduced to the problem. It is true, of course, that each new method of attack did provide some advantages which simplified the approach to certain aspects of the design problem. The more mathematically inclined readers of this literature would probably correctly assess the degree of simplification achieved and also the exact sphere of application, but for the majority of readers who found the formulas presented to be slightly over their heads, these articles have proved to be somewhat misleading.

Reading between the formulas it appeared that various simplifications were achieved, but because the formula was not thoroughly understood, the sphere of application of each simplification was not correctly assessed. The most prominent example of this concerns the principle that there exists a unique relationship between the attenuation response, the phase response and the mathematical representations of the combined response by the more advanced complex p plane, with poles and zeros, etc.

Most readers understand the idea of an attenuation response, because this is something that can readily be plotted out, by applying a constant input, changing the frequency, and measuring the output. Phase response is not difficult to comprehend either, because this can be shown on the oscilloscope by means of an ellipse which compares the output voltage and phase with the input voltage. But, when the mathematician dives off into his presentation on a complex p plane, and tells the reader that left and right of the vertical axis correspond with active and passive circuits, and above and below the horizontal axis are conjugate pairs corresponding to real frequencies, most readers are quite lost. The various quadrants of this diagram mean nothing to him in relation to a tangible frequency response.

It is still true, of course, that a particular pattern of poles and zeros, plotted on such a complex p plane, have a unique relationship with the attenuation and phase characteristics which it represents, but this does not help the reader very much to see how he can apply the unique relationship. So the only thing that our readers have gleaned is that their exists such a unique relationship. This *should* be very useful. And the average teacher, being of an inventive turn of mind, and wanting to apply information to his own advantage, tries to find some other way to use this unique relationship, that does not involve the complex p plane, which he completely fails to understand.

Unit Slope

Next we come to the concept of unit slope, which also has been introduced with the necessary mathematics. The general idea of unit slope is built around the fact that a single reactance, contributing to a roll-off characteristic, produces an ultimate slope of 6 db per octave. A further reactance will modify the shape of the roll-off and ultimately produce a slope of 12 db per octave so each 6 db per octave of slope is considered a "unit" slope, Associated with each unit slope is a characteristic phase shift of 90 deg. because the single-unit reactance roll-off produces an ultimate slope of 6 db per octave and an ultimate phase shift of 90 deg.

* *150-46 18th Ave., Whitestone 57, N. Y.*

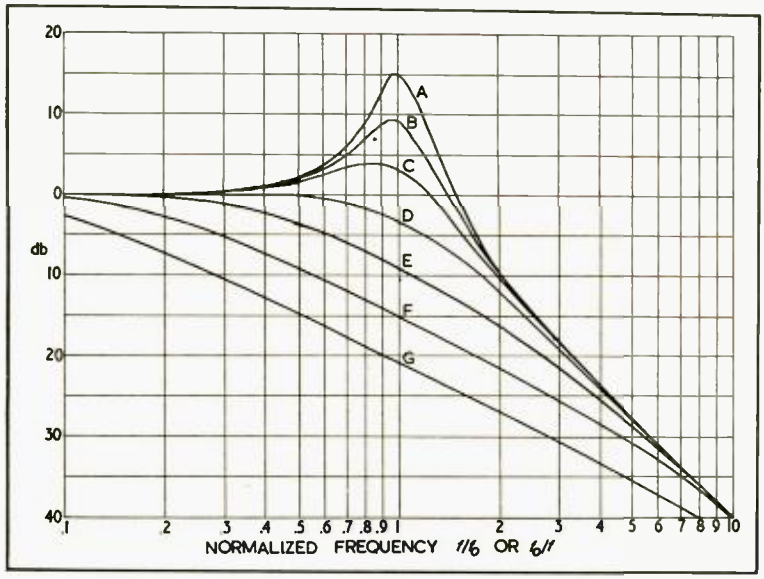

Fig. 1. Family of attenuation characteristics for two-reactance roll-off circuits.

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With these general ideas mulling around, the reader with insufficient mathematical backround tries to apply the information, on the assumption that there is *some* inherent relationship between the slope of the attenuation characteristic at any point and the phase characteristic at this point. This misconception is natural enough, arising out of inaccurate knowledge and an over-simplification of the various presentations available. The purpose of this article is to help readers who have been unintentionally led up this particlular garden to see that it is not really quite as simple as this, so that they do not fall into some of the pitfalls that arise from this over-simplification.

Starting with a single reactance roll-off, either at the low- or high-frequency end, the relationship between the attenuation characteristic and phase characteristic is always completely unique. The 3-db point corresponds with the phase shift of 45 deg. and every other attenuation point corresponds with its own unique value of phase shift. So, by normalizing frequency to a reference point of 3 db or 45 deg., a single pair of curves represents every possible response of this type.

Turn now to the case of roll-offs for which two reactances are responsible, either in successive stages of an amplifier, or in a single coupling circuit where there is inductance as well as capacitance, or where feedback may produce a similar interaction between successive stages to that occurring between inductance and capacitance. Here a whole family of characteristics is possible. This family of characteristics, referred to the most useful normalization frequency, is shown in *Figs.* 1 and 2.

This normalization frequency is the only point at which there is a unique relationship between attenuation characteristic and phase response for the two reactance combination. The point of 6-db-per-octave slope on the attenuation characteristic always corresponds with the 90-deg-phase-shift point.

Apart from this there are other unique features about the individual characteristic—for example, there is an upward maximum slope and a downward maximum slope in the case where a peak exists. These points are spaced apart so that the 6 db per octave slope point is a mean between them. The frequency of peak and the frequency where the attenuation response recrosses the zero level are always related to one another by the ratio $\sqrt{2}$. If the peak frequency—or where there is no peak, a corresponding imaginary transition frequency—is used as the normalizing reference frequency, the attenuation response can be given in universalized form, with a sliding scale, modified, for db reference. For any particular pair of attenuation and phase responses, there is a unique relationship between this normalizing frequency and the one used for the responses illustrated in *Figs.* 1 and 2.

Any particular shape of attenuation characteristic always corresponds uniquely with a particular phase response in the family.

Now we proceed to circuits employing three or more reactances to produce the roll-off at one end of the frequency response. The mathematics for the three reactance case, given in the appendix to this article, show that there is no longer any particularly unique reference between phase and attenuation. As already stated any completely specified attenuation response will have a unique corresponding phase response, but there is no simple means for determining one from the other by a simple two reference system, as was the case with the two-reactance roll-off. One might expect the 90-deg. and 180-deg. points to correspond with the 6- and 12-db-per-octave slope points, but they do not necessarily, in fact it would be a very special case where this occurred.

Summary

The performance of a network *can* be completely specified in a number of ways, and there are unique relationships between any complete specification and any other.

The statement of what constitutes a complete specification seems to have been left rather vague in earlier literature on the subject. One reason why mathematicians prefer the specifications on the complex p plane is because this is easier to comprehend from this viewpoint of the complete specification than the attenuation or phase characteristics. But it is not too easy to see immediately from such a presentation what the attenuation and the phase characteristics will look like.

The coefficients of the various order terms in the equation for frequency response can also be a basis for complete specification of the characteristic, as will appear from the Eqs. (*1*), (*4*), and (*12*) in the appendix. It is possible to analyze these formulas in much greater detail than is given here, where only enough has been given to illustrate the purpose of this article.

To completely specify a characteristic, it is necessary to know something corresponding to

(a) the number of reactance elements involved to produce the response and

(b) the relationship between the various reactances.

There is a variety of ways of specifying this, such as the complex p plane or the complete response equations of the form given in the appendix. But to know the unique relationship between attenuation and phase characteristic, it is necessary to have something corresponding with the whole expression.

On this basis it is hypothetically possible, given the complete attenuation characteristic from zero to infinity, to compute the complete phase characteristic from zero to infinity, or vice versa, but it is not possible, except in the simplest of characteristics, to compute one response from the other, given only a few points and the slope or attenuation at these points.

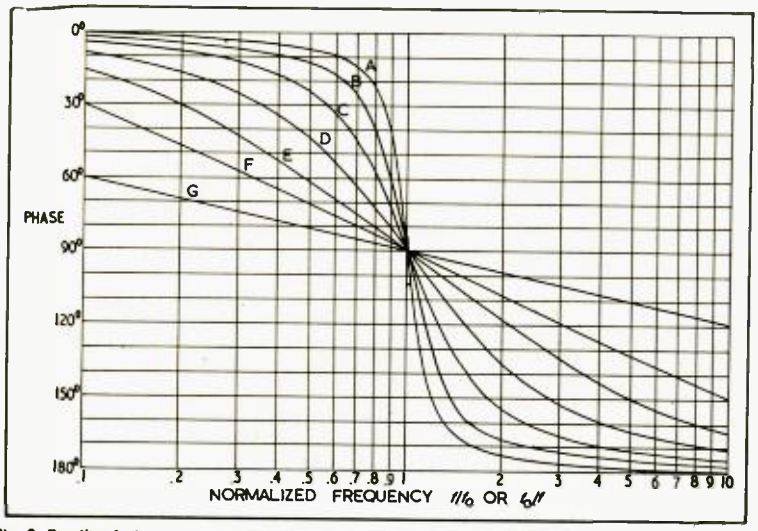

Fig. 2. Family of phase characteristics corresponding with the attenuation characteristics of Fig. 1.

Appendix

Using x to stand for f/f_n, where f_n is the normalizing frequency for a high-frequency roll-off, or for f_n/f, where f_n is the normalizing frequency for a low-frequency roll-off, the complex attenuation factor for a single-reactance roll-off can be expressed:

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

From this we can derive the attenuation response,

$$dbatt = 10 \log_{10} (1 + x^2) \qquad (2)$$

and the phase response,

$$\varphi = \tan^{-1} x \qquad (3)$$

Where two reactances contribute to a roll-off, the complex attenuation factor can be generalized,

$$A = 1 - x^2 + jax \qquad (4)$$

From this we can derive the attenuation response,

$$dbatt = 10 \log_{10} [1 + (a^2 - 2)x^2 + x^4] \qquad (5)$$

and the phase response

$$\varphi = \tan^{-1} \frac{ax}{1 - x^2} \qquad (6)$$

(*Continued on page 106*)

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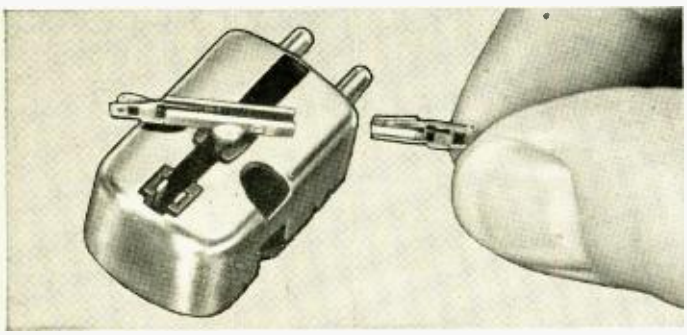

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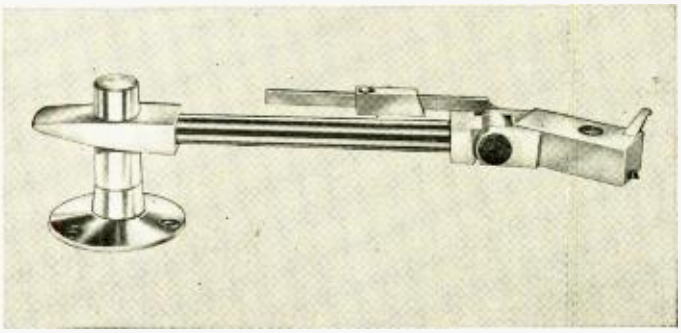

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High-Gain Transistor Amplifier

JAMES J. DAVIDSON*

The author describes the preamplifier section of one of the first commercial radio-phonograph combinations to employ a transistor for this purpose.

AN ASPECT OF THE TRANSISTOR often overlooked in its application is the tremendous voltage gain available when the unit operates into a high impedance. The design engineer often considers the use of tubes exclusively, or transistors exclusively, with little thought toward the advantages to be gained by using both units as companions.

Transistor art and economics have advanced to the point where transistors should seriously be considered in low-level applications where the input loading is not a serious drawback. The transistor appears inherently capable of a lower noise factor than vacuum tubes. This is due to the absence of microphonics and the complete elimination of heater problems. In combination with a voltage gain of the order of 1000 to 1500 times over the complete audio-frequency range, the transistor offers wide possibilities in such low-level applications as dynamic microphones and phonograph pickups.

The Basic Circuit

A very simple and basic circuit which will demonstrate the advantages and disadvantages of high-gain transistor amplifiers is shown in *Fig.* 1. The circuit diagram is presented in a simple straightforward manner solely for the purpose of illustrating the fundamental considerations of the high-gain amplifier. Therefore, no attempt is made to compensate for temperature effects which severely alter the behavior of the transistor in this circuit unless the ambient temperature is kept within the range of 20° to 25° C. The subject of compensation will be treated subsequently.

* *Engineering Department, RCA Victor Radio and "Victrola" Division, Camden, N. J.*

Slow in gaining a foothold in high-quality audio applications, the transistor is certain to find its niche in this field. As shown by this author, lower noise levels and higher gain can be achieved. Articles on uses of transistors in amplifiers and test equipment will be welcomed, particularly where the uses are in keeping with the requirements for hi-fi reproduction.

In terms of familiar vacuum tube parameters, the most startling difference between tubes and transistors is in the range of transconductance. While the customary values of tube transconductances lie in the range of 3000 to 8000 micromhos, with special types of tubes going as high as 11,000, ordinary transistors exhibit characteristic values in the range of 30,000 to 40,000 micromhos. This remarkable property, in combination with an output impedance of the order of 100,000 ohms yields unusual audio-voltage-gain figures. For example, assuming an output impedance of 100,000 ohms, a g_m of .03 mho, and a load resistance of 100,000 ohms, the gain

$$K = g_m \frac{(R_o R_L)}{(R_o + R_L)} = .03\ (50{,}000) = 1500$$

The measured gain of *Fig.* 1 is 1300, and is down 3 db at 23 kc. The input impedance is 2000 ohms.

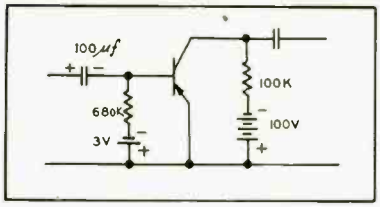

Fig. 1. The basic high-gain transistor amplifier.

Distortion Comparisons

In most applications, the linearity of the stage is an important factor. For small input signals, the input characteristic offers no trouble, but, unfortunately, the same cannot be said for the output. *Figure* 2 shows a family of collector curves for 3 microamp increments in base current. The slope of each line represents the dynamic output impedance of the unit, as the bias is varied. As is clearly indicated, the impedance decreases from 200,000 ohms to about 60,000 ohms as the base current increases from 0 microamps to 24 microamps. Although impedance variations resulting from collector current changes do contribute to distortion, the problem is not serious in most cases. When the load impedance is small, such as that presented by another transistor, an output impedance as low as 60,000 ohms will be negligible compared to the load impedance of 2000 ohms or less. When the load impedance is high, the collector-current swing is quite limited. This reduces the impedance swing to a very small value, as indicated by the 100,000 ohms load line in *Fig.* 2. In any case, this form of distortion is comparable with the nonlinearities found in vacuum tubes.

Another, and far more serious source of distortion, is indicated in *Fig.* 3, and

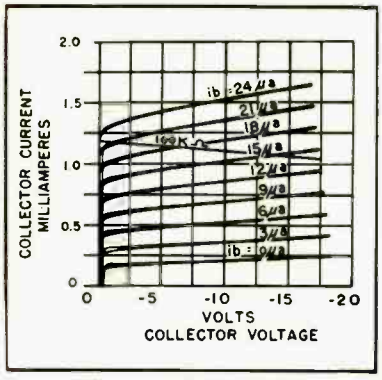

Fig. 2. Collector curve family for typical RCA 2N104 junction transistor

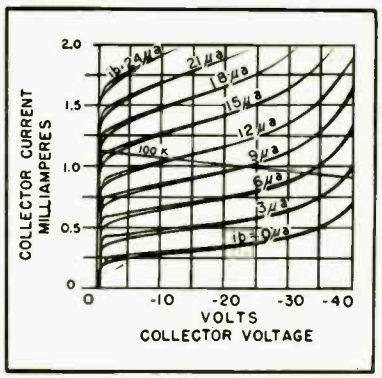

Fig. 3. Collector curve family extended to higher voltages to show possibility of distortion due to bending of curves.

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Features a new-design Peerless output transformer and KT66 output tubes. Frequency response within +1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts. 4, 8, or 16 ohms output. Hum and noise, 99 db below rated output. Uses 2-12AU7's, 2-KT66's and 5R4GY. Attractive physical appearance harmonizes with WA-P2 Preamplifier. Kit combinations:

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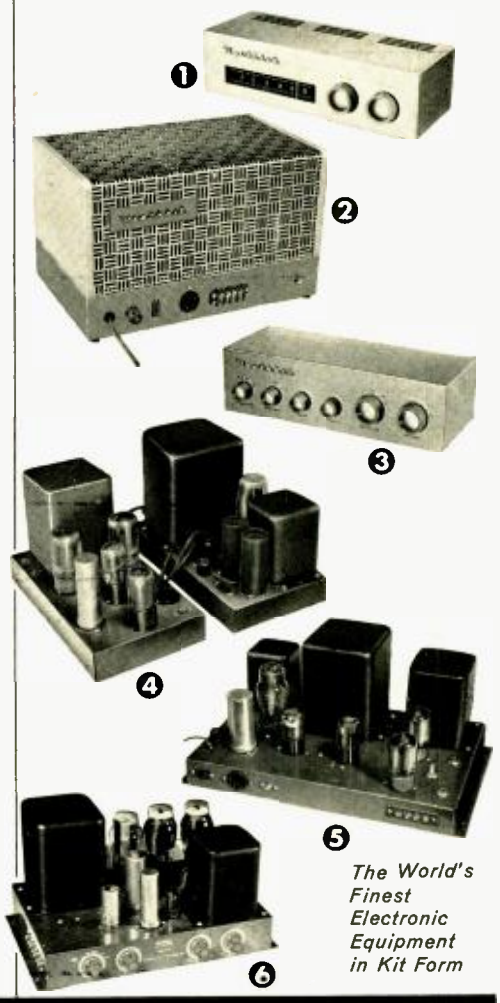

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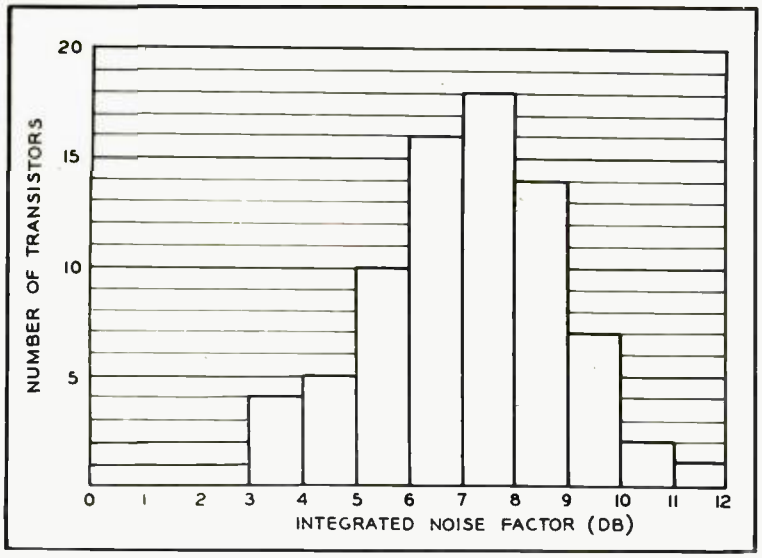


Fig. 4. Representative production spread of noise factor for RCA type 2N104 transistor. Chart represents total of 77 units.

is peculiar to the transistor as a device, and the application in particular. When dealing with gains of 1000 and above, it is desirable to maintain an appreciable signal-handling capacity. For example, a 15 millivolt rms input signal, when amplified 1000 times, requires a 42.5 volt peak-to-peak output swing. In order to accommodate this swing, the collector quiescent voltage must be above 20 volts. As indicated in *Fig.* 3, the transistor begins to break down in the region of 30 to 40 volts, with resultant bending of the output characteristics. This bending will contribute the major share of distortion to an amplifier operating over voltage swings of 40 volts. Quantitatively, a unit, operating at 20 volts, 1 milliamp, into a load of 100,000 ohms, and handling an a.c. output of 39 volts peak-to-peak, will generate about 3 per cent total harmonic distortion.

Noise Considerations

With the input limited to 10 to 15 millivolts maximum, the next consideration is the minimum usable input, or noise level. In the matter of noise, transistors, within a very few years, have established their superiority over vacuum tubes. The RCA type 2N104 transistor is a controlled-noise unit with a maximum Noise Factor of 12 db. A representative spread of Noise Factors is shown in *Fig.* 4, which indicates that an average unit will run about 7 db. The optimum source impedance for noise considerations is about 500 ohms,[1] at which value the units were measured. Assuming this value and substituting in the noise equation

$$E_{noise} = \sqrt{4KTR(f_2 - f_1)}$$

Where $K = 1.374 \times 10^{-23}$ Joule/degree Kelvin (Boltzmann's constant)
$T = 300°$ Kelvin
$R = 500$ ohms
$f_2 = 23{,}000$ cps
$f_1 \cong 0$

[1] P. M. Bargallini and M. B. Herscher, "Investigations of noise in audio amplifiers using junction transistors," *Proc. IRE*, p. 217, Feb. 1955.

the generator noise is 0.436 microvolt. A 2N104 transistor having a Noise Factor of 12 db, has an equivalent noise input of 1.69 microvolts.

If an average unit with a 7 db Noise Factor is chosen, the input can be as low as 0.872 microvolt for unity signal-to-noise ratio. For an average unit, therefore the input may range from 1 microvolt to 10 millivolts, a range of 80 db.

Temperature Stability

Having established the basic operating parameters of the circuit in *Fig.* 1, attention is next devoted to developing a circuit which will eliminate the gross temperature dependence. Because of the wide collector swings, it is desirable to stabilize the operating point as firmly as possible. This can be done by utilizing a combination of several stabilizing schemes, all of which are known to the art. *Figure* 5 shows a completed circuit which combines three methods: current-voltage bias, constant emitter-current stabilization, and d.c. feedback. With the circuit constants shown, the stability, factor, Sr—defined as the change in collector current, I_c, for a given change in cutoff current I_{co}—is equal to $\partial I_c / I_{co}$, or 1.37. This means that the change in I_{co} (which is unavoidable when the junction temperature changes) is multiplied only by 1.37 as a change in collector current, rather than by β (40 or 50), as in *Fig.* 1. In this way, the collector voltage is held quite constant, varying from –22 volts at –79° C (dry ice temperature) to –17 volts at 65° C.

In addition to excellent temperature stability, the gain is quite independent of transistor parameter variations, changing only ±1 db from its normal gain of 60 db. This proves to be true with nearly any transistor in good working condition.

A disadvantage of using d.c. feedback (as established by R_4) arises from the presence of a.c., which is also fed back. In this case, the amount of degeneration is determined by the generator impedance, across which the feedback voltage is developed. For the case of resistive source of 500 ohms, the voltage division is in the ratio of 100,000 to 500, or 200 to 1. Therefore, the gain of 1000 without feedback is reduced by 15.5 db. The situ-

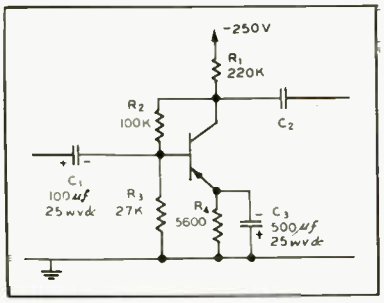


Fig. 5. Schematic of temperature-stabilized high-gain amplifier.

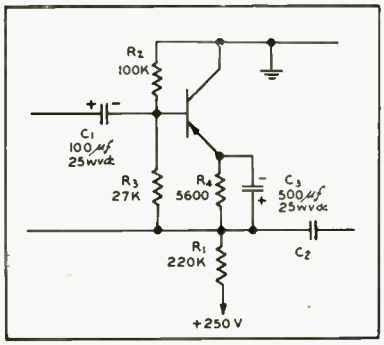


Fig. 6. Inverted amplifier with the same characteristics as the amplifier of Fig. 5, but adaptable to conventional negative-ground power supply.

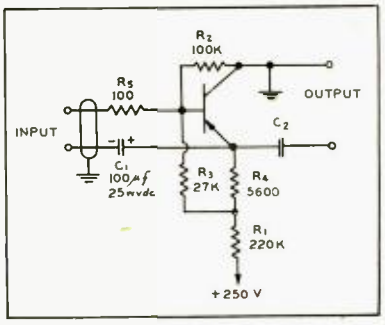
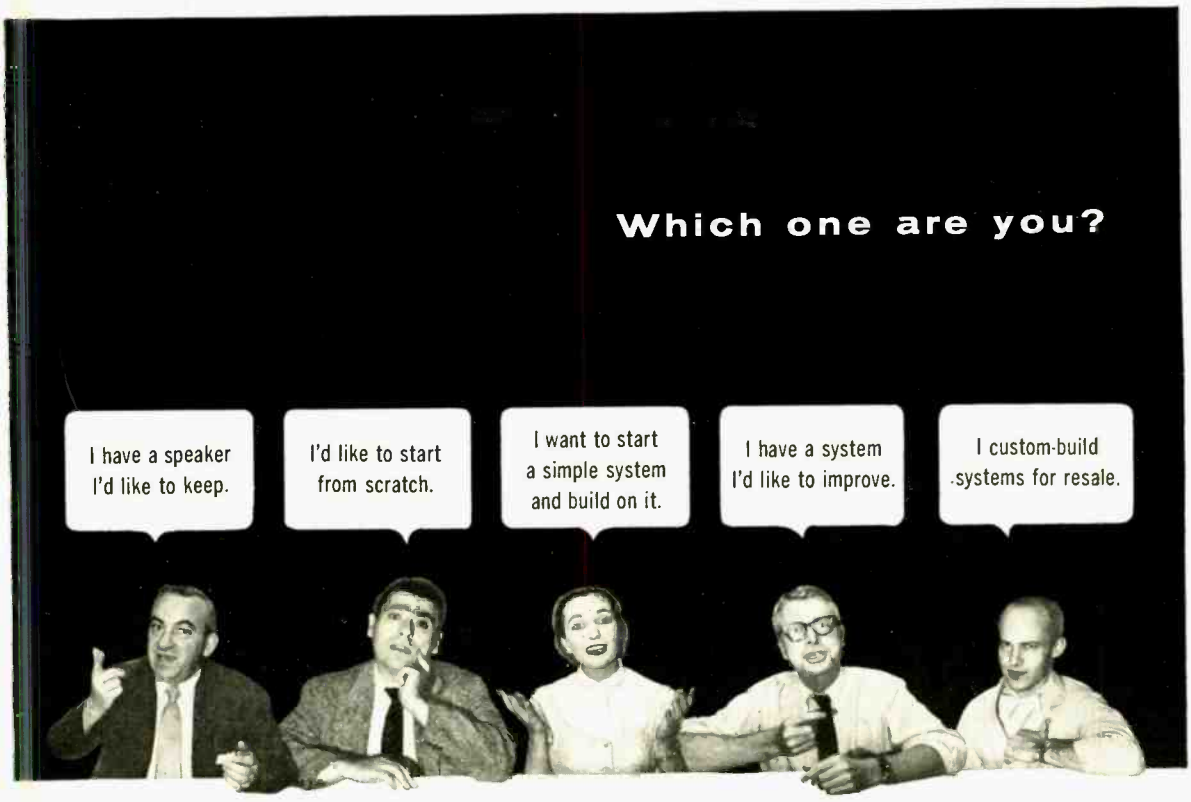


Fig. 7. High-gain phonograph preamplifier as used in RCA models 6HF1 and 6HF2.



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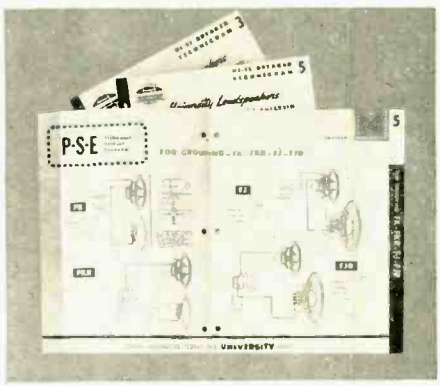

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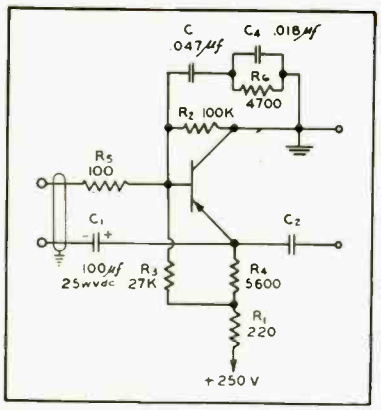


Fig. 8. Phonograph preamplifier with complete compensation for the RIAA recording characteristic.

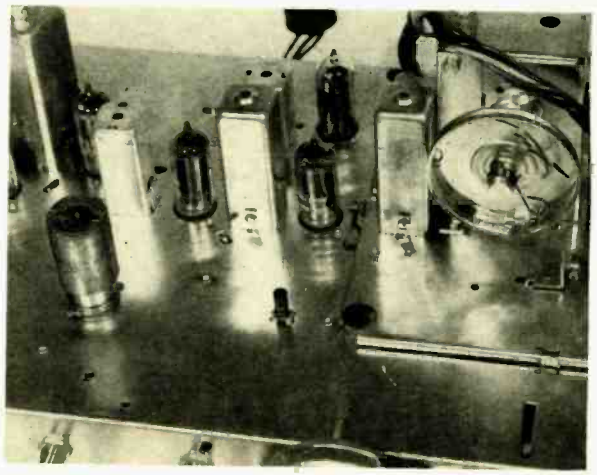


Fig. 9. Transistor is almost lost among the "massive" other components.

ation can be avoided by splitting R_2 and inserting a bypass to ground.

Voltage Supply

Since the most logical use of the circuit of *Fig.* 5 will be to feed a vacuum tube grid, the use of negative 250 volt supply is a practical handicap. In order to utilize the positive supply already available where tubes are present, the ground point may simply be shifted, as indicated in *Fig.* 6. The new circuit is identical to that in *Fig.* 5, except that it now utilizes a positive supply, and the input is floating at 25 volts above ground, necessitating the use of a two-wire shielded cable input. The only new consideration is the capacitance to ground of the source, which can be a problem in the case of a.c. operated oscillators and signal generators. It is of less significance in applications utilizing phonograph pickups, microphones, or other such transducers.

Final Phonograph Preamplifier Circuit

With the modifications shown in *Fig.* 7, this circuit is in current production as a phonograph preamplifier in two RCA "high fidelity" consoles, models 6HF1 and 6HF2. The pickup is of the moving-coil dynamic type, having excellent frequency response and very low distortion. Its average level output is on the order of 1 millivolt, and its impedance is less than 2 ohms. Because of the unusually low output voltage, when the pickup is used with tube preamplifiers, noise becomes a severe problem. Normally, an input transformer is required to overcome it. With the transistor, on the other hand, the noise level is 55 to 60 db below average level, which is completely satisfactory.

The circuit of *Fig.* 7 was designed with this type pickup in mind. R_3 was inserted to introduce controlled degeneration. Since the absolute peak recording level of modern microgroove records is 26 db above average level, the maximum output from the pickup will be 26 db above 1 millivolt, or 20 millivolts rms. As outlined previously, the preamplifier cannot handle inputs as high as this, and the easiest way to solve the problem is by the use of feedback. In this case, with a gain of 1000, and a division between R_2 and R_3 of 100,000 to 100, the gain is cut 6 db. Additionally, the feedback reduces the total harmonic distortion for peak level (20 millivolts) input to less than 2 per cent and extends the frequency response to 38 kc. R_3 is only effective, however, because of the very low impedance of the pickup. Normally, it is impractical to use feedback on the input circuit, since variations of the source impedance with frequency would upset the loop. Where the source impedance is negligible in comparison with 100 ohms, however, this scheme makes it possible to control the degeneration fully.

Since the input is already floating, it is desirable to connect one side directly to the emitter, rather than the junction of R_3 and R_4. This removes R_4 as a source of a.c. degeneration, eliminating the need for a bypass capacitor, while retaining its very valuable function of temperature stabilization. Capacitor C_1 is placed in the emitter lead for protection of the pickup. If it were in the base lead, in series with R_3, and the pickup became shorted to ground, somewhat more than 1 ma would flow through the pickup. Placing the capacitor in the emitter lead effectively ties the base to the collector when there is a short, making the transistor just a forward-biased diode. Therefore, most of the current is shunted through the transistor, and a negligible current of 250 microamps flows into the pickup.

Figure 8 shows the phonograph preamplifier with the addition of freqency selective feedback to compensate for the RIAA/NARTB recording characteristic. Because of the large amount of low-frequency equalization necessary, the gain at 1000 cps is reduced to 44 times, and the distortion is reduced correspondingly, to a few tenths of a per cent. Since the signal is "flat" however, only one succeeding stage of amplification is necessary to bring the signal up to the two-volt level required by many power amplifiers. *Figure* 9 shows the transistor in place in the 6HF1 chassis, and *Fig.* 10 shows the complete circuit of the preamp to indicate the four types of equalization.

Conclusion

Transistors, when operated as low-level, high-gain amplifiers, offer distinct advantages over tubes from a noise standpoint. When it is considered that at least two, and usually more, tube stages are required to produce comparable gain figures, the transistor is also in a favorable competitive position from the standpoint of economy.

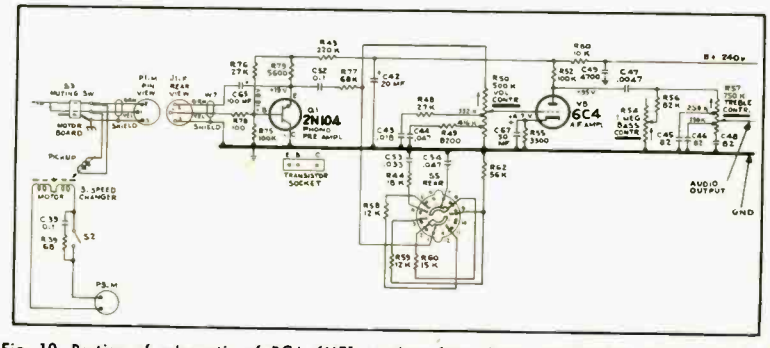
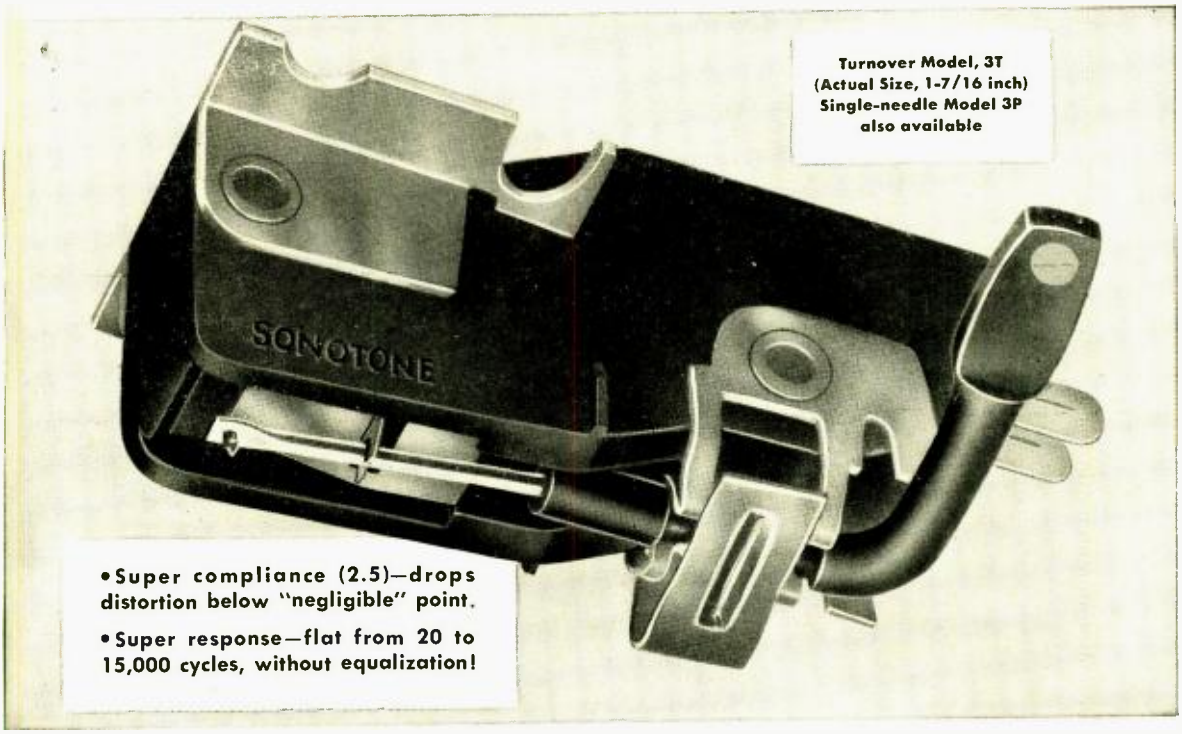


Fig. 10. Portion of schematic of RCA 6HF1 to show four phono equalization curves. Switch S_2 is shown in position 1, RIAA. Clockwise rotation through positions 2, 3, and 4 give LP, AES, and 78 curves, respectively.

First Announcement!

New Sonotone "3" Series SUPER-FIDELITY Ceramic Cartridges



PARDON US IF WE CALL THEM "REVOLUTIONARY"...

but these new cartridges *obsolete* pre-amplifiers, equalizers, and old-style pickups!

If you've followed the development of ceramic cartridges since Sonotone pioneered them in 1946, you know we've made enormous advances.

Recently Sonotone has offered ceramic cartridges equal, by test, to most velocity types. Now, Sonotone presents the "3" Series, which set utterly *new* standards of finest performance, by all the measurements engineers know how to make. And your ears will confirm their findings.

But that's not all the story. The performance of these new cartridges makes the *inherent* advantages of the ceramic type loom larger than ever. Consider:

WHY A PRE-AMP?

There is only one reason for a pre-amplifier—a velocity pickup puts out too feeble a voltage to drive your amplifier directly. But these Sonotone "3" Series cartridges deliver a whopping 0.5 volts—roughly 50 times as much as most velocity types. So you can *eliminate* the circuitry, noise, space and expense a pre-amp involves. (If you now have a pre-amp, our simple adaptor permits immediate use of Sonotone "3" Series cartridges in your present system.)

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THE MINSHALL ORGAN

(*From page 60*)

the transformer secondary. The power supply is standard, furnishing B-plus and filament voltage to generators and tablet board through connectors as shown. The tablet-board connector also carries preamplifier output to the power amplifier grids and to a pair of sockets into which lines to booster amplifiers may be plugged.

The vibrato oscillator, a 6SN7, is also in the power supply. This is a simple feedback oscillator the frequency of which can be adjusted over a range of about 5 to 8 cps by switching different resistors across R_s. This is done at the tablet board and a line from the cathode for this purpose is carried up through the large connector. Regulated B-plus is applied to the vibrato-oscillator plates (note the VR tubes) and the "vibrated" voltage is carried to the master oscillator plates through the generator plate supply.

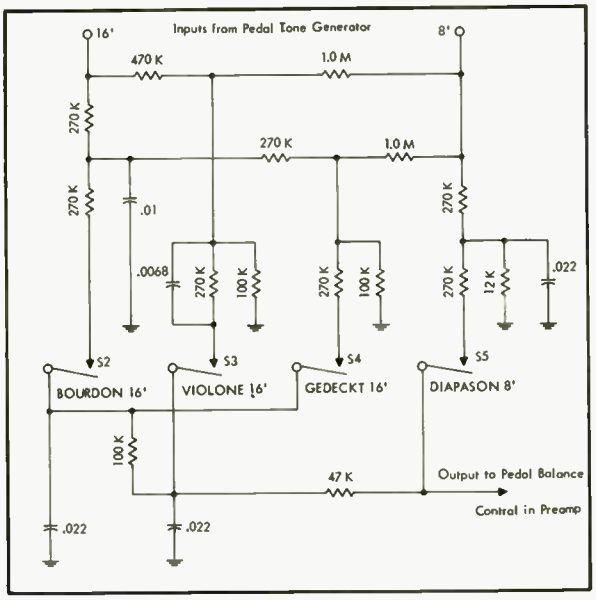


Fig. 18. Circuits of the four pedal tone filters.

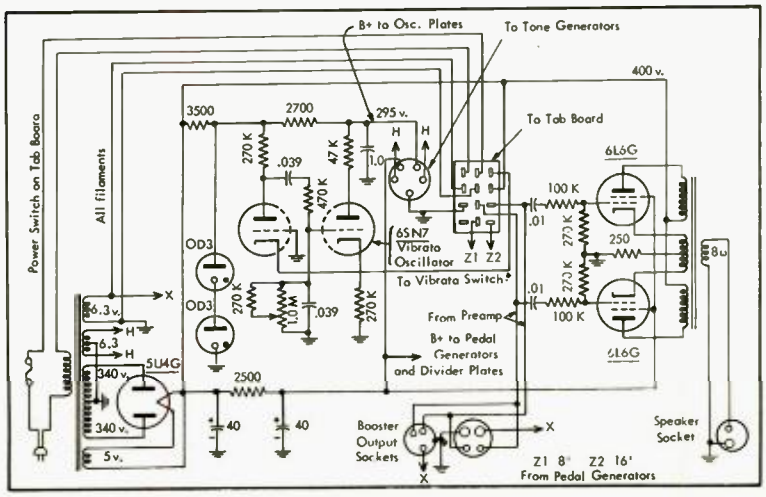


Fig. 20. Schematic diagram of the power amplifier and power supply with vibrato oscillator.

Equipment Report

H. H. Scott 710-A Stroboscopic Turntable—National "Criterion" AM/FM Tuner Acoustic Research AR-1 Loudspeaker System—Harman-Kardon C-300 "Trend" Amplifier

SCOTT TYPE 710-A STROBOSCOPIC TURNTABLE

"A RADICALLY DIFFERENT TURNTABLE for high-quality music reproduction" might well be offered as subtitle to this unit, for the design is not like any other heretofore offered. Yet after a thorough inspection, one is likely to say, "Why didn't I think of that?"

The Scott turntable *is* different in many respects. Like some other types, it employs a horizontal motor which drives the turntable through a worm and gear, but there the resemblance ends. The motor—together with the speed change mechanism—is flexibly mounted to the base plate so that a minimum of motor vibration is transmitted either from the motor to the base or from external vibrations to the motor. Drive from the speed-change mechanism to the turntable shaft passes through two extremely flexible rubber couplings, so that practically no motor vibration is transmitted to the record and pickup.

The turntable and the pickup mounting platform are rigidly coupled together with an aluminum casting—a necessity, of course, since no relative movement between them can be permitted—and this assembly is flexibly mounted to the base plate. The antivibration mountings used for both motor and turntable assemblies consist of coil springs with sponge rubber damping washers to eliminate the effect of spring resonance. The springs themselves are wound with a portion of the coil being cylindrical and a portion being conical, further broadening the resonant frequency of the spring mounting. This type of vibration isolation effectively prevents any disturbances from external sources reaching the turntable and arm, and the double isolation between motor and turntable reduces rumble to a minimum.

The selection of speeds is effected by depressing one of three buttons on the base plate. These, in turn, cause an idler to bear against a stepped motor shaft and an aluminum drum, and the latter is connected to the worm gear box through the soft rubber universal joints. Each of the steps on the motor shaft is slightly conical, and the idlers can be moved longitudinally over a small range, such movement being controlled by knobs on the panel. Since the shaft of the motor is conical, the longitudinal movement of the idlers permits a vernier adjustment of speed over a range of ±5 per cent from the nominal value.

Stroboscopic markings on the underside of the turntable are illuminated by a neon lamp when the motor is running, and can be viewed in a mirror mounted on the base plate. Speed may be adjusted to the exact values readily, or may be changed a small amount to "tune" the record to a musical instrument, for example.

On the debit side, although not of much importance to the average user, is the use of an induction motor for the driving power. While these motors are smooth, and in four-pole designs have relatively little external field, they do take from 15 to 30 minutes to "come up to speed." When first turned on, they run at approximately 1725 rpm, and after warming up they run at about 1740. Thus for any application where an absolute constancy of speed is required, the hysteresis motor is more suitable, and it does have less intrinsic vibration than the induction type. However, this is of little importance with a mounting of the type used in the Scott turntable, and since it is so very easy to make minor adjustments in turntable speed during the warm-up time, if the absolute speed is important for a particular use.

As described in EQUIPMENT REPORT for March, 1955, it is quite difficult to make valid measurements of rumble without well controlled laboratory conditions. One of the problems is in obtaining a test record in which the rumble is non-existent, since another turntable had to be used in making the original master of an unmodulated track, and its characteristics are unavoidably impressed on the record. However, using the same test records as used previously, and taking as much care as possible in evaluating the results, it appears that the rumble from the Scott turntable is approximately 54 db below a maximum recording level of 20 cm/sec (which AUDIO considers a practical maximum level, even though many records have been measured at as high as 28 cm/sec stylus velocity). NARTB standards for turntable performance are based on a stylus velocity of 7 cm/sec, but usable signal-to-noise ratio should be related to the maximum recording level likely to be encountered. In any case, rumble is sufficiently low as to be effectively

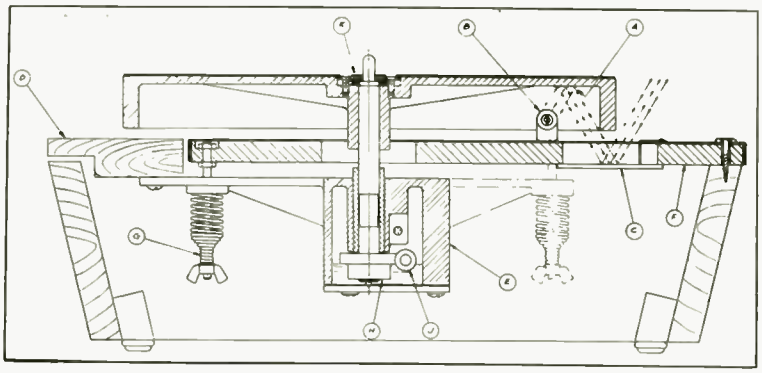
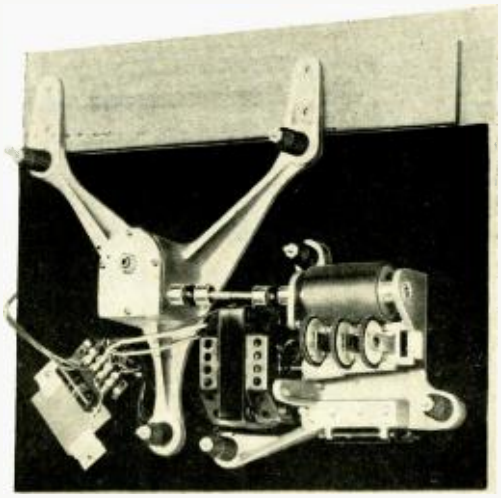


Fig. 1 (below). H. H. Scott's 710-A Stroboscopic turntable. Pickup arm mounts on wooden shelf at rear. Fig. 2 (right). Underside of Scott turntable showing unique construction. Drive mechanism is flexibly mounted to the base plate, and turntable and pickup arm platform—solidly tied together—are also mounted flexibly to base plate. "Universal joints" of soft rubber connect the two elements. Fig. 3 (above). Cross section of turntable mounting.



inaudible through a high-quality loudspeaker system with the amplifier gain set for high levels of reproduction, and then listening to an unmodulated groove. The turntable comes up to speed in approximately one revolution at any speed setting, with only a slight overshoot as speed is reached. Wow and flutter cannot be detected by ear on any speed.

With the entire mechanism isolated completely from the base plate, the Scott turntable is easy to mount into a cabinet, since it may be screwed down firmly without need for any spring or rubber mountings. A capacitor across the a.c. switch eliminates any possibility of pops in the system when the motor is started or stopped. Because of its effective isolation from the mounting board, this unit is particularly suitable for installations that must be made in the same cabinet with a loudspeaker, and no interaction is likely to be encountered. P 20

NATIONAL "CRITERION" AM/FM TUNER

One of the most interesting tuners on the hi-fi market these days is the National Criterion, which brings a professional type "system" into the realm of comfortable home usage. About the only practical facility not offered by this deluxe model is the ability to switch right and left channels of a stereophonic program.

The audio enthusiast who is likely to engage in recording occasionally often wants to listen to one program while recording another—he may want to feed one program to a speaker sytem in one part of the house while he feeds another to a second speaker. He may want stereophonic reproduction, or possibly he has developed some device which needs the supersonic control frequency sent out by many of the "storecasting" FM stations.

Whatever his demands, most of them can be met easily by the Criterion—with its one-half microvolt sensitivity on FM and 10 microvolt sensitivity on AM and its flexibility of operation. In addition, it incorporates automatic gain control in the FM section to prevent overload of the early stages, a "Mutamatic" circuit which effectively silences the receiver between stations (on FM), and a high-speed limiter which employs two cascaded 6BN6's to eliminate the short-impulse interference so often heard on FM receivers.

Because any AM/FM receiver involves a large number of circuits, the block schematic of *Fig.* 4 is shown to provide a greater understanding of the functioning of this particular model. In particular, the operation of the Mutamatic circuit is of interest, for in most squelch circuits the controlling circuits operate on an audio-amplifier stage with a consequent possibility of being noisy in operation, usually with a thump. In this circuit, however, the control voltage is derived from the input transformer to the first limiter stage, and after rectification, is fed to the squelch triode to be amplified sufficiently to control the limiter stage.

Audio Facilities

Note that there are several outputs in this tuner. The Multiplex output is taken from the FM detector circuit ahead of the de-emphasis network, and thus is capable of passing frequencies as high as can be used for modulating the carrier. Future applications of multiplexing—if and when they come—will make it possible to transmit both channels of a stereophonic program on one FM carrier, or transmit two entirely different programs on the same carrier. At the present time, many FM stations are using the frequencies above audibility to effect a change in gain of the audio cricuits so as to cut out announcements for Muzak-type programming which provides only music, or to increase the volume of announcements for "storecasting."

The FM "Binaural" output is directly connected to the FM circuits without passing through the selector switch and thus may he fed on a permanent basis (if desired) to one channel of the audio system. The Tuner Output is controlled by the selector switch, and is used when the unit is to be connected to a single-channel amplifier-speaker system.

The AM "Binaural" output is connected directly to the AM circuits without passing through the selector switch, in the same fashion as the FM connection. The Recording Signal Output is provided for a permanent connection to a recorder, and is controlled by the selector switch. Note that no signal is fed to this output when the selector switch is on BINAURAL, and that the Tuner Output is connected to FM on this position of the switch. Cathode followers provide suitably low impedances for all outputs except Recorder.

The partial schematic in *Fig.* 5 shows the detector of the FM section, as well as the succeeding amplifier and the cathode follower. This detector is of the wide-band type, and simplifies tuning by eliminating the three-point response. Thus the selectivity of the receiver is controlled almost entirely by the i.f. band-pass characteristics,

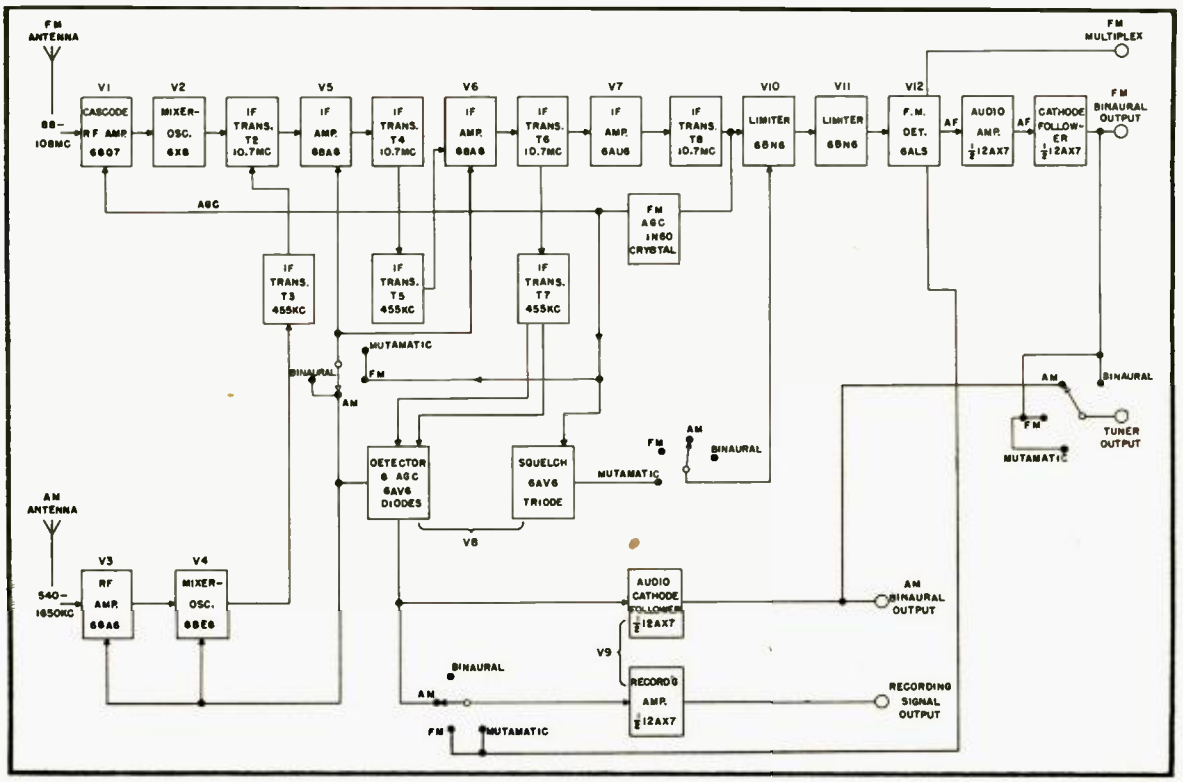


Fig. 4. Block schematic of National "Criterion" AM/FM tuner.

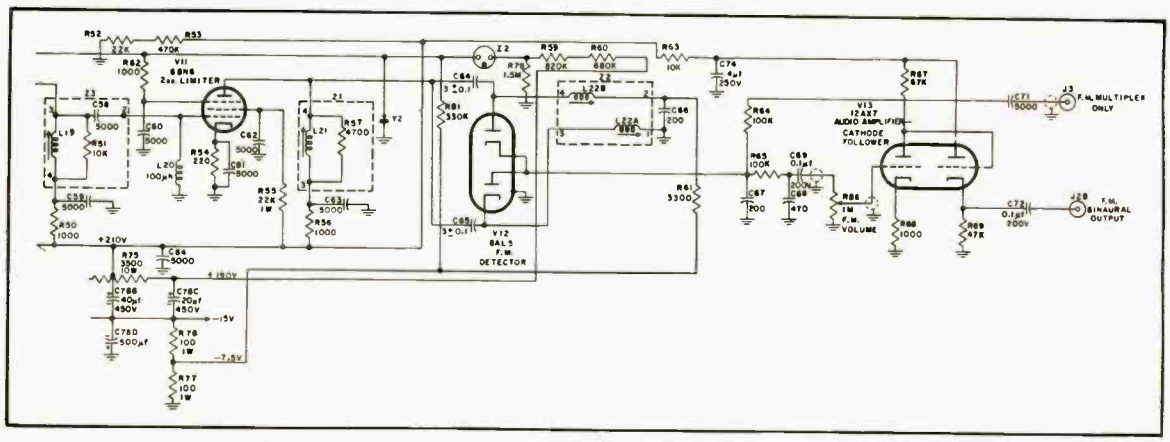


Fig. 5. Section of Criterion schematic to show detector and audio output stages.

and if the signal is heard at all it is heard without distortion. This, together with the Mutamatic feature, makes the receiver easy to tune, and as the dial is scanned, stations drop in and out from a completely silent background.

In the AM section, a band-pass i.f. provides response within ± 1 db up to 7000 cps, is comparable to FM quality on programs transmitted over land lines.

In operation, the set is easy to handle, and has sufficient sensitivity for the more remote installations. From our testing location on Long Island, FM signals are regularly picked up from Philadelphia stations through the many signals from New York City. The capture ratio—the ability of the tuner to eliminate interference from weaker signals on the same channel—is high, and strong stations from adjacent channels have a minimum of effect on weak distant signals.

One advantage of the Criterion is the facility for plugging in the Horizon 5 preamplifier, with phono preamp and tone controls. With this unit, the volume control operates on both of the Binaural outputs simultaneously, so that the relative levels of the two channels can be set by the controls on the tuner, and both can then be controlled simultaneously by the volume control on the Horizon 5.

On the whole, this unit offers a maximum of convenience and flexibility for the most avid experimenter, and combines with it both excellent quality and high sensitivity. **P-21**

ACOUSTIC RESEARCH AR-1 LOUDSPEAKER SYSTEM

After its original description in the October, 1954, issue, we have looked forward for an opportunity to "live with" the production model of this system for long enough to evaluate its performance in direct comparison with our "standard" of loudspeaker quality.

Although the AR-1 is small in physical size, it should not necessarily be judged with the usual allowances which are made when the enclosure is less than eight cubic feet in volume. Results of measurements on this speaker were shown in Mr. Villchur's article in the July, 1955 issue, and the observations contained herein are primarily of a subjective nature.

On first switching from a more conventional type of loudspeaker system, it appears that the AR-1 is slightly deficient in bass (although it does not so measure) but after a few minutes listening the sound takes on a realism that defies description. Switching back and forth at short intervals—five or ten minutes, for example—gives the same impression, but thorough consideration of the quality brings out the belief that only a minor boost in the over-all low-frequency response is completely adequate to place this system in the category of a true wide-range unit.

Efficiency is not as high as with some other models—in direct comparison with other well-known models, the differential is of the order of 3 to 4 db. For listening rooms of conventional living-room size, this is not a disadvantage, but if it were necessary to fill a large hall, for instance, it is doubtful if the output from a typical amplifier of 10 watts would be adequate.

The AR-1 is designed to work from an impedance of 4 ohms, and is at somewhat of a disadvantage when it must be worked from an 8-ohm amplifier, since the speaker works, in effect, with a series resistance of 4 ohms to load the amplifier correctly, and thus dissipates part of the amplifier power without a corresponding acoustic output.

The unit is available in several forms—in furniture cabinets of either blonde or mahogany or in unfinished cabinets with a complete two-way system which comprises the 12-inch woofer and an 8-inch tweeter. The woofer and cabinet—which must be purchased as a unit since the enclosure must be completely airtight and of specific size and acoustic treatment—may be obtained separately in either finished or unfinished form, to be coupled with a high-frequency section of any desired type.

For installations where size is of primary importance, the AR-1 is likely to be considered an excellent choice, since it gives big-speaker performance from a relatively small box. However, it is not necessary to make any concessions to its size when comparing performance. **P-22**

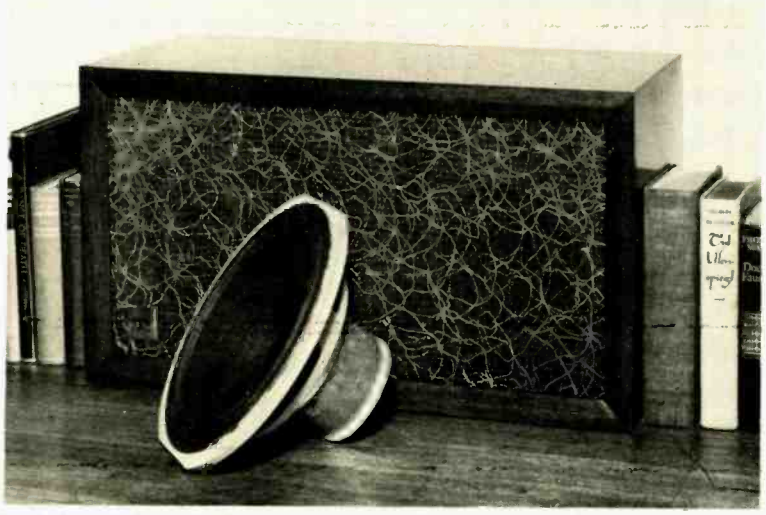


Fig. 6. Acoustic Research AR-1 speaker system, with special type of low-frequency cone-type driver.

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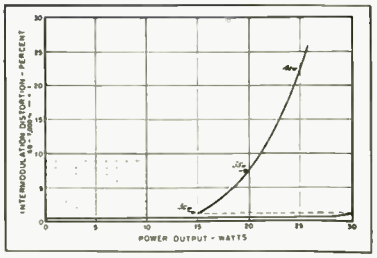


HARMAN-KARDON C-300 "TREND" AMPLIFIER

The "Trend" is a remarkable design of amplifier in many respects, not the least of which is mechanical rather than electronic. The use of 5881's in the output stage naturally causes the generation of considerable heat, and in a small enclosure this is likely to cause overheating of some of the components. In this model, however, the arrangement of the tubes themselves and the shape of the air passages around them causes a high velocity of air current past the tubes and a consequent maximum of cooling effect without unduly heating the other components of the amplifier.

In the electronic department, the amplifier also offers many desirable features. Complete curves of response are not given since the three phono curves are close matches to the prescribed values, and tone control curves are quite conventional. The loudness contour control is unique, since it permits adjustment to exact match for the F-M curves, or to either 5 or 10 db more or 5 or 10 db less than the F-M curves. This gives a wide range of compensation which can be chosen to suit any particular ear. Note from the schematic that there are two positions for each of the phono curves —one set being located at each end of the selector switch. One set gives normal phono curves, while the other introduces a high-pass filter effect to eliminate rumble. A switch is provided to match Pickering, GE, or Fairchild pickups, and an individual level control is provided for each of the high-level inputs. Note also that an output is provided to feed a tape recorder.

The variable damping control is of interest since it permits a change in the damping over six steps—and allows the user to compensate for the type of speaker used. Maximum damping is quite high, and is desirable for the highest quality speakers, with lesser degrees of damping giving optimum quality of reproduction with certain types of speakers and housings. **P-23**

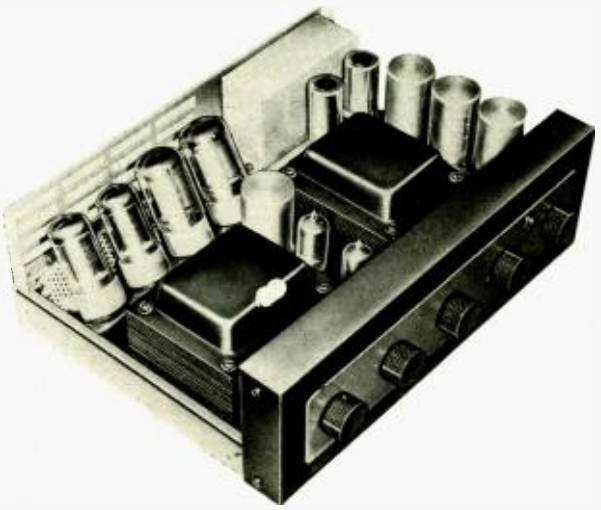
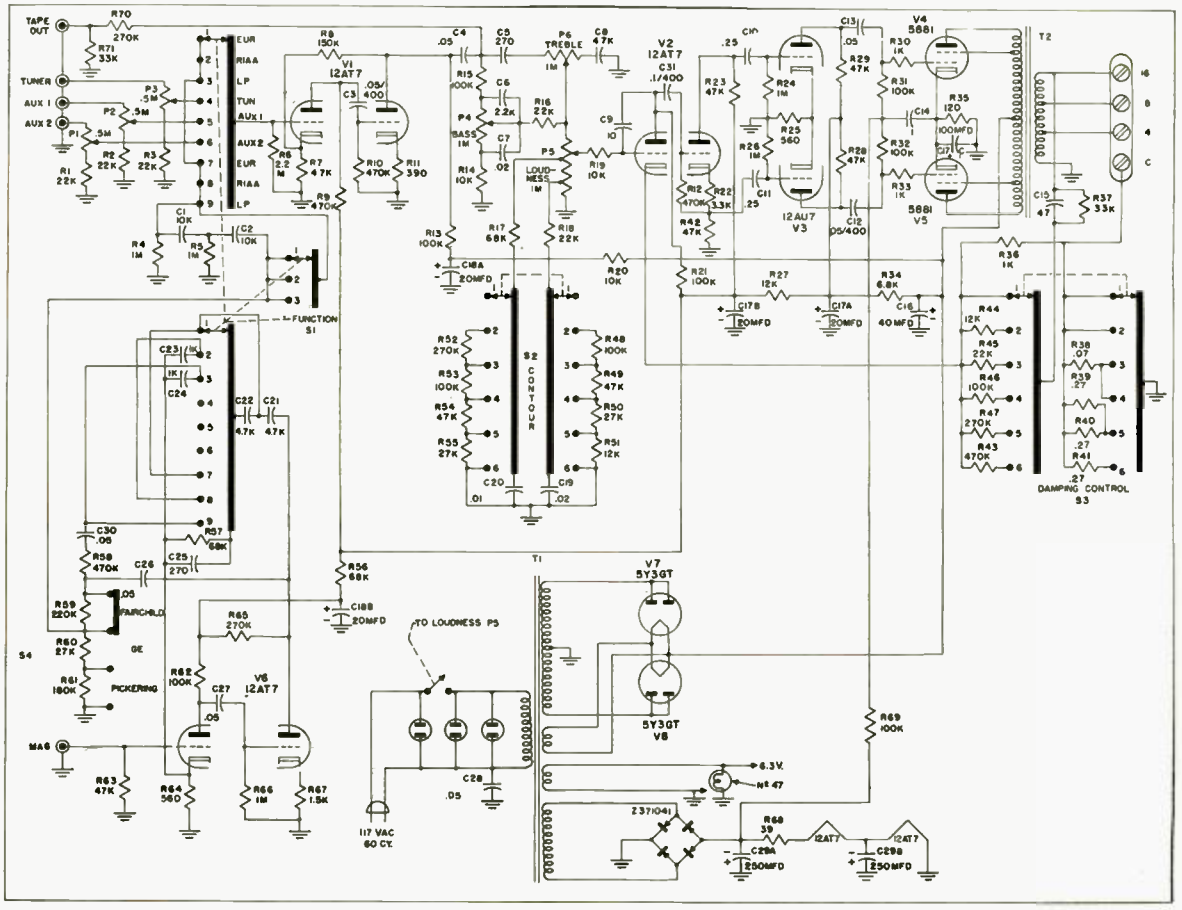


Fig. 7 (above, left). Power output vs. IM distortion curves. Fig. 8. (left) Harman-Kardon C-300 amplifier. Fig. 9 (below) Over - all schematic.



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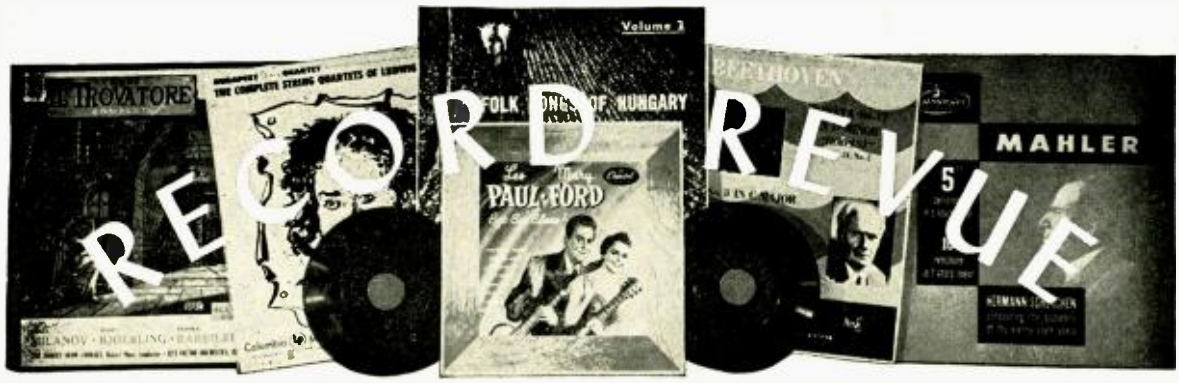

EDWARD TATNALL CANBY*

1. MUSIC OF THE PEOPLE

Music of India. Ustad Ali Akbar Kahn, Pandit Chatur Lal. Introd. by Yehudi Menuhin.

Angel 35283

This is more than just another hi-fi disc of oriental sounds, exotic but largely incomprehensible to Western ears. The reason that it is more than this is simple—here, as rarely happens, are two *complete* samples of a type of non-Western Music, played at full LP length without a break, taking advantage of the LP medium to do more than merely sample a few tiny moments here and there out of numerous much longer wholes. That's what we really hear from the orient.

I don't mean to imply that these two works of music, one on each side, have a rigidly determined length. Not at all, if I understand this sort of highly controlled improvising. Neither does a jazz jam session have a rigidly predetermined length. But a three-minute sampling of a jazz get-together tells us about as much about the whole thing as a three-minute slice of these "ragas"—compared to a full LP side, as here recorded. Perhaps on occasion these semi-improvisations from India are longer, or shorter. But a half hour, more or less, is easily enough to encompass a full accounting in muscial terms of the "raga" expression. It builds up from a quiet beginning, over this long period to time, to an almost frenzied ending—and a brief sample, whether at the beginning, middle or end, could not possibly convey to us the sense of rising tension and drama, the almost hypnotically dynamic monotony, of this highly skilled and stylized music. It gets over even on one hearing—it's music, after all, and it is produced by and for human beings who are not basically unrelated to ourselves! It should, and does, have a direct appeal even to the uninitiated, when given its proper chance—i.e. a proper time-length.

I'll leave the listening to you, without too much explanation, except to say that this music is constructed by a string (twang-and-pluck) player and a percussion man, on a mutual play of variation, gradually building up, based on two fundamental and fixed ideas—a fancy scale or mode for the pitch and a rhythmic pattern, repeated, for the percussion. The scale is related to our scales, as any ear can hear—with an effort not unlike our majors and minors and folksong modes—but it also includes strange notes that at first seem out of tune, though of course they aren't—for Indian ears. Or for ours either, once we get used to them.

An immediately interesting feature of the scales used here, the ragas, is that they go upward with one set of tones and downward with quite a different set. Two scales in one. Even more odd, the scale does not progress straight downward but turns back up occasionally, like a melody—thereby indicating that a "scale" to an Indian is not exactly what it is to us. In fact, the raga is a sort of combination of mode—like our major or minor—and theme, serving in both functions as a basis for the ensuing improvisation.

Not so strange, when you come to think of it; for we have double-function ideas too. The harmonic sequence of chords that goes with a popular tune serves just as much as a basis for jazz variation as does the melody itself, and any old ear (any ear that's listened to radio or juke box) can hear both things at work in a jazz session. Harmony pattern, melody pattern. This Indian music, wholly different in sound and style (and without harmony), nevertheless works on the human ear in a similar way, however complicated the theory and the rules and whatnot. People are people, the world over.

Can we hear all this in the music? Yes! Maybe you won't get it all the first time. But just play through either one of these pieces and then go back and play the introduction, with Menuhin's explanation, and listen to the "scale" or raga itself. You can't miss the connection between it and what has happened for a half hour. It's dinned into your head, after all. And the two ragas, a morning one and an evening one, are very clearly and noticeably different, to the most untutored musical ear. As different as major and minor, only more so.

A real hi-fi sound, though in the nature of it the music hasn't much bass and won't do much for your horn-type woofer. Lots of twang for the tweeter.

Note: The artists, recorded in N. Y., are top-flight specialists in India. Menuhin "fell" for this music on a recent trip to India—hence his spoken presentation here. No violin playing from him, but an interesting enthusiasm. No singing voices. All instrumental. The ragas are extremely ancient and the rules and the meanings attached to this music are exact, subtle, and complex; this is a high-class sort of jazz-type tradition that, however, has been kept alive for untold centuries instead of a mere forty-odd years. Will *we* last as long?

Yugoslav Rhapsody. Yugoslav Folk Songs. Members Yugoslav Nat. Dance Theatre; The Slovenski Octet, Ljuljana.

Epic LC 3171

If I've said it before, I'll say it once more: folk music, when still "free," still music of and by people taking its own natural course according to local popularity, skill, taste—is always changing, always "modern," always a reflection of its own surroundings. Most important, it always combines older traditions with newer, present-day influences, whatever they may be.

"Pure" folk music in this sense doesn't exist, or if it does, then it merely reflects an isolated, "pure" civilization removed from any thing but itself. That doesn't happen very often these days. Only in places like the Australian bush, a few deep back valleys of Kentucky and Tennessee, or the hinterlands of Scotland where, during the last 300 years, our modern harmony has still failed to penetrate.

This very musical Yugoslav recording, festival-style, assembles a lot of present-day local music-making in a series of pieces from different parts of that very mixed country, made up of groups and groups of unlike people, only beginning to unify their culture into one highly colored patchwork quilt. The music is strongly local, nationalistic in sound, but thoroughly modern. Accordions, mandolin-like plucked instruments like those of the Russians, Poles, etc., ordinary violins, basses and standard accordions, play in orchestral format, touched up with exotic sounds now and then from strange "folk" instruments of one sort or another; the tunes range characteristically all the way from those that sound almost Austrian or Italian (nearby areas) to Russian- or Czech-style tunes and wild and strange Turkish-Eastern melodies that defy harmonization, yet somehow are harmonized anyway.

The voices are similarly mixed. Trained voices, amateur-style choruses, local "folk" singers are all here. Solos, some of them exotic and highly ornamented in some ancient tradition, are mixed with harmonized choruses, local yells—JAA-HOOO!—and sophisticated harmony-humming. This is the way folk music goes—bending freely to every influence that comes along, ancient or modern, local or from the outside. Strictly mixed breed and very genuine.

The tunes on the first side are the best, as done by the Dance Theatre people. Many are really beautiful, with that eloquent sort of expression we know already in Czech and Russian and Polish music. Many of them fall into that expressive mode technically called mixolydian—from G to G in white notes on the piano—which is a rarity in English folk music (including the U. S. Southern mountain music) but, oddly, is the very basis for our blues, the "lowered 7th" or "blue note" scale. It lends itself wonderfully to a certain ecstatic, simple harmony, often heard in Russian folk music, as well as to the "off-color" effects of the blues.

The second side is devoted to a male Octet, unaccompanied, singing in close harmony. It sounds Don Cossackish a bit (with big, wavery solos) but softened by a sort of Austrian Tyrolese schmaltz. (At least to our ears it might be thus described.) A bit too fancy for my taste, but those who like male harmonizing should run for this quick. Very polished stuff.

Second World Festival of Folk Song and Folk Dance, 1953. Douglas Kennedy, commentator

Westminster WL 5334

This generous LP record contains excerpts from the folk presentations of the world—or at least the eighteen countries represented at this festival, held in two towns on the French-Spanish border, Pamplona and Biarritz. Westminster has attacked the eternal problem of excerpting here in a happy way. The musical examples are introduced by Douglas Kennedy, head of the English Folk Dance and Song Society and one of the leading figures at the festival, whose clear British voice and friendly personality make this disc far easier listening than most of its type; he maintains continuity from one event to another and his explanations allow the lazy man to listen without the laborious following-of-the-notes that is usually necessary if you want to have any idea what's going on.

This, again, is living folk music mostly, and again it varies according to local option from the archaic, carefully preserved, to the strictly modern-influenced. There are orchestras, harmonies, sophisticated night-clubby sounds and also sounds that are weird and primitive; but the average is in-between, a most interesting mixture of both.

It should be pointed out, I think, that this mixture is no compromise on the management's part.

*780 Greenwich St., New York 14, N. Y.

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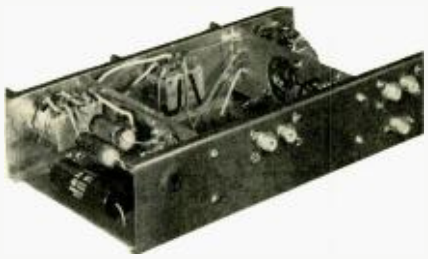

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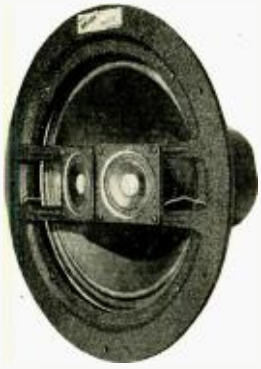

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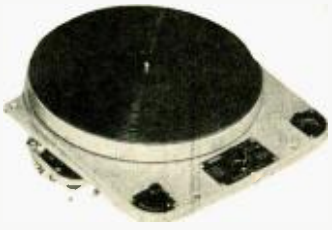

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It does, indeed, represent folk music as it now exists in many localities; it does, indeed, reflect the world as it is, part fused and as one, part independent and sectional. What counts in a folk festival is, first, that somewhat abstruse quality, real musical value—"the best" of each type of music—and secondly, what one might call wise moderation in choosing material, midway between the primitive (so often artificially kept alive, beyond its time) and the too-modern, influenced by commercialized radio and recorded material, heard the world over. If you know the musical pitfalls into which this kind of a jamboree can tumble, you'll agree that Mr. Kennedy and his international cohorts did a good job here.

As to the editing—a gallant attempt to solve an impossible problem! The trouble is, you can't play all of each piece, for most of them tend to go on and on. Westminster has done nobly with most, catching the music at the end of a verse, at a cadence, or if necessary, just fading it gently—very gently—away. But there are a few horrid moments, such as that when our own Jean Ritchie, of Kentucky, is cut off only a few notes from the end of one of her songs. (But she sings another one complete.) Excellent recording, a minimum of background clutter and plenty of hi-fi clarity.

Les Bords du Saint-Laurent. Pierrette Champoux, sopr.
Esoteric ES 526

Russian Folk Songs. Great (Russian) solo artists.
Vanguard VRS 7024 (10")

Siqueira: Xango. Eight Brazilian Folk Songs. Alice Ribeiro, sopr., Cho. & Orch.
Vanguard VRS 465

Here are three folk records illustrating three approaches to folk music that, in my book, are something less than hot stuff.

The "Saint-Laurent" disc features a pleasant night-clubby entertainer with a piano-and-fiddle accompaniment, singing French-Canadian and French songs. Musically the performance is of the shallowest interest, notably in the feeble tum-tum-tum accompaniment. The tunes are good and the words (French) come through.

The Russian disc makes the classic mistake (again, in my book) of assigning famous singing voices to the folk-song role. The orchestra is folksy but most of the singers, Russians all, have had too much opera and the like to put aside the stage stuff that so quickly spoils any sort of folk tune. In the same category as "Home Sweet Home" or "Swing Low" sung by Helen Traubel with Symphony Orchestra, and a lot of people like it. But it ain't folk, not even in Russia.

The third disc, from Brazil, features a composed "cantata" based on folk-like ideas. I found it pretty dreadful and awfully endless, though the soprano is excellent and the performers (in the hundreds, it seems) are enthusiastic. The folk songs, on side 2, are arranged for a sophisticated and slithery modern orchestra which, fortunately, is recorded rather in the background, letting the tunes get through on their own. Arrangements by the conductor-composer, Mr. Siqueira.

Music of Africa. Mouange & His African Ensemble
Vanguard VRS 7023 (10")

Festival in Haiti. Jean Léon Destiné.
Elektra 30 (10")

These two are of the travelling troupe variety and both have a good deal of interest, in spite of the entertainment veneer that inevitably gets into these presentations. Both are super hi-fi and good for that reason too.

The Mouange disc, a group from the Cameroons, shows frank and open "Western" influence—and is interesting for that very reason, since the clear (for us) traces of Bing Crosby and his successors, of American banjo and guitar music, are still only beginning to be digested. What probably sounds highly sophisticated to the African locals has a strange air of primitivism for our ears. Bing in a loin cloth! Native dialect, of course, and plenty of African tradition, as well.

The Haitian-French Destiné record, from nearer home, is best in its primitive moments, with calypso-like chorus repetitions, fancy drum work. Destiné's own voice has acquired a very Hollywoodish polish somewhere along the way to fame (he is a dancer as a first attraction) but the Haitian stuff is still pleasingly present and the record is attractive.

Best feature is a remarkable tin-pipe player who does a set of variations, "Carnival in Venice" style, on his penny whistle that is as extraordinarily musical as it is utterly un-Caribbean. A real musician, that one, and a virtuoso of the instrument.

Folk Songs and Dances of the Basque Country. Chorale Basque Oldarra, Oyhamburu.
Vanguard VRS 7031 (10")

Austrian Folk Music, Vol. 1. Preinfalk Choir and Folk Orch.
Vanguard VRS 7026 (10")

These two are both highly musical—and what more can you ask? Both contain, once more, that modern, "free" folk music that is not out of collections but out of continuing daily use. That means, of course, harmony, arrangements, a "folk" orchestra of ordinary standard instruments, and as usual a touch here and there of ancient local customs. In Austria it's a yodel or two; in the Basque country (France-Spain) it's a peculiar vocal scream—supposedly imitating a horse's neigh or something—as well as a species of tinny flute that joins in every so often.

These are decidedly Shorter Play LP records, but the quality is terrific, at any price. Excellent listening.

The Columbia World Library of Folk and Primitive Music. Vol. XI: Japan, the Ryukyus, Formosa, and Korea.
Columbia SL-214 (1)

Another volume in this remarkable series—I'm taking them a few at a time rather than tackle a lump review of all umpteen records at once. There's much too much in them for that. (See "Scotland," below.)

The Japanese volume is most interesting and quite beautifully done. I tried out some of the Japan-proper stuff on one of the girls from Hiroshima, staying with us pending her plastic surgery, and got an instant recognition, as well as a translation. But other music from further afield—even from nearby parts of Japan—was un-

familiar to her, and not even mildly intelligible. Evidently much of this music is of a sort midway between our folk and popular music categories, combining the wide currency of our disc jockey favorites with the immemorial localized traditions of the oldest folk music.

Much of the music is thoroughly un-Western, with strange instruments and odd, wheedling, snarling voices, but there is, for a good contrast, quite a bit of recognizable Western influence to varying degrees in some of the music, no doubt reflecting actual conditions as of now. A reasonable and intelligent choice of material, it would seem.

The outer geographical areas included are utterly different in their music, emphasizing the sharp ethnological differences between peoples of the once Japanese empire. An interesting section concerns the Formosa tribe that sings in harmony, of an odd and beautiful sort. Big question, not settled: is this actually an independent oriental discovery of the harmonic combinations of sound upon which Western music has been built? Or, just possibly, does this music represent the last remains of some forgotten Western missionary hymn-sing in ages past, taken over and absorbed by the oriental natives? Sounds very much like the latter to me.

A good part of this disc rates "hi fi" and all of it is easily and comfortably listenable. The selections are generally long enough to allow musical interest to get through.

The Col. World History of Folk and Primitive Music, Vol. VI: Scotland.
Columbia SL-209 (1)

This one is a far cry from the Japanese disc, and even more interesting; indeed, it is a priceless collection and may well revolutionize your ideas not only of Scotch song but of the possibilities in folk music of our own "background" peoples, in the English-speaking area. Does music like this exist in Great Britain—today? It most certainly does! Most of the recordings were made, hi fi, in 1951.

The two sides are divided appropriately into that expected over-simplification, the Lowlands and the Highlands. A more noticeable and much more audible division is linguistic, between the lowlands Scotch-English and the Gaelic of the Highlands that occupies side 2 almost exclusively. What an extraordinary language and how very much alive it is still! If Italian is the finest tongue for fancy opera and the like, then surely Gaelic beats them all for folk music. Such effects, such effortless and complex rhythms you can scarcely imagine. And such friendly, good-humored, energetic, exciting, foot-tingling music has seldom been put on records.

Side 1 (it might as well be in Gaelic for all I can understand of the Scots) features the more urbane and civilized music, bagpipers, bands, pub songs, ballads in great profusion. Side 2 gets into the remarkable work songs of the more isolated Gaelic-speaking areas and it is here that the memorable stuff occurs. I'll say no more—but the disc is recommended very highly for anybody at all with an ear for good tunes and rhythms and beautifully projected language.

(Note: If your dealer hasn't got this series in stock he should be able to order it for you without trouble. The records are available singly.)

SOLOS FROM CAPITOL
Moussorgsky: Sunless Cycle.
Prokofieff: Five Poems of Anna Akhmatova.
Gretchaninoff: Six Songs. Maria Kurenko, soprano, Vsevolod Pastukhoff, pf.
Capitol P 8310

A first-rate collection of Russian solo songs, sung by one of the great Russian-language singers in a remarkably clear and transparent recording my only reservation being that the piano is too much in the background for the strength that is in much of the piano writing here. The voice is close-to, with wonderful presence and naturalness. Kurenko has a superb microphone personality—she is as phonogenic as Jennie Tourel, which is saying a lot.

The Moussorgsky "Sunless" cycle is of that unique, dark, dramatic expression for the solo voice, half speaking, half beautiful melody, with shifting, brooding harmonies, that you've heard in "Boris Goudonov" and in the Songs and Dances of Death. Nothing else quite like it in song literature. The Prokofieff works are strangely similar, written in the same dark-colored Russian tradition, with Prokofieff's own fine melodic sense

and piquant harmonies. Gretchaninoff's songs are much less stark, flowing easily from the great Romantic tradition. Their piano accompaniments are more active than the others. come through more effectively in this recorded balance that favors the voice.

Extremely quiet surfaces, very low distortion—high fidelity in truth.

Bach: Partita #2 in D Minor; Sonata #1 in G Minor, for Violin Alone. Nathan Milstein.

Capitol P 8298

Turn your bass control all the way down for these works—there is no bass below middle G on the bass clef, the lowest string on the fiddle. Somewhere around 200 cps.

The unaccompanied Bach works persist in appearing both in concert and recorded form again and again and it is not entirely the desire of violinists to show off their prowess. The music is of the sturdiest and most effective sort, the only technical difficulty in the way of understanding it being simply that these are skeleton works—big compositions sketched out on the fiddle with a minimum of notes, suggesting many harmonies that aren't actually played, compound voices that can merely be touched on, juggled with, a bit of one than a bit of another, to keep them all flowing in the listening mind. Proof of the music's easy appeal is in numerous transcriptions, for piano, orchestra, etc., that, with the implications all realized and written out in so many notes, have long since become popular favorites.

Several things make the solo works easier for today's listening than in the past. First, hi-fi and big, resonant acoustics blend the brilliant fiddle tones together making the harmonies easier to grasp, enlarging the music to its intended "size" and impressiveness.

Second, with the general spread in Bach-style knowledge and familiarity. the violinists themselves make a great deal more sense of these works than their elder counterparts used to do. They hear the harmonies; they play with more accurate pitch, less fancy slithering, and thus they get the sense of the music over to the listeners—who themselves tend to know the style better now than in the past.

Milstein's performance is the epitome of perfection in these respects. Big, resonant, ultra-clear hi-fi recording, beautifully accurate in pitch, the harmonies and suggested skeleton superbly projected and thus easy to follow in the listening. The music isn't all "easy," notably the slow movements; but the light-fingered dance movements, suite style, make up for them for the beginner. If you are onto Bach at all you'll find this highly palatable stuff, bass or no bass.

Capitol has a major asset in Milstein and I suggest a long listen to his other Capitol recordings, notably with the Pittsburgh Symphony and Steinberg.

Beethoven: Piano Sonatas #23 ("Appassionata"); #21 ("Waldstein"). Gorodnitzki.

Capitol P 8264

Excellent Beethoven of a modernly lean and angular sort but highly musical. Gorodnitzki pays plenty of attention to the details, bringing out the fast notes in the "background" that many a more romantic pianist tends to blur into the general dramatic picture. His bass-feeling is excellent, the progression of harmonies always clear and with a fine sense of harmonic drama. There are no fancy rubatos nor other idiosyncrasies to annoy you; the music is neither overdramatized—"this is a famous work"—nor is it tired-sounding, those being the twin plagues of too many playings of this sort of music. In other words, here's a good bet if you want real Beethoven, and a good disc to compare with those of other famous Beethoven performers who may have other things to contribute to the music.

Surfaces on this somewhat older pressing are not too good but newer printings no doubt are up to Capitol's current ultra-high standard. The piano is recorded fairly close, a bit on the percussive side, with fine, full bass.

La Valse. (Ravel: La Valse, piano version; Valses Nobles et Sentimentales. Delibes: Naila Waltz, transc. Dohnanyi. Joh. Strauss: Sweetheart Waltzes, transc. Dohnanyi.) Leonard Pennario.

Capitol P 8294

A collection of waltzes on the piano among which the two Ravel works, extended compositions, occupy the biggest place. I'll have to say again what I've felt before, that Mr. Pennario's fabulous finger technique does not make up for a hard, unmusical approach. that turns the sensitive and powerful Ravel here into an ugly mechanical powerhouse of crashing superpianism. Pennario bangs the strong beat unmercifully; with all his dexterity he somehow lacks what both dancers and musicians might call rhythmic "lift," and his sense of style is not agile enough to project the Gallic edge, the rapier strength and polish, of Ravel's extraordinary music. The other works, less important (and much less subtle) come through more effectively and pleasantly.

Fauré: Four Piano Works; Ravel: Valses Nobles et Sentimentales; Toccata (Tombeau de Couperin). Jean Michel Damase, piano.

London Int. TW 91035

A comparison with the above. Damase, young and French, plays the Ravel waltzes in a startlingly different manner from Pennario—it would be hard to guess they are from the same printed notes. This version is all coy and quiet. a French salon. Parisian might club sort of Ravel. No grand concert hall; the recording is soft and close-up, discreet as any background music, the playing is minus pedal in an almost jazz-popular style. And yet. though this is hardly the Ravel most experienced listeners would expect. it is nevertheless very musical—that subtle quality that can make even an out-of-style performance good. If you're curious, try it yourself; it's well worthwhile.

The Fauré. out of an earlier time, is played perforce more loudly and Romantically. I prefer the Ravel. The old master would have made a fine night club pianist himself, you may be sure.

Notes, in this International edition, are entirely in French, on the inner liner. Nice, if you savvy.

A NOTE ON CAMDEN

Camden records. RCA Victor's mostly semi-anonymous low-priced line, are a boon to listeners but somewhat of a problem to reviewers. who if they have lived long enough have already reviewed many of the items in their old 78 rpm non-

anonymous guises. The Camden proposition is a clever and useful one—to reissue the "oldies" (and some brand new specialties too) at a very low price, with full quality RCA technical work and first class material for the discs themselves, the price made possible by amortization over the years of the first cost of the recording sessions themselves plus an anonymous billing for those records—most of the Camdens—which compete with the musical produce of the same organizations today.

Every commentator and most collectors have busily solved the somewhat transparent riddle of orchestral anonymity posed by such names, maintained consistently by RCA, as the Centennial Symphony Orchestra (Boston Symphony), Warwick (Philadelphia), Festival Concert Orchestra (Boston Pops), Carlyle (Czech Philharmonic), Star Symphony (Hollywood Bowl), and so on; the conductors are nameless and not so easily spotted, though an old record book or catalogue of the pre-1948 date will show you most of them quickly enough if you want to identify them.

What is there in Camdens for the record owner with good, wide-range equipment? As RCA says, here are some of the great recorded performances, tops musically in their time and certainly tops today as well in many examples. For the moment, let's not quibble as to choice in the reissues—the general principle is clear, that these were once-fancy high grade performances and, musically, still are. These are first-rank performers in the main.

Technically most of the Camden recordings are very much out of date (though some are recent and a few are brand-new). They are in major respects improved over the originals—notably in the unbroken long-play and in the complete absence of surface noise. The bass, even in the oldest ones, is generally good—far better than could be reproduced at the time they were released. But the highs are largely lacking and on good equipment this tends to make the total sound seem tubby and dull unless you roll off your bass, to match. (Table-type phonographs don't have enough bass to create a problem here.) For your information in your own scheme of things, here are some further observations.

A. Highs are generally rolled off to around 6000 cps, as I hear them. This, of course, is higher than the highest tones that could be reproduced by the older phonographs. But for many of us it will still be noticeably dull, compared to the sound of new recordings. Not necessarily important—if you value the musical performance.

B. Distortion is a more vital matter. It varies from nil to quite noticeable, in spite of RCA's best current wizardry. Watch out for several kinds—mostly absent, I hasten to say, but not always. 1. "Peaky," ringing sound, a sort of hollow effect, or a background whistling. (Some of this may have been added to bring up brilliance on very old but valuable recordings). 2. Buzzy, tinny sounds in the louder passages—the rest may be beautiful. This is inevitable among many older 78 recordings. (Also there may be periodic deterioration as the 78-rpm sides reach the inner grooves). 3. An over-all thinness of sound, partly acoustical and partly in the recording. Our tastes in acoustics have changed radically since pre-war times; we may dislike now what we used to enjoy. Many of the older recordings, in any case, lack the sharp definition that modern microphone placement gives us—lots of close-up detail work, in a big, golden liveness. Some people like it better the old way.

Don't be overly discouraged by the above. Just look first at the prices and then at the performances and—for one reason or both—you'll find yourself ready to risk the old sound. Generally speaking, Camdens are not going to sound like new records on fancy equipment no matter how you dicker the controls—except the few that are in fact brand new. But on average commercial home one-piece phonographs they will be mostly indistinguishable (as RCA well knows) from the newer discs, and are therefore top values.

Indeed, this, I suggest, is the solid main base of the Camden idea, and it is realistic. Most people, in the mass, still listen lo-fi and can't really tell a new record from an old one. They enjoy both!

A NOTE ON STEREO TAPES

I'll take a bit more review space to say that, though at the moment there are very few two-track stereophonic ("binaural") tapes on the market and they are expensive, the possibilities, now that the Ampex sterephonic phonograph has

(*Continued on page 110*)

AUDIO ETC.

Edward Tatnall Canby

1. Business as Usual

I SUPPOSE I COULD start this month's contribution with any one of several stock openings—"By the time you read this," or "As I write the following lines," or maybe the corniest opening of all, "This is the story of . . .". Not a one of them, right now, seems potent enough to yank you, the reader, right back with me into the middle of late summer and to my present—as of this writing—place-time situation.

You see, as of this moment, we in Northwestern Connecticut have been wholly out of touch with the outside world (including the main office of AUDIO) for three or four days. No telephoning allowed, no mail, no papers, and only a few thousand hours of hysterical generalizations on the radio to tell us what's happening 'tother side of the mountain. All this because of two fickle ladies, first Connie, then Diane; Diane is the gal who was unabashedly pronounced dead a couple of days before she lambasted this area with some fifteen-odd inches of rain in a bit more than a day. For us, that's a mere four months' supply of the liquid, and Miss Connie had presented us a few days earlier with nine or ten inches, another three months' worth. Phew!

And the silly part of it is (as with all such disasters) that here I sit and survey a scene completely undamaged, perfectly normal. We have phone (though we can't call long distance); we have lights, power, water, our road is merely potholed; my local gas station overflowed my tank absent-mindedly when I went to fill 'er up, and wasted a half-gallon.

Half of our people are oft scouring the local disaster areas looking for volunteer work—and mostly getting pushed out of the way as tourists. Everybody and his brother is out volunteering but nobody seems to volunteer to organize the volunteers, which is the way the human species operates when things happen too fast! The other half of us, including yrs tly, are getting about our own private business in a half-hearted way, (who knows when this will get through to Outside) fighting desperately against the feeling that we ought to be Doing Something, that our regular tasks somehow have shrunk down to utter insignificance—when in our hearts we know perfectly well that the world must and will go on again, including Audio and hi-fi, and that if we are *really* needed (and things get organized) we won't have to volunteer; we'll be called upon but quick.

The day after the big rain, I went to the local Village to survey the damage. Amazing. Our railroad's main line was hanging in the air over numerous vast and rocky caverns; the butcher shop had been washed down the main street, which was a narrow strip of hard-top flanked by two enormous gullies ten or fifteen feet deep. The covered bridge, normally fifteen feet above sluggish water, was awash in an unbelievable torrent of yellow flood that moved by solidly like oil at a prodigious speed. The local stream, coming down the mountain, had boomed a thousand times normal, washed straight through the slope of the town taking all with it, leaving cars sitting in garages that towered over strange precipices where the front drive ought to be. But enough—the funny thing was that (a) it never occurred to any of us that this was more than OUR flood, that anybody outside the town had been hit, and (b) it also didn't occur to anybody, that early morning, to do anything but chat and stare and kibitz. Human injury is what brings out the volunteers quick; we had no injuries, and the old people had been moved out of the flood on chairs during the night to safe ground. So everybody went around exchanging gossip (local) and taking pictures. A festive air.

Then, come the next day, things began to happen. That is, crowds of would-be helpers turned up, trucks by the dozen, state highway-men, forestry men, town officials, and most of the populace, plus the guests who were going to have to stay around awhile before getting back to the Big City. Immediately, a table was set up with a sign saying REGISTER HERE and everybody went at registering for service with a fine show of cooperation. But, for those of us who owned merely our own hands and feet plus, perhaps, a shovel—feeble instrument in this day of machine power—there was agonizingly little to do. Pick up loose branches, bottles, pebbles, move them from here to there, shovel sand ineffectually into a vast ten-foot hole that would take a solid year of hand-shoveling to fill up, untangle somebody's wire fence from a couple of tons of mixed branches, garden flowers, and rotting leaves. A gang of five or six spent all morning hoisting an uprooted septic tank onto a truck and out of the way to a dump heap—only to be told that it was too valuable to junk and they'd better put it right back where they found it, which they did. Another gang happily sprayed water from a hose on a truckload of cans of beer, rescued from the stream. They didn't bother to wash all the mud off and so a group of ardent ladies inside a store wiped away at it with vast numbers of paper towels, displaying commendable energy but not much organization! And so it went.

Earlier in the day we had signed up for a dozen displaced persons and were warned, ominously, that thousands were being evacuated from other towns nearby and we might have to take on many more. We worked up a fine head of steam over this and were all set to turn our homes inside out if it would help; but we haven't heard a thing since. Not a word. Said they'd contact us when the moment came. And here I sit, a couple of days later, wondering where all the evacuees went. Nobody knows.

The radio still says the situation is desperate and help is urgently needed nearby;

a crowd of young people set off in our truck early in the morning and haven't been heard of since. But a few practical-minded telephone calls by the rest of us brought a polite thank you—no help needed right now and please keep off the roads.

And so, back to work. It's a beautiful day, never so lovely, and you'd never know a thing had happened.

2. Ampex Stereo

My old interest in anything two-channel —whether for sight or for hearing—is as strong as ever. I took a couple of rolls of color-stereo flood pictures the other day, between times, adding to a stereo library that began, believe it or not, when a rich and elderly lady patroness of my boyhood school, noting that I was selling home-developed postcards of school vistas to the other pupils, presented me with an enormous and expensive stereo camera that she had somehow acquired in Germany and didn't know what to do with. That was 1927! I used its two "channels" alternately, for awhile, and got twice as many pictures. (It took the largest size roll film available.) But eventually I tried a few two-channel photos, and that was that. Been at it ever since, and my latest is stereo projection, complete with glasses. Biggest audience to date: 58.

Thus two-channel sound, when it first began to be noised about in the new tape form, intrigued me immediately. As ancient readers of this mag will remember, I went clean overboard for the initial taped "binaural" demonstrations, perhaps a bit more than I now wish I had. Later on, after more and bigger 'binaural," I had to backwater fairly strenuously. And my year of on-and-off experimenting at Washington University in St. Louis taught me a lot about what's good and what isn't in the way of "binaural" (with loudspeakers), now better known as stereophonic.

And so Ampex's announcement of a new stereophonic tape phonograph had me very much interested, backwater or no. I went, I saw, I heard—and I was impressed, where a good many earlier two-track demonstrations have left me with a strictly "so what" feeling of impracticality. The Ampex 612 stereophonic system is, I'll venture to say, the first really practical and down-to-earth form of two-channel sound to be offered for the home market. Not the gadgeteers' market and the wealthy buy-everything-new market. The plain, ordinary *home* market, the market that is looking for musical values. And this even though the basic system costs some $700 complete.

Paving the Way

Yes, I agree that there have been many two-track sound developments of interest in the three years or so since "binaural" burst upon the audio world. Useful ones, too, that did much to pave the way towards whatever is now upcoming. But I am inclined to put them in a class that we might call, with all due respect, contributory.

"Binaural" amplifiers, for instance. A good development and an inevitable one, as soon as the very idea of two-track sound began to percolate. But the double amplifier is only part of a home two-channel system, incomplete. And, as is usually the case, those first double-channel amplifiers were fairly expensive, not for their own value but simply because, after all, they *were* double, with complications. They work, and you can use them with any new two-channel developments, including the Ampex 612.

Similarly, there have been two-channel tapes on the market for a year or so—a few, not many. Prohibitively expensive (almost

four times the cost of the same sound on a single-track LP disc) and, again, only part of a system—for you must have a player to play them, after all, as well as a double amplifier and double speaker. The painful bifurcation between "staggered" head and "stacked" head two-track tapes has only made things more involved and more expensive.

"Binaural" speaker systems have been offered too, contributing another aspect of this paving-the-way operation, systems like the Bozak with two speaker channels facing away from each other out of one cabinet, the sound reflected forward via side-wing doors. A good experiment and these speakers, of course, can be used for single-channel, two-speaker reproduction too. But here again is an expensive and isolated unit, only part of a home stereo system. A contributory development and, like the others, perfectly good now and for the future, but not a fundamental, complete, new arrangement for the home.

Yes, there have been "binaural" discs, too, and paired pickup systems (with the usual double amplifier-speaker requirements) to go with them—a more dubious development as I see it and one that is *per se* an interim step, not a final solution to the problem as far as discs are concerned. Similarly, there are the "binaural" FM-AM tuners that can receive both types of signal simultaneously, sending the few available "binaural" broadcasts via FM and AM through the double home system. This, too, seems to me a dubious proposition and an interim step, that must eventually be superseded by a better arrangement (such as FM multiplexing) if two-channel broadcasts are to become important.

It is really quite remarkable how these various two-channel developments share a certain pioneering aspect of impracticality and mutual isolation, a certain similar degree of, to use my favorite newly-coined word, *interimity*. They represent a typical phase of a new movement, through which we inevitably seem to pass. Reminds me of the early post-war days when "hi-fi" equipment came in hopelessly non-standardized units, every amplifier with its own plug system or none at all, when cartridges lacked preamplifiers, preamplifiers lacked uniform equalization, and nothing *ever* had a simple power cord attached.

And so, as of this last year, it has been quite possible, though expensive, to rig up a very fancy home two-channel system from the various components available here and there. A fair number of enterprising gadgeteers—the kind who bought the ball-point pen at $13—have got themselves "binaural" or stereophonic (take your pick) set-ups, playing the few two-channel tapes or making their own, tinkering with two-channel discs and/or two-channel broadcasts, when and if. But these systems have cost a pile of cash. And, when you come down to it, unless you have been making your own two-track tapes there really hasn't been very much to play on them. If I am right, RCA's first tape release contained just one two-channel tape. (Maybe it was two.) And how many LP record releases does RCA put forth in a year?

So, you see, two-channel music, whatever its eventual merits from the home viewpoint, hasn't been practical at all in terms of availabilities. About as practical, so far, as home color TV. At least, until now.

Yes, as some readers are clamoring to remind me at this point, there have been some actual complete two-channel home systems on the market. I looked, for example, at the Allegro "Symphonic" console at last year's Audio Fair, including a two-channel tape system, built-in, and two

speaker systems, one at each end with the angled wing-door reflectors mentioned above. Complete, and reasonably practical. Two-channel tape players have been offered, too in connection with some of the new tape libraries featuring announcements of two-channel tape, such as the Audiosphere "Bi-Fi" player unit at only $100.

But, again with all due respect, I suggest that these are still in the pioneering, paving-the-way, contributory class. First, they are essentially enterprising, forward-looking adaptations of existing equipment. (Allegro used a Pentron tape unit, if I am right) rather than fundamentally newly designed systems. No criticism intended! We are always in debt to those who barge ahead quickly to offer new-type facilities, making use of whatever is at hand for a rapid advance into undeveloped territory. Remember the first two-speed and three-speed changers? Adaptations all, but they were available quickly and there wasn't anything better for a long time.

And secondly, I doubt if these two-track home systems have achieved anything like a large national distribution. I doubt if they were intended to. Instead, they are path-breaking models, for the few, but designed to open up new interests and, of course, new sales possibilities. Good. Paving the way.

I should mention, finally, the sort of hi-fi quality record-playback equipment that has been available for two-channel work, to give a better idea of the background into which the new Ampex 612 tape stereo phonograph fits. To my knowledge, no high-quality playback-only unit has been available; the record-play combination has been standard, and costs money. The Concertone models, with easily juggleable heads, have been available in this form at perhaps the lowest price for professional or "hi-fi" quality, around $500 and up, and Magnecord's "Binaural" Magnecordette, home adaptation of the Magnecorder, sells for a similar price, around $550. This, remember, does not include dual speakers or dual power amplifiers. The big, professional Magnecorder two-track job is up in the $850 range and the Ampex stereophonic model, with the more modern "stacked" two-track single-unit head, costs a cool $1953. You can have that one with three tracks for a mere $2514! So, you see, this has been no chicken-feed hobby. Millionaires love it.

I received one taped stereophonic fan-letter from a gentleman, the head of a steel company, who had two of everything you could imagine that costs big money. I played his tape on a mere $600 one-track-at-a-time machine and wrote to him that I was sorry, I wouldn't be able to get the stereo effects about which he talked. ("Now I'm walking towards the right-hand Telefunken mike, thump, thump, thump, and now I'll move over to the left-hand one—can you hear the difference?") Natch, he had the Ampex Stereophonic recorder, the $1953 item, two elephantine speakers, amplifiers, and a room to match, or so I judged from the one half of his tape I could hear. His mike technique wasn't much but his enthusiasm was the real hi-fi McCoy. Even went out and shut off the refrigerator and the furnace, to achieve Absolute Silence for his recording. That was two-track home music, as of last year!

The Smaller The Better

And now—the Ampex 612 system. I'll put off a detailed discussion of its effectiveness until I've got one in my home. But I saw and heard enough in the preliminary demonstration to convince me that this really is something new.

First, the machine is "hi-fi" and no com-

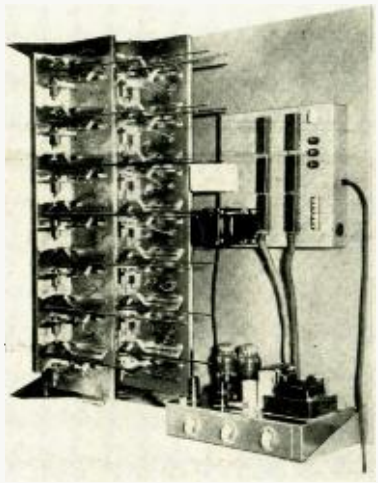
(*Continued on page 108*)

NEW PRODUCTS

• **Cutter-Splicer.** Designed for repairing and editing computer, industrial and special purpose tapes, the new Robins cutter-splicer is available in models for handling tape ranging in width from one-quarter to one inch. The device houses a knob-controlled, moveable, cutter carriage which mounts three replaceable blades. With the knob moved to the back of the unit the recording tape in the guide is cut diagonally. With the knob moved forward the

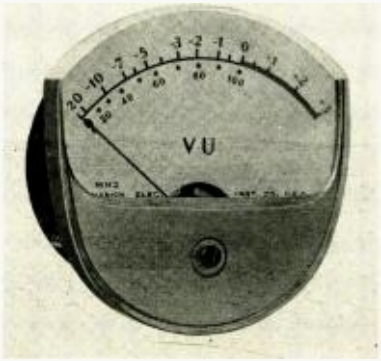
splice is trimmed parallel to the tape with a "Gibson girl" shape—two concave cuts made in the tape edges. Tape ends to be spliced are held in the tape guide by pressure fingers. The unit is mounted on a heavy cast base for bench use, but may be removed from the base and mounted directly on a recorder. Manufactured by Robins Industries Corporation, 41-08 Bell Blvd., Bayside 61, N. Y. **P-9**

• **Electronic Carillon.** Production of the true tones of Flemish tuned bells is achieved electronically in the "Flemish Master" electronic carillon recently announced by the Stromberg-Carlson Company, Rochester 3, N. Y. Not only does the instrument produce Flemish bell tones, but the carilloneur can change the tones to those of English-type electronic bells, or to chimes, simply by turning a knob on the



carillon console. The "Flemish Master" has 25 tone bars, giving it a range of two full octaves. Rolls similar to those used for player pianos, providing a wide selection of hymns and familiar classics, are available. When installed in conjunction with a pipe organ, the instrument can be connected directly with the organ console and played from the same keyboard. In such an installation it can be played either in harmony with the organ, or separately. The playing mechanism of the "Flemish Master" is contained in a metal cabinet 31" l x 37" h x 13" d. Weight is 100 lbs. It is designed for either floor or wall mounting. **P-10**

• **VU Meter.** Developed as part of the recently introduced Marion Medalist line of panel instruments, this new two-inch meter features clear Plexiglass case construction which results in virtually shadow-free illumination by admitting light from the top and bottom as well as



from the front. Designed for precise indication and measurement of audio frequency voltages in broadcast, recording and hi-fi applications, the meter meets the latest A.S.A. specification for "volume measurements of electrical speech and program waves." Complete data on the MM2VU meter are available from Marion Electrical Instrument Company, Manchester, N. H. **P-11**

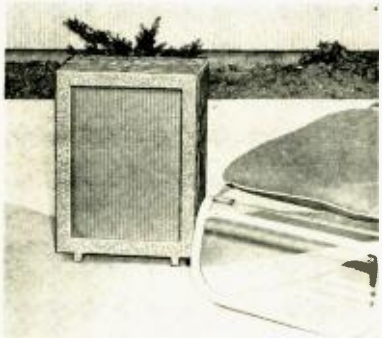
• **General Radio Z-Y Bridge.** This instrument is unusual in the fact that it can be balanced for **any** impedance connected to its terminals. From short circuit to open circuit, real or imaginary, positive or negative, a bridge balance can be obtained with ease. Nominal accuracy of the Type 1603-A bridge is 1 per cent over the frequency range from 20 to 20,000 cps. Readings are direct. Measurements may be taken of impedances which are grounded, ungrounded, or balanced to ground. An audio generator and null detector are required for use with the instrument. In addition to the obvious measurement of R, L, and C components, the Z-Y bridge is

useful for measuring the impedance-frequency characteristics of such devices as electro-acoustic transducers, capacitors, transformers, and filters. Manufactured by General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass. **P-12**

• **Improved Thorens Record Players.** Many improvements are inherent in the new Swiss-made changers and turntables recently introduced in this country for the first time by the Thorens Company, New Hyde Park, N. Y. As opposed to earlier models in which speed reduction from 45 to 33-1/3 rpm was accomplished by braking action on a governor, the new models are powered by a direct-drive motor which utilizes a separate gear for

each standard speed. Operating convenience is enhanced by the adoption of a dial-action control knob for selection of the three standard speeds. Concentric with this dial is a fine-tuning knob which permits speed adjustment as much as 5 per cent above or below standard. For easier installation all of the new Thorens units are equipped with permanently attached shock mounts. Among improvements in the new Thorens Model CD-43 record changer, illustrated, is a provision for manual operation. Further information is available on request. **P-13**

• **Portable Speaker Enclosure.** Equipped with a concealed carrying handle and weighing only 20 lbs., a new popular-priced speaker enclosure designed especially to provide durability for outdoor use has been announced by Manfredi Wood Products Corporation, 226 New York Ave., Huntington, N. Y. The unit combines colorful cabinetry with a fully-insulated



bass-reflex speaker compartment. Exterior finish is of Conolite, a laminated plastic veneer. Fiberglas insulation is provided on both sides and top of the speaker compartment which is for use with 8- or 12-in. cutouts. A Fiberglas curtain is also used for elimination of boominess. Dimensions are 22" h x 16" w x 12" d. **P-14**

• **Fisher Audio Control.** Virtually every feature which could be desired in affording audio control of a high-fidelity music system is incorporated in the new Fisher Series 80-C Master Audio Control. Although it permits flexibility of control which is normally encountered in professional studio consoles, the self-powered 80-C is remarkably simple in operation. Among its features are included mixing and fading facilities for from two to five channels, tape input for operation directly from tape playback head, sixteen combinations of phonograph equalization, a calibrated loudness-balance control, and push-button channel selectors which, in addition

hrc HARVEY the House of Audio

MAGNECORD

M81 Series

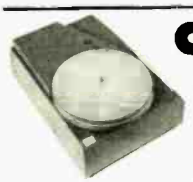
Portable

TAPE RECORDER

The basic tape transport mechanism operates at 15 and 7½"/sec. A switch is used for speed selection. Other controls are push-button operated. Accommodates reels up to 10½". Frequency response at 15"/sec. extends from 40-15,000 cycles ±2db. Employs 3 heads: erase, record and playback. In 'record' position playback head serves as monitor.

Separate record and playback amplifiers are available thus permitting simultaneous monitoring from tape. Record amplifier has high impedance, unbalanced microphone input and unbalanced bridge input. Balanced 50 ohm mike input and balanced bridge input available through use of optional plug-in transformer. Meter is provided for bias, record and playback. Has cathode follower output. Optional plug-in transformer provides balanced 600 ohm output.

M81-A	Recorder Mechanism in portable case	**$635.00**
M81-AX	Same as above but less case, for rack mounting	575.00
91X1552	Case only for recorder mechanism (with blower assembly)	62.50
M81-C	Record/Playback Amplifier in portable case	245.00
M81-CX	Same as above but less case, for rack mounting	225.00
81D50	Case only for Record/Playback Amplifier	28.00
M81-AC	Recorder Mechanism and Amplifier combination in portable carrying case	870.00



COMPONENTS

Professional 3-SPEED TURNTABLE

A high quality record turntable with extremely low rumble and wow content. Employs a constant speed, shielded induction motor, double shock-mounted to isolate vibration. An endless fabric belt drives the turntable directly from the motor shaft. Speed change is made by placing the endless belt on the proper pulley step.

The turntable itself is a 25-pound steel disc with a polished steel shaft riding on a ball thrust bearing. An expanding spindle is used which automatically centers the record. The entire turntable assembly is mounted on damped coil springs to absorb floor and cabinet vibration. The table provides ample room for mounting a pickup arm.

Blonde or Mahogany **$99.50**

Base Skirt (as shown in illustration) 15.00

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

Printed-Circuit Miniaturized *"Preamp with Presence"*

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Basic kit containing the 1.0 henry encapsulated choke, the printed circuit panel completely drilled, and the four metal chassis parts **$7.50**

The complete kit of parts, including the basic kit and all other parts and tubes as specified by author. With complete, simplified instructions **$35.50**

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A-440A PREAMPLIFIER — Three high-level and two low-level inputs, equalized or flat. Main amplifier and recorder outputs. At 1 KC with tone controls flat, gain is 60 db on phono (low level, equalized), 63.5 db on mic. (low level, flat), and 26 db on TV, tape, or radio (high level). Frequency response is flat from 20 to 20,000 cps. Noise level is better than 95 db below 1.5 volts output. Seven controls, 3 AC receptacles, self-contained power supply. In mahogany or blonde cabinet **$139.00**

A-340A AMPLIFIER — 35-watt output with less than 0.5% total harmonic distortion. 66.5 db gain. 1.3 volt rms input sensitivity for 35 watts output. 200,000 ohm input impedance. Frequency response 5 to 100,000 cps within 1 db. Noise level 95 db below full output. Load impedance 8 and 16 ohms, adjustable from —4 to +4.5 ohms on 8 ohm tap, less than .52 ohms on 16 ohm tap, with damping factor of 35 on 16 ohm tap and 1.8 through infinity to —2.0 on 8 ohm tap. Gain and R_G adjustment controls.

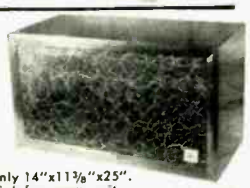
Complete **$159.00**

The New

ACOUSTIC RESEARCH

AR-1

SPEAKER SYSTEM



Revolutionary acoustic suspension system provides a bass response hitherto unobtainable. At the same time, this is accomplished with a speaker cabinet only 14"x11⅜"x25". AR-1 with 12" woofer and 8" mid-and-high frequency unit in finished cabinet **$185.00**

AR-1U same as above in unfinished cabinet **$172.00**

AR-1W woofer only in finished cabinet **$145.00**

AR-1WU woofer only in unfinished cabinet **$132.00**

LEAK

Dynamic PICKUP ARM & CARTRIDGE

Minimum inertia and friction. Provision for plug-in interchangeable heads. Coil impedance 6 ohms at 1000 cps — distortion-free because no magnetic core is used. Diamond stylus and arm rest provided. Lower record and stylus wear than any other pickup. Frequency response independent of temperature 40 to 20,000 cps ±1 db. 11 mV output for each cm/sec. rms recorded velocity easily loads amplifier with a sensitivity of 40 mV at 1000 cps by the pickup from commercial records.

Arm with moving-coil pickup for microgroove (33⅓ and 45 rpm) records with diamond stylus installed and matching transformer **$59.00**

Moving-coil pickup only, with diamond stylus for standard (78 rpm) records —less arm and transformer **$32.50**

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CONCERT CD-43

Three-Speed Record Changer

Intermixes 12", 10", and 7" disks. Repeat control replays any record size. Pause-and-Reject Control allows immediate record reject and adjustable pause between records. Automatic last-record shutoff and muting switch assure noiseless changing. Condenser blocks switch-to-speaker noise. Easily adjustable tracking weight and set-screw cartridge alignment minimize record wear. With pre-assembled shock mounts and switch for semi-manual operation **$93.75**

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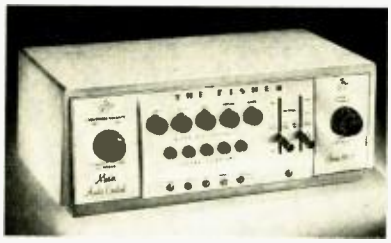
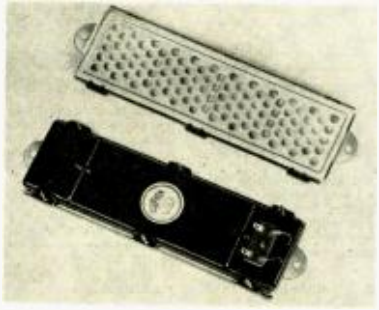
to selecting audio input channels, also control a.c. power to auxiliary equipment. Seven inputs are provided, including a separate high-gain microphone preamplifier. Bass and treble controls are of



the variable-crossover feedback type. Frequency response is 10 to 100,000 cps and hum and distortion are reduced to negligibility. Descriptive sheet is available from Fisher Radio Corporation, 21-21 44th Drive, Long Island, N. Y. **P-15**

• **Electrostatic Speakers.** Available in both rectangular and round types, the new Isophon electrostatic speakers are designed for covering a frequency range of 7000 to 20,000 cps. Special construction of the vibrating membrane assures even distribution of radiated sound. Low cost and



good quality combine to make the line of Isophon speakers of particular interest to manufacturers of radio and TV receivers. Manufactured in Western Germany, they are available in this country from Arnhold Ceramics, Inc., 1 E. 57th St., New York City, N. Y. Complete information will be mailed on request. **P-16**

• **Professional Film Recorders.** Designated the Model S6 system, a new line of professional magnetic film equipment has been introduced by Stancil-Hoffman

to answer the need for portable recording facilities which can be operated from either batteries or normal a.c. line voltage. The studio production unit consists of three portable carrying cases, each 10¾ x 14½ x 6 ins. The first contains a two-channel microphone preamplifier-mixer with an announce microphone and buzzer system. The second contains the recording amplifier, playback amplifier, and power supply. The third contains the film transport which has a film capacity of 1000 feet. The S6 system is available for 16 or 17½-mm film. A complete description of the various camera drive systems for field operation may be obtained by writing Stancil-Hoffman Corporation, 921 N. Highland Ave., Hollywood 38, Calif. **P-17**

• **Specialized Goodmans Speakers.** In order to afford exactness in meeting specific use requirements, the new Audiom speakers manufactured by Goodmans of England are available in a choice of different resonant frequencies. Two models are even provided with simple means for interchangeability of cones, thus permitting selection of a cone whose fundamental resonance most closely matches the needs.

The speakers were designed particularly for public-address and industrial applications, electronic organs, and as bass reproducers in a 2- or 3-way high-fidelity music system. Largest of the Audioms is the Model 90, an 18-in. speaker with power handling capacity of 50 watts. Fitted with an easily detachable cone-coil assembly, a unit may be selected with fundamental resonance of either 35 or 50 cps. The smallest Audiom is Model 60, a 12-in. speaker rated at 15 watts with choice of 35, 55, or 75 cps resonance. Crossover design data and recommended enclosure specifications are available on request. Write Rockbar Corporation, 215 E. 37th St., New York, 16, N. Y. **P-18**

• **Spotlight Socket Wrench Set.** Especially handy for working on electronic equipment in subdued light or in complete darkness, a new screw driver and socket wrench set contains a built-in spotlight which illuminates the screw or nut to be manipulated. The shaft on both tools is

hardened chrome steel. The handle, which also serves as a battery case, is of heavy-duty plastic. Uses single penlight cell. The socket set comes with six detachable socket heads. Contour Marker Corp., 1843 E. Compton Blvd., Compton, Calif. **P-19**

RECORD DEALER VIEWS

(from page 32)

some solution to the vexing problem of the defective record.

Our first step was to install a "needle clinic" complete with microscope, the widest assortment of needles, needle literature, and so on, and we engaged a needle technician. *Talk* about needles and their effect upon the performance of a record was not enough. It was necessary to *prove* that a needle was good or bad, and that a faulty needle was the cause of faulty play back. Equipped with a microscope, this single technician (today we employ three such specialists) went on to prove conclusively to our customers that here was the solution to faulty record reproduction.

Handling Complaints

A defective-record complaint was handled in the following manner. First, a test laying on the hi-fi phonograph installed just for this purpose—actually this machine is an ordinary record player having no special gadgets which might make it behave differently from any other player. If the record played to the customer's satisfaction, as was predominantly the case, he was then taken to the needle department where the technician attempted to ascertain the type of needle he used and the time of actual usage. After consultation, many customers were willing to admit that their needle had been used far beyond its useful life and they were willing to purchase new ones. Others stubbornly refused to accept the technician's explanation and only grudgingly consented to a microscopic examination of their stylus. Many of those who bought new needles came back and gratefully admitted that the records which did not play properly the day before, played perfectly now. Those who brought their needles in for inspection were shown the culprit under the microscopic and were forced to admit that the jagged point certainly looked unlike a new needle. Defective-record complaints decreased sharply, but the complete solution was not yet at hand.

Our next idea was to determine the useful life of the various types of needles under actual playing conditions. We devised a simple series of tests which would, once and for all, controvert such fancy descriptions of a stylus as being "long life," "everlasting," or "permanent." We had to have black and white proof which could be understood by all our customers, even the most uninformed.

For seemingly endless hours, various styli—osmium, sapphire, and diamond, were played. About 150 osmium needles and well over 250 sapphire needles were used in this research and no major needle manufacturer's product was omitted from these exhaustive tests. Even though a diamond point was considered the best of all phonograph needles, we questioned this fact, since hearsay evidence was not sufficient. We sub-

jected over 50 varieties of diamond needles to the same series of tests and kept accurate records of all of the hours played and the results of microscopic examination. Consideration was given to the conditions under which these needles would be used, and pickup arms were used on which stylus force could be varied from 2 to 20 grams.

These tests proved conclusively that the term "permanent" as applied to *any* needle was misleading and absolutely false. We found that the only needle demonstrating any prolonged usefulness was a diamond, and even this was sharply circumscribed by the actual conditions of play. Nevertheless, the useful life of the diamond was fantastically greater than the other two types. Osmium needles were found to be good for about 15 hours at the most, whereas the widely used sapphire was playable for a maximum of 40 hours before it began to damage the record. The life of the diamond needle fluctuated from 600 playing hours up to 1800 hours (some of my meticulous customers who kept a log on their needles proved that there were occasional cases of diamonds lasting more than 2000 hours when used with a properly weighted and balanced tone arm). However, to the best of my knowledge no one has yet proven that either osmium or sapphire styli were useful beyond the hours indicated.

We found that *no* needle will function properly under abnormal weight applications. Under certain conditions, stylus forces as low as 2½ grams were found to be as injurious to a record and needle as were those of 20 grams. The lower force caused needle flutter stemming from an insufficient weight necessary to ensure the needle point riding properly in the groove. The net result was that the unsatisfactory sound emanating from the record was as bad, if not worse, than the same results obtained with maximum force. Within the scope of this test it was discovered that dust particles accumulating on the surface of the record were of sufficient abrasive quality to decrease the life span of both needle and record considerably.

All of the evidence about defective needles was displayed on a series of placards posted about the store and in handbills which were given to our customers. Consumer indifference and even resistance were not substantially reduced, largely because of the misinformation sponsored by certain phonograph manufacturers and sales personnel who created fanciful figures about "permanent" needle life in order to lend finality to a successfully concluded sale.

Manufacturers' Responsibility

It has been our contention, from the very first, that it is the primary responsibility of the manufacturer of phonographs to advise the customer as to the correct time-use of the stylus incorporated in the machine. It is very discouraging to see a brochure, which usually accompanies a new record player, in which the manufacturer blandly states that the stylus included in his machine is "permanent" or has a useful life of a year. This statement could be true if the needle were used for only 15 to 40 hours *within* the 52 weeks. One of our customers, sensitive to this situation, inquired of a

well-known manufacturer of record players as to the proper amount of playing time his needle should be allowed before replacement would become advisable. The reply, signed by the vice-president of the company, stated categorically that the needle would give him good service for at least two years. This reply, it should be understood, was given without any question as to the type of needle point used or the amount of playing hours involved within this period.

This type of advice offends as much as does that of those manufacturers of phonographs who build their 3-speed machines with a one-needle cartridge—one with a "universal" or "all groove" stylus. Obviously, they imply that it is proper to play all speeds of records with this one needle which has a tip radius of 2 mils. They well know that the grooves on an LP and 45 records are designed to play with a 1-mil stylus, and the standard 78 record has a 2.5- to 3-mil requirement. In all honesty, how can the manufacturer reconcile the use of this "all purpose" needle without expecting either damage or improper playback reproduction. Individuals who purchase these machines are generally lacking in specific technical information and accept as gospel the manufacturer's claim that all types of records can be played with this one stylus. Inevitably these individuals will constitute the preponderance of complainants about faulty record reproduction.

On February 26th of this year, we published, in *The Billboard* (a trade magazine), a full-page open letter in which we took to task both the record and the phonograph manufacturer. We pleaded the case of the misguided consumer and the tormented dealer and then challenged these manufacturers to reveal the true facts concerning this needle problem. The facts supplied in this open letter were essentially the same as the foregoing statements. The open letter gave further emphasis also to the problem of improper stylus force. All machines leaving the factory should not only carry the proper stylus but should also be correctly adjusted insofar as stylus force is concerned. That this admonition is necessary is sufficient commentary on the indifference displayed by certain companies toward this problem. One would hope, at least, that barring factory adjustment, some written instructions to the dealer or the consumer would be made, advising how any particular tone arm could be correctly adjusted. In this open letter we pointed out the enormous investment the record producers had made in their product and the large expenditures which most of them had made in advertising their records. However, nowhere on the sleeve or the inner liner was there any information informing the buyer that the record he had just purchased was a precision-made commodity and that it was essential to play it back with a 1-mil needle (I believe that only 3 out of 240 record manufacturers do so inform the buyer). No mention is made anywhere of the absolute necessity for playing these records with a perfect stylus. Any statements to this effect, if they do appear on a record, must be in such fine print that they can be deciphered only with

the aid of a magnifying glass. Thus it is left to the inexperienced retailer and the uninformed customer to try to discover these facts for themselves.

There are other problems with which our needle technicians are faced. Important among them is the non-uniformity of cartridges which are installed on like machines of a single manufacturer. For example, one machine—let us call it Model X—will come off the assembly line with a variety of cartridges, either Shure, Astatic, or Webster Electric, whichever happens to be available at the time. Each of these cartridges requires a needle of an individual type and none is interchangeable with any other. Thus, when a customer requires needle replacement for a Model X phonograph how does he or the dealer know exactly which needle he requires?

Cartridges

Most cartridges are of simple construction and do not demand any mechanical ability in needle replacement. However, there are still too many cartridges being manufactured upon which even a skilled repairman hesitates to work. The deficiencies of these latter lie mainly in the delicate and involved manipulation necessary before needle replacement can be made. Some require removal of the cartridge from the tone arm; others are of the type in which the needle has been inserted under heavy pressure, so that breakage or damage to the cartridge almost always occurs at the slightest touch, when removing the needle. Faced with all these problems we insist that our technicians educate the record buyer in every way possible and at every possible opportunity. It is almost as though we were operating a place of learning specializing in the subject of *preservation of a valuable record.*

Many people who visit our needle clinic do so with an open mind, and are willing to accept our proof that their equipment is at fault. Nevertheless, there are still too many who retain a strong bias and insist that the manufacturer who specified that he gave them a "permanent" needle knew what he was talking about; and that anyway we are just trying to sell more needles. We hear a great deal from this type about the ultra-sensitivity of his phonograph and how it has the intelligence to reproduce properly only the most perfect record. Many of them become very sheepish, however, when their "defective" record tracks perfectly on our equipment.

Having stated the problem, we have found it necessary to employ all ethical means to protect ourselves. The foregoing has indicated some facets of the problem and we must admit that there is not yet at hand the possibility of a solution to satisfy everyone. Aside from talk and demonstration, we include the Sam Goody warranty in every package leaving our premises a guarantee that all records will play perfectly if properly handled.

The long-playing record is still relatively new and has by its outstanding and desirable characteristics proven a boon to the industry. Shall it be allowed now to become a bane? It is the responsibility of the record manufacturer to acquaint the purchaser with the proper playing conditions which must

be met for proper reproduction. He should state, without equivocation and as precisely as possible, the useful playing life of the three types of needles. He should advise the purchaser as to the proper type of replacement needle and illustrate simply and clearly the right method for replacement. He should also make sure that all machines of the same model and make have uniform cartridges in which the needle can be changed easily and without fear of damage. It may interest the reader to know that there are more than 100 different types of cartridge now in use for which there must be an equal number of replacement needle types. Things must be done as simply as possible so that the layman-customer needs no special mechanical knowledge nor a complete tool box.

BUILDING SIMPLICITY

(*from page 52*)

control, and to re-route the wire which carries the output of the cathode-follower directly to the "output to tape recorder" jack. One of the "AUX" input jacks may have its wire disconnected from the selector switch, and connected directly to the "loudness" control. New labels should be made, showing this last jack as the "tone control input" or such other language as suits the user. With these wiring changes, the cathode-follower output of the selector switch is connected directly to the input of the tape recorder, whose output is then connected directly to the volume control, tone controls, power amplifier, and loudspeaker. The recorder may then be turned on whenever the system is in use, so as to feed all signals through to the amplifier and loudspeaker, or it may be equipped with a switch which connects its input to its own output whenever the recorder is turned off, so as to be effectively out of the circuit except when in use.

A careful examination of the schematic diagram of any equipment to which a tape recorder is to be connected will usually reveal a point in the circuit where level is high, and not subject to variation with the volume control setting, and a point which has not been subjected to tone control. Usually, this point occurs immediately after the selector switch. If a cathode-follower happens to be in the circuit immediately following the selector switch, so much the better—the output to the tape recorder may then satisfactorily be connected here, rather than directly to the selector switch, provided the volume control was not placed earlier in the circuit than the point selected for the output to the tape recorder. Usually, this configuration will result in a system which can "howl" if the monitor selector on the tape recorder is set at "input" when the control box selector is set for "tape," but the system will be capable of making high-quality tapes, with adequate level, and with flat frequency response. "Howl" can be positively eliminated only by adopting the "series" type of connection for the tape recorder.

AT HOME WITH AUDIO

(*From page 31*)

type, but family usage and custom frequently deviate to a point where an automatic device is used for uninterrupted playing of music for dancing (the children do) or perhaps for background music while dining (frequent); and not forgetting the tuner as a source, either. Hence selection follows selection, each being dropped mechanically for as many as the spindle can accommodate. For the matured appreciator of music, the open choice of tone arm, cartridge and stylus possible with the manual professional-type turntable, and the deep pleasures they can bring, are a most attractive prospect.

As an example of another additive for which the expansion-attic principle has made this cabinet ready is the second section, narrower but plenty adequate to accommodate any one of the well-known makes of the higher quality tape recorders. In this case the new 20/20 Concertone machine has been fitted into a mounting board atop a drawer practically universally dimensioned as to height, depth, and width (*Fig. 7*). In the same area can be used the tape transport mechanisms of other units with similar size base plates: certain models of the Ampex, Dynacord, Magnecord, Presto, etc. Naturally, the amplifiers would in each case be fitted into the panel placed directly over the transport mechanism, as shown, for easy operation and to maintain the proportions.

Call this "powerhouse" a basic hi-fi cabinet, or not; the point is that this kind of design will let you grow as the hi-fi arts develop and grow and you occasionally find reason to replace one piece of equipment with another, or change to costlier units as your hi-fi sights can affordably be raised. In this cabinetry system there is a total of four flat pieces of wood, three of them oblong (one for the record player, one for both the tuner and amplifier control, and one for the tape recorder amplifier); and the other almost square, for the tape recorder transport unit. The odds are that the tuner and preamplifier-control panel would need cutting anew if these units were changed and perhaps the same might be true of the "downstairs" or record player panel. In each case, the instrument panel proper or mounting plate is easily taken out by loosening the manufacturer's mounting screws; then the wood panel comes out by removing three brass countersunk wood screws at each end (a total of six, for solid security). The record player platform is taken out by lifting it from its sliding tracks. The tape transport is easily removed by loosening the four metal plate screws; and then the wood carrier panel can be taken from its deep-drawer housing by removing four countersunk brass wood screws, set one in each corner. And that is all there is to making any equipment changeovers or, for that matter, removal of any of it for servicing, cleaning or repair.

Breathe Out the Hot Airs

There's no point in overheating—in fact, it is a bad climate for sustained system efficiency. So this cabinet has features like that divided air-space right over the tuner and the amplifier assembly to keep the fine finish of the top of the cabinet from being overheated and perhaps crazed, in time. (*Fig. 10.*) The tape recorder is ventilated by means of eight three-inch holes bored in-line into the back panel of its draw-out compartment, and a similar number of facing holes bored into the panel screwed on to the back of the cabinet (*Fig. 8*). The oblong port near the top of this portion of the cabinet helps dissipate the generated heat, and handily permits insertion of the lead-ins and cord-sets necessary for the operation of the tape-recorder for playing or recording through the main system. (*Fig. 9*). Stability of the draw-out parts is assured by use of three heavy-duty slide tracks mounted in parallel on the bottom of the sliding base of the weighty tape recorder. Unlike this is the mounting of the slides for the lighter-weight record player—on a pair of double sliding, side-mounted heavy-duty tracks, the whole platform removable with a sharp lift of the ball-bearing trolley wheels out of the forward ends of the tracks. Another move towards stability is the installation of two strips of three-inch metal worked into the rear of the record player compartment. One is a permanent magnet attached to the fixed inner face of the cabinet's back panel, and on a level with it the other piece is attached to the inside edge of

the sliding record player platform. Since it is free-moving on roller slides nd absolutely level, it was discovered that the platform rebounded of its own inertia when pushed back in, with the likelihood of jarring the pickup from the record groove and maybe damaging cartridge and disc. The bar magnet. drawing the slide to with a reassuringly firm but gentle pull. prevents this.

How the Powerhouse Took Shape

In its constuction the cabinet was handled like a small house. You can say it is a ranch type "shack," all of it under ne long-stretching roof. The framing at the front is built of sturdy 2×2 stock, top and bottom—the lintel and sill, so to speak. The sides total one inch thick, built of ¾-inch wild grain fir plywood. faced with ¼-inch Korina veneer. You can stop with the fir plywood and save the cost of the Korina (about 25–30 dollars more) and still have a sturdy cabinet structure with. besides, a graining similar to (but not as fine) as the teakwood now so favored for certain letter class furniture units. The Korina facing is neutral as to grain and its light wheat finish gives it a passive presence that neither housewife nor interior decorator find objectionable. Its facade offers a few accents with the black knobs and brass finished escutcheons of the hi-fi fittings, otherwise it makes rather a muted note in a room with light painted walls and a large roomwide casement window.

Definitely, the hi-fi equipment came first, and then the cabinet was built around it. The equipment was acquired piece by piece and then collated for installation. The cabinet was erected, the author taking part, at the workshop of Modern Furniture Craftsmen, New York City. Without their patient help and advice the author's suggestions and very rough sketches, mostly made by waving of hands, could not have been shaped into the finished product. Near as one can tell the cost of lumber and hardware came to about sixty–seventy dollars, give or take a few.

We hardly expect that this exercise in hi-fi housing (a subject for AT HOME WITH AUDIO promised in our agenda) could become exactly pandemic in the realms and warrens of home hi-fi. But it has its points, not the least of which (in addition to those enumerated above) is that its design seems to have hit upon a sit-down "strike"—in the sense that all the equipment can be operated and controlled chairside as mentioned above. though cased in a full-scale wall cabinet. Planned for uncrowded disposal of the components, it is a convenient extensor of your ten fingers, with you meanwhile *couchant,* as they sometimes say in heraldry.

It would seem that the spacious plan holds the components in an uncrowded array that to some hi-fi stalwarts is akin to the feeling of an organ console. And thus they would "play" it, wide-swinging in spirit and taking from it the gift that

is anybody's for the reaching: music from the heavens of inspiration, winging along electronic paths to Edens of listening, and calling out to the purity that is in each one of us. . . . Old Dr. Eiliott's famed five-foot shelf of basic books has nothing, for comprehensiveness, on this cabinet's sixty inches of electronic stepping stones reaching out, like Blake's ladder to the moon, towards the attainment of man's everlastingly chanted, "I want, I want." . . . It is free of mechanical crowding, control-knob bunching, cute disguising, or Rube Goldbergian contortion. Seated before this "console," you find that the control knob of the main amplifier is at about its exact center. Reach out with your left hand to tune the radio, or with your right, to bring in the tape recorder when (again with your left) you turn the selector knob that way. With both hands, bearing right—but not having to move from your chair—you put the reels on the tape machine; and, with both hands, but bearing left, you turn on the record player. And of course you can dub onto tape any one of these signal sources, singly or combined with the microphone; and listen at the same time through the loudspeaker whilst monitoring by VU meter, thus sharing with others the incoming signals even as they are recorded to tape without overloading; and of course you can monitor with headphones, still allowing others present to hear the signal, from the source, or as it emanates from the tape whilst being recorded.

Once you get the pattern fixed in your mind, its rather box-kitish construction practically puts itself together for you. It is a hollow rectangle with (if you like) an off-beat Mondrianic subdivision of its facade, and hence its cubic contents, and with only a partial fixed front, as seen in the panels for tuner and preamplifier control, and for the tape recorder amplifier. (*Fig.* 11). The rest of the front is removably attached either with piano hinges (as the pull-out "platform" doors) or with drawer slides. The rear of the cabinet has been faced with ¼-inch Korina veneer, finished like the rest of the cabinet in golden wheat. When used as a room-divider (which it could decoratively be) this back with its crew-cut array of wire, cable and cordsets, can be over-faced, a one or two-inch space away with, say, a clip-mounted perforated hardboard panel easily removed for access for repairs, and so on.

One of the subdivisions is a third larger than the other. The total of 15 cubic feet has been assymetrically divided. The larger one has nine cubic feet, the other six cubic feet—either one ample enough to house a good speaker or speaker system—if that should be *your* way with a cabinet. The *height* of the larger section is virtually the same as the *width* of the smaller, and this proportioning establishes a relationship of masses akin to an (architectural) "order"—which is a structural truth that occasionally can result from a convergence of utility and form—and which in this case we are flattered that it very nearly is.

But let us pull this rhetoric down a peg or two—and say that some of us are advocates of the packing-case, or complete surround, technique of hi-fi housing; as opposed, say, to the kitchen

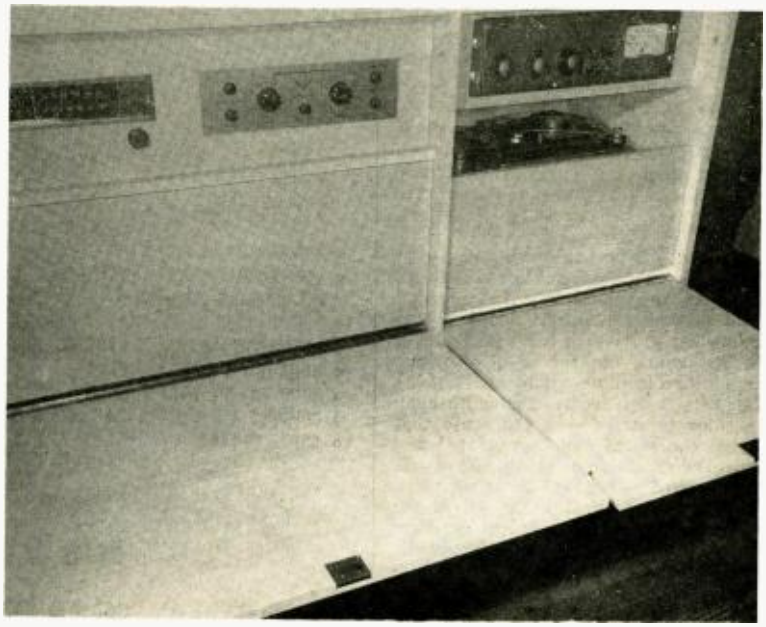


Fig. 11. The summing up: Sheer wood surfaces support and protect hi-fi system well-spaced out for flexible operation. Doors at full "out" position remain rigid and level; full length brass piano hinges and flush locks match the finish of instrument panels.

range or open style, top-of-the-cabinet placement. Either way, the point is that the equipment you choose for containment in the housing you choose, should not be such that (for horrid example) an amplifier vents torrents of decibelicose tantrums upon a mismate like an under-excursioned speaker cone. They should better be on deci-bil and coo terms, to carry the pun to the mach-*nth* degree of (your) tolerance. An essential consideration this, as the final choice is mind-made in the conviction that, of all the parts and components seen and heard at Audio Fair or audio-demo salon or friend's home, you prefer "this" rather than "that" item. Where price is no object, the odds are that what you choose will be of compatible qualities and capacities. But where cost must be held like a carrot before our eagerly twitching hi-fi noses, then we must beware lest it lead us to false economy—which is a mislead, indeed.

The components in the system under inspection this month are, on the other hand, of a representative quality. The hi-fi services they offer and are capable of are not necessarily confined to any one brand. Those we have selected are (or were, some months ago when we began this "powerhouse" deal) for one, the latest available production models; for another they represent in fair measure optimum compatible quality, individually and collectively, at a price that can justifiably be said to make them a 'smart buy."

LETTERS

(*from page 10*)

the story is certainly indicated, and we would be more than glad to enlarge further on this subject or the arguments contained herein.

Cullen H. Macpherson, Asst. Mgr.,
Reproducing Components Division,
ELECTRO-VOICE, INC.,
Buchanan, Michigan.

(We appreciate Mr. Macpherson's recognition of what we meant to say. That we failed to make our opinion clear is an indictment of our semantics rather than of our engineering. Let us be practical: no commercially available loudspeaker reaches an efficiency of as much as 25 per cent over the entire audio spectrum—*most will range between 5 and 10 per cent. Thus the difference between two hi-fi loudspeaker systems is not likely to be more than 6 db, but that is more than enough to trap the unwary ear and cause the louder of the two to sound better. We do think that output levels should be equalized for demonstration purposes, and the main point of our editorial was that the equalization should take place ahead of the power amplifier rather than between amplifier and speakers.*

We must not undersell efficiency, for an efficient speaker will permit us to run the amplifier at a lower level with consequent less distortion from that source, but it should not be the controlling factor in the selection of a loudspeaker. In any case, give both speakers a fair chance when making listening tests on a comparative basis. ED.)

THE ACOUSTIC EARSET

(*from page 44*)

S_R (cross sectional area of constricted air path leading into earset) = 1 cm^2 = 10^{-4} m^2

$$M_{A1} = \frac{\rho_o T_L}{T_R} \qquad (1)$$

$$= \frac{1.18 \times 0.76}{11 \times 10^{-7}}$$

$$= 1277 \times 10^3 \ kg/m^4$$

$$M_{A2} = \frac{\rho_o E_L}{E_R} \qquad (2)$$

$$= \frac{1.18 \times 0.027}{0.3815 \times 10^{-4}} = 83 \ kg/m^4$$

$$M_{A3} = \frac{\rho_o S_L}{S_R} \qquad (3)$$

$$= \frac{1.18 \times 0.01}{10^{-4}} = 118 \ kg/m^4$$

$$C_{A3} = \frac{S_c}{\gamma P_o} \qquad (4)$$

$$= \frac{5 \times 10^{-6}}{1.4 \times 10^5} = 3.5 \times 10^{-11} \ m^5/newton$$

where

γ = ratio of specific heat of air at constant pressure to specific heat of air at constant volume = 1.4

P_o = Atmospheric pressure in newtons/sq. meter = 10^5

ρ_o = density of air in kilograms per cu. meter = 1.18 kg/m^3

(the cutoff frequency)

$$= \frac{1}{\sqrt{M_{A3} C_{A3}}} \qquad (5)$$

$$= \frac{1}{\sqrt{118 \times 3.5 \times 10^{-11}}}$$

$$= \frac{10^8}{6429} = 15{,}550$$

radians per sec. = 2476 cps.

From this it can be seen that the cavity volume S_c must be made as small as practicable so as to raise the frequency of resonance.

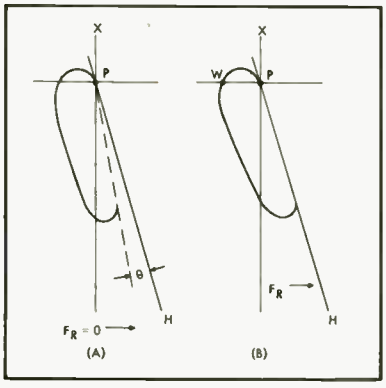


Fig. 5. Static balance resulting from shape of earset.

Fig. 6. Appearance of experimental model of acoustic earset.

The Static Balance

The most satisfactory seal can probably be obtained only by means of an externally applied axial force against the earset from a spring steel headband.

Practical tests have shown, however, that good closure of the air leak can also be obtained by loading the earset with a small weight or concentrating the mass of the molding material on the axis corresponding to the pivotal suspension.

The method is shown graphically in *Fig.* 5 in which (A) is a free-body diagram showing the unloaded earset suspended at point P which is the resting point on the ear.

(A) in *Fig.* 5 shows that the horizontal force $F_r = O$ and a small gap θ will occur if equilibrium is reached before the earset touches the inclined headline H. In this state, the vector sum of the forces acting about point P merely combine to produce a downward resultant.

To realize a horizontal component of force and close the gap, a clockwise moment or torque about P must take place. The moment M is equal to force times perpendicular distance from axis y. From inspection of (B) in *Fig.* 5 it will be apparent that the maximum resultant F_r for a given added weight W will occur when the latter is placed as far as to the left of P on axis x as is possible.

The experimental earset shown in the photograph was fashioned from hardwood and weighs 1.6 ounces. The dimensions are 2¾ in. long by 1⅜ in. wide. Subjective listening tests show the earset to be entirely satisfactory for the intended applications. Suitable molding ma-

UNIQUE RELATIONSHIPS

(from page 64)

The slope of the attenuation response, expressed in terms of "unit slope" can be given as

$$db_n = \frac{x^2\,[2x^2 + (a^2 - 2)\,]}{x^4 + (a^2 - 2)\,x^2 + 1} \qquad (7)$$

Where peaking occurs the frequency of peak is given by

$$x^2 = \frac{2 - a^2}{2} \qquad (8)$$

and, substituting (8) in (5), the height of the peak is given by,

$$db_{peak} = -10 \log_{10} \left[a^2 - \frac{a^4}{4} \right] \qquad (9)$$

In expressions (5) to (9), frequency given by x is normalized to the unit slope point, or 90-deg. phase response. An alternative normalizing reference for the attenuation response is the frequency of peak. Using y for frequency normalized at this point, y is given by

$$y^2 = \frac{2x^2}{2 - a^2} \qquad (10)$$

and the attenuation response becomes,

$$db_{att} = 10 \log_{10} 1 + \left(\frac{2 - a^2}{2} \right)^2 (y^4 - 2y^2) \qquad (11)$$

From this expression it is evident that the attenuation response will cross the zero reference at $y^2 = 2$, or $y = \sqrt{2}$.

Where three reactances contribute to a roll-off, the complex attenuation factor can be written,

$$A = 1 - ax^2 + jbx - jx^3 \qquad (12)$$

Using these constants, the attenuation response is

$$db_{att} = 10 \log_{10} 1 + (b^2 - 2a)\,x^2 + (a^2 - 2b)\,x^4 + x^6 \qquad (13)$$

and the phase response is,

$$\varphi = \tan^{-1} \frac{bx - x^3}{1 - x^2} \qquad (14)$$

from which the 90-deg. phase-response point is $x^2 = 1/a$, and the 180-deg. point is $x^2 = b$.
The slope of the attenuation response, in terms of unit slope, is

$$db_n = \frac{x^2\,3x^4 + 2(a^2 - 2b)\,x^2 + (b^2 - 2a)}{x^6 + (a^2 - 2b)\,x^4 + (b^2 - 2a)\,x^2 + 1} \qquad (15)$$

from which the slope at the 90- and 180-deg. phase points can be evaluated:

$$slope_{\varphi} = 90° = \frac{3a - b}{a - b} \qquad (16)$$

$$slope_{\varphi} = 180° = \frac{2ab}{ab - 1} \qquad (17)$$

The unit slope point is given by the solution to the expression,

$$2x^6 + (a^2 - 2b)\,x^4 - 1 = 0 \qquad (18)$$

and the two-unit slope point is given by the solution to the expression,

$$x^6 - (b^2 - 2a)\,x^2 - 2 = 0 \qquad (19)$$

The form of expressions (18) and (19) show that there may be more than one real solution for some values of the constants a and b. This can occur where the attenuation response has a dip followed by a peak. But the phase response is always progressively in the same direction—delay for high-frequency roll-off, and advance for low-frequency roll-off.

terials for a manufactured product are the phenolic compounds such as Durez, cellulose acetate such as Lumarith and others with similar physical properties.

BIBLIOGRAPHY

"Speech translating system," *Electrical Communication*, July 1936, pp. 98 and 99.

A. Haag and R. Bolts, "Die Siemens ubersetzeranlage," *Siemens Zietschrift*, November 1938.

"U.N. broadcasting and sound system," *Tele-Tech*, January 1947.

"Radio Translation — U.N. Equipment," *Wireless World*, March 1947.

A. W. Schneider, "U.N. broadcast and P.A. systems," AUDIO ENGINEERING, August 1947.

C. A. Tuthill, "Multilingual interpretation systems." AUDIO ENGINEERING, June 1947.

D. W. Pipe, "Sound reinforcing system, Church House, Westminster, England." *Wireless World*, March 1951.

Frank Massa, *Acoustic Design Charts*, Blakiston Company, (1942).

Leo L. Beranek, *Acoustics*, McGraw-Hill Book Company, Inc., 1st ed. (1954).

COMING EVENTS

Oct. 3-5—National Electronics Conference, Hotel Sherman, Chicago.

Oct. 12-15—Seventh Annual AES Convention, Hotel New Yorker, New York City. Annual banquet on evening of Oct. 12.

Oct. 13-16—The Audio Fair—Hotel New Yorker, New York City.

Oct. 21-23—New England High Fidelity and Music Show, Hotel Touraine, Boston, Mass.

Nov. 4-6—Philadelphia High Fidelity Show, Benjamin Franklin Hotel, Philadelphia, Pa. A fifty-cent admission charge has been agreed upon to assure attendance by an interested hi-fi conscious audience.

Nov. 3-6—First Mexican Audio Fair, Hotel Reforma, Mexico City. For information, write Mario R. Aguilar, Lopez 43-301, Mexico 1, D. F.

Jan. 18-20—Canadian Audio Show, Windsor Hotel, Montreal, Canada. Managing Director, Emery Justus, 1022 Sherbrooke St. W. Montreal, P. Q.

Feb. 8-11—1956 High Fidelity Music Show, co-sponsored by the Institute of High Fidelity Manufacturers and the West Coast Electronic Manufacturers' Association.

CASCODE PREAMP

(from page 27)

level was about 1.22 μv. (shorted input). "Line bumps" again come through about 10 to 12 db above average noise unless a gas tube (VR-105 or 5651) regulator is used to supply the input-stage plate voltage. The design output level was 1.5 volts, the IM (60 to 7,000 cps, 4:1) was not measurable above the residual instrument level at this output. The IM was about 0.15 per cent at 8 volts output and came up to 0.47 per cent at 15 volts.

In both of these amplifiers the major flicker effects were 4 to 8 db peaks while the frequency components of this flicker appeared to be under 30 or 40 cps. This fact, plus the problems of turntable rumble and the inevitable poor amplifier and speaker performance in this "subsonic" range of 25 to 30 cps further indicate the desirability for the use of low-frequency cut-off circuits following a preamplifier. Such a rumble filter will be described in a subsequent article covering an environmental and level control unit where such a filter is available as an integral section of the system.

The frequency response of this unit is shown in *Fig.* 7. This matches the RIAA curve to within approximately ±0.5 db. The environmental equalizing controls will normally provide more than adequate compensation for any other curve as has been previously pointed out.[9]

A power-supply unit providing both filament and plate power is shown schematically in *Fig.* 8 and pictorially in *Fig.* 9. This unit is also used with the previously mentioned level and equalizer system. Where a more compact and simpler power supply is desired for use with only the preamplifier, then the circuit and components of *Fig.* 10 will provide satisfactory results. A number of careful design and application techniques must be utilized in the use of a high-gain preamplifier such as the unit under consideration. Some of the salient features which contributed markedly to the excellent performance of this low-level amplifier were:

1. D.c. filament supply, properly and adequately filtered.
2. Wire-wound resistors in cascode plate, grid and cathode circuits, deposited film resistor in grid of second tube section.
3. Shock mounted assembly of cascode-stage tube.
4. Minimum area of input circuit loop.
5. Mu-metal shield around input tube and grounded. Tube kept away from strong external magnetic fields with tube oriented such that maximum magnetic field is kept at right angles to the tube elements (if necessary).
6. Maximum isolation of input circuits from filament lines.
7. One point grounding of the system and careful avoidance of "ground loops."
8. Non-magnetic chassis.
9. Proper use of an input transformer.
10. Proper use of a following low-frequency cut-off filter.

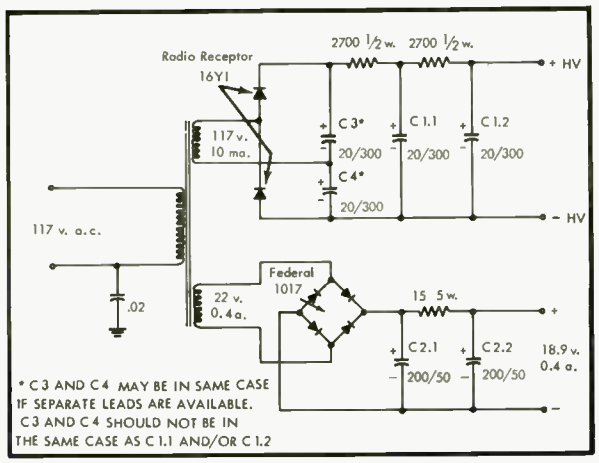


Fig. 10. Smaller and less costly power supply which will serve adequately when only the preamplifier is to be powered.

AUDIO ETC

(*from page 91*)

promise. It uses the basic 600 unit introduced awhile back and guarantees a quality, subject of course to the tape being played, that is only microscopically less fancy than that of professional 15-inch tape sound. Second, the system, with this quality, is remarkably low in price. $700 covers the works—all but the tape. You don't have to pay for the expensive recording elements. This is a tape phonograph. It plays only. You get the 600 mechanism, minus recording and erase sections, mounted (alternatively) as a home phono unit, in a small and phonograph-like wood box. (You can have it in the Samsonite case if you prefer.) You get the 620 speaker system, developed to match the 600 recorder, mounted similarly in a neat home-type table cabinet. Two of them. And the power amplifiers are already built into these speaker units.

Thirdly, this system—at last—is small, to suit home users. Really small: three modestly sized boxes, not one of them very much bigger than the usual portable table tape recorder, all of them table-style (though I assume the speakers can sit on the floor if desirable).

This is a vast change from most earlier two-channel systems! It represents a compromise of sorts, of course, but a compromise of the most practical and intelligent kind in the way of home thinking. The small speaker cabinets are, in the new manner, fixed up to produce a remarkable amount of useable musical bass out of a small space. Only a slight boominess (to the well-versed ear) betrays the presence of a relatively tiny enclosure. It will bother very few music lovers, if any. The loss in pure fidelity is relatively tiny in the face of the gains in practicability for home listening.

Indeed, the demonstration of the 612 was in rather startling contrast, you may guess, to that of numerous earlier "binaural" or stereophonic systems, where expensive tape players, enormous amplifiers and great batteries of massive loud-speakers have given most newcomers the impression that two-track sound in the home will never do unless it weighs a couple of tons, costs thousands, and can blast holes through every wall with sheer sound volume! It was this new and, I felt, happy combination of extreme compactness, simple home-style looks and high sound quality that first made me think, here finally, is the beginning of practicality in the two-track field—for honest musical enjoyment, not merely gadgetizing.

There were other things, too. The tricky dramatic presentation, via a small portable stage with curtains that concealed the actual units but let the sound through by itself, was a legitimate stunt. It emphasized the "big" sound that these small units could make, and did. And, for the first time I've ever heard it publicly, a comparison was made which seems to me the only honest one if two-track sound is to be valued against one-track sound. The double-tracked music, two tracks through two speakers, was compared directly, AB-style, with the sound of one track alone through *the same two speakers.* In too many earlier presentations this vital comparison has been unaccountably missing. Too often I've heard two-channel sound on two speaker systems compared misleadingly with one-channel sound on *only one* of the speakers.

Unexpected Dividends

Well—did it work? Did the double-track music sound better than one track through both speakers? Yes, and this was not unexpected. As has been fairly evident all along, a two-channel system usually "works" to some extent, given a halfway decent tape (and we heard a couple of the excellent RCA jobs). That is, there is almost always some listening area, somewhere in front of the two speakers, where the sound fuses nicely into one sound-picture, not clearly coming from either source but spread out uniformly between them, and within it a directional sense, a feeling of space and immediacy. In most demonstrations and experiments I've been in on, this has happened, even though the dual mikes may have been placed anywhere from six inches to twenty feet or more apart. It happened very nicely with the Ampex demonstration.

The only trouble is—where? That is the rub! In some listening rooms it hardly happens at all, due to unevenness in the room acoustics, especially where the two sides of the room are unlike. Even when the room is quite symmetrical, the favorable listening area is apt only too often to be confined to a straight, thin line right down the middle! People listening off to the sides—most of the audience—simply hear two speakers. No fusion. This is particularly unfortunate in big demonstrations with big speakers for big spaces. A single-file line of listeners right down the middle hears everything perfectly. The rest of the folks don't get the effect at all.

Now I've only heard the Ampex 612 once at this point, but I'm going out on a tiny limb to suggest that it has, by its very compactness, perhaps hit some jackpots in listening that the big systems have missed out on. I won't be able to confirm this for awhile and neither will you. But we shall see.

Stereophonic two-channel listening is very dependent upon angles. Most important, upon the angle between you, the listener, and the two speaker systems. This is a spatial effect, after all; you can't have direction without direction, so to speak. Granted that the walls and ceiling and general acoustics are terribly important. But the basic listening angle comes first.

Put the speakers too close together—for you—and the two sounds might as well be one. (There still can be some improvement, possibly due to phasing differences and an induced sense of direction, but this is a complex business and it isn't at all clear yet, to me at least, just what goes on between the two ears.) Put the speakers at too wide an angle apart, and you cease to fill up the space between them. The fusion unfuses and you have simply two speakers, two separate sound sources. The magic is gone.

The optimum stereo listening set-up, as far as I can figure it, involves an angle from you to the two speakers of from about 20 deg. to 45 or 50, roughly speaking. In some situations you might stretch it further each way. This separation spreads the sound out enough for space-feeling and directionality but not far enough to break the vital fusion of the two sounds into one. Equal distance, of course, from each speaker—and the tolerance there, again, is not very great. Side listeners always lose out. The middle is best.

Now here are my points anent the unexpected dividends in compact, small-speaker stereo listening, as with the Ampex 612 system.

1. In a large hall very few people can hope to find themselves in a good stereo listening position. Wrong angle and, worse, offside unbalance, one speaker closer than the other. (Big-hall liveness can pretty much wreck the stereo effect, too.) So also with many large home stereo or "binaural" installations where big speakers are placed, almost necessarily, a good distance apart. (Many people put them too far apart in a mistaken search for more "perspective."

But in the average home there is only a handful of listeners and there isn't much room. The ideal listening area may be pretty small—yet it can still accommodate the whole "audience" quite comfortably. But it has to be close to the two speakers. Space requires it, and most people want to be close to the music, anyway. Matter of national habit.

2. The small, compact stereophonic two-speaker system, then, has irrefutable benefits in the home: A. The smaller the speakers, the closer we can get ourselves to them without audible and visual discomfort. B. The small, table-type speakers produce their most favorable *angle* for stereo listening at precisely the right distance for the average room. Say from four to eight feet.

Figure it out for yourself. It's simply a combination of volume and angle, to fit the living room space. Not that the Ampex speakers—two of them, remember, and twice as much sound as one speaker system – don't make all the noise you're likely to want. They filled a hotel parlor, ten times the size of a living room, with the greatest of ease. The point is that their optimum volume level is just right for the average sensible, musical home. So is the natural angle you'll get between them in a common-sense furniture arrangement of the sort convenient with small, table-style speaker boxes.

3. One final point. Room shape, walls, reflections, have much to do with two-track loudspeaker success. Where an oddly shaped room (say with an L in it to one side) is practically impossible, another, with symmetrical walls on each side of the speaker positions, is excellent.

The larger your speakers, the wider your spacing, the more immediate is this annoying trouble with side-reflections or unbalances.

The smaller, the more compact your two-speaker system is, the closer you can get to it the less influence is there due to walls and room shape.

The chances for good stereo listening via a system such as the Ampex 612 then would seem to me, speculatively, to be much greater than with the large, bulky big-speaker systems heretofore sold.

To sum it all up, put it in four words: *The smaller the better.* That's my hunch for stereophonic listening in the home, and I think Ampex has got the bull by the horns, or mare by the tail. Stereo has finally arrived.

* * * * * * *

What about two-channel stereo tapes? See RECORD REVUE, this issue.

3. ATR for Tape—concluded

It wasn't exactly "tomorrow" as I promised, but I did get to finish the experiment with the ATR heavy-duty (model 12RHF) 12-volt inverter described interim-wise in the August issue. You'll remember that the idea was—will a good auto battery inverter, 6 or 12 volts to a.c. line, operate a tape recorder for amateur, emergency, or experimental recordings in the field? The model I got was designed to take heavy loads, a professional tape recorder or equivalent, and my first experiment merely loaded it with a Columbia 360 phonograph, drawing relatively little juice.

The "hash" and extraneous noise was reasonably low and, it seemed to me, would not cause serious trouble in recording. But the pitch—alas—was wrong. Played a half step too high. A tape recording made under such circumstances would play back on power line current a half step too *low*, which is a lot and too much.

But was the inverter adequately loaded down? I thought not. And so, just now, I strung up my lines (with every extension cord in the house) and plugged my Magnecorder, plus a ten-watt amplifier, into the inverter. Same test: I played a tape, already made, then quick-like-a-flash, shifted the whole load over to the house current, for an AB comparison of pitch under load.

I was right in my hunch. At least mostly. The inverter definitely ran slower than it had with nothing but the Columbia 360 to load it down. But it still ran slightly too high in frequency though the voltage setting was at the "low" position. (Adjustable voltage output on the inverter.) The music still played slightly lower in pitch on the power line than on the inverter.

Much less difference than before, but enough to cause trouble in a careful recording job. (A tape made this way would play back a bit too fast on power-line current.) Most people would scarcely notice the difference, however.

Aha, says I, let's carry this on a bit further. More load, and maybe the pitch will came down to par, 60 cps. So on goes my transcription table, added to the Magnecorder and the ten-watt amplifier. Ought to be quite a heavy drain with all this going at once. Then, just to see what would happen, I went out and diabolically switched the inverter away from "low" voltage up to "max"—to see how much faster the equipment would then run, when, whoops . . . the fuse blew. End of experiment.

I took that fuse out of the inverter and found it was a 20 amp. model! Don't anyone tell me I didn't load down that heavy-duty inverter heavily enough.

Conclusions: 1. It seems that most auto inverters tend to run a bit too fast (high in frequency), even under load. I've run into the same trouble before. It's hard to get them down to a flat 60 cps. Maybe an excess of caution on the makers' part? Phono changers sometimes run too fast for a similar reason—the makers are afraid of heavy loads that would slow the table down, and so set them to run too fast at normal loads.

2. Inverters tend to be variable in frequency (pitch) according to load, inevitably. (If they didn't they'd cost far too much. Whaddya want for your money?) The difference is not more than a quarter to a half tone, but it may be very noticeable to the ear, whether in playing standard recordings or in playing back inverter-made tape recordings on power-line equipment.

3. The simple inverter nevertheless is a highly useful gadget and can give superb service if you keep all this in mind—and especially if you run simple tests ahead of time to find out just what your inverter will do with a given load and a given situation.

Semi-professional users note this: If you plan to make disc pressings or tape copies of your inverter-made tapes--don't worry. Almost any professional recording device will run your tapes slightly faster than standard to correct the pitch discrepancy in the copying process. That is—*if you tell them about it!* Be prepared.

Industry Notes . . .

Heralding the season of audio exhibits, New York's fashionable **Liberty Music Shops** entertained nearly 8000 visitors at its "Hi-Fi Show" October 12 to 14. Participating exhibitors included such well-known manufacturers as Pilot, Ampex, Interelectronics, Pentron, RCA, Magnavox, Bozak, North American Phillips, Jensen, etc. Virtually an Audio Fair in miniature, the Liberty Hi-Fi show was a graphic example of what a promotion-wise dealer can do to stimulate interest in high fidelity in his locality.

Precision Radiation Instruments, Inc., Los Angeles, Calif., announced recently that it has contracted for the acquisition of **Radio Craftsmen,** Chicago manufacturer of high-fidelity components and equipment. President Leslie M. Norman of Precision stated that the Chicago firm will be operated as a subsidiary and will continue to increase output of amplifiers, tuners, filters, and equalizers. John H. Cashman, president of Radio Craftsmen, will serve in an advisory capacity until December 31.

Opening of new facilities in New York City for the repair, modification and overhaul of all RCA commercial and industrial electronic equipment took place September 12. Located at 419 W. 54th St., the shop is operated by **RCA Service Company, Inc.,** and supplements the company's present similar facilities in Camden. The new shop will service RCA equipment users in the New York Metropolitan area, such as broadcasters, schools, electronic distributors, and service agencies. Under the management of J. J. Brown, this latest addition to RCA's expanding service facilities will be staffed by factory-trained personnel.

United Transformer Company has started operations at its new plant located at 4008 W. Jefferson Blvd., Los Angeles, Calif. Allen Mitchell, UTC president, in announcing the opening, stated that the new plant is fully equipped with the most modern production facilities for the manufacture of all types of transformers, reactors, solenoids, variable-voltage transformers, and filters for the electronic field.

RECORDS

(from page 87)

been launched, are perhaps much greater than you would think. The reason is simple.

For a good while many record companies have been taking down two versions of all recording sessions, one on standard single-track tape and another, with different mikes, on two simultaneous tracks. The double-track version is simply put in storage; or (as in the case of a recent Dessoff Choir recording about to be issued) the two tracks are combined into one to make the final "standard" version.

Not all of these two-trackers, to be sure, are guaranteed to make good stereophonic listening. The two-channel technique isn't that well understood yet. But it is boiling down, so to speak, to a reasonably uniform approach among the more enterprising engineers. And remember that a two-channel tape is as easy to reproduce in quanity as the usual half-track, play-it-one-way-and-play-it-back type now on the market. Indeed, the copying technique is virtually identical.

The only difference is the doubling of the tape cost as compared to the half-track tape with two musical "sides," one each direction. But keep in mind that recent improvements have already brought wide-range hi-fi at 7½ ips where formerly the 15 ips speed was necessary, thus effectively cutting hi-fi tape cost in half. Other savings, when tape begins to sell in something more than driblets, should begin to restore a balance.

Note: More tape reviews, stereo and plain, in coming issues.

CLASSIFIED

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

Industry People...

Bill Herrman, who covers the audio and hi-fi industry in New York for "Retailing Daily," has announced his resignation effective the middle of October. His final chore will be coverage of The Audio Fair, after which he will depart for Southern California. Both his competitors and his contemporaries are unanimous in the consensus that the West Coast's gain will be a distinct loss to the Manhattan chapter of The Fourth Estate . . . **Walter Stanton,** president of Pickering and Company, proved beyond question that a single individual can harbor both administrative and engineering talent, in his delivery of a technical paper describing the new Pickering Fluxvalve cartridge before the September 13 meeting of the New York chapter of the Audio Engineering Society; more than 250 members turned out.

Harry L. Owens, formerly chief of the Solid State Devices branch of the Signal Corps laboratory at Fort Monmouth, N. J., has joined Texas Instruments, Inc., Dallas, Tex., as chief engineer of the Semiconductor Products division . . . **Luther M. Sandwick** has been appointed sales manager of Pilot Radio Corporation—he was previously with TDC Division of the Bell & Howell Company, Wilcox-Gay Corporation, and The Magnavox Company . . . **Curtis B. Hoffman** is newly-appointed vice-president in charge of sales for Brush Electronics Company.

New appointments to the staff of Ampex International, recently-formed division of Ampex Corporation, are **J. E. Hogg,** manager of the export marketing department, and **Miss Peggy L. McElligott,** manager of the economic and organization planning department. Other Ampex appointments include **Charles L. Range** who has been named audio representative in the Washington, D. C., district office, and **Harold J. Bresson** who has been transferred from the company's Redwood City plant to the audio staff of the New York district office.

Arthur Priest, formerly national sales manager of the cartridge division of Recoton Corporation, has joined Audiogersh Corporation and Kingdom Products, Ltd., both New York, in a similar capacity . . . **Thomas B. Aldrich,** until recently sales manager of Presto Recording Corporation, is now associated with the **Leon L. Adelman Company,** New York factory representatives—there has been established an Adelman-Aldrich Division which will concentrate on representation in the industrial field . . . **John B. Gray,** for many years a member of the technical staff of Hughes Aircraft Company, has been named chief engineer of Berlant Instruments, Los Angeles . . . Jovial and able **Ed Cornfield** has the industry's best wishes in his new assignment as national sales manager for the Tape Recorder Division of Dejur-Amsco Corporation.

ADVERTISING INDEX

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Readers have told us that they often want to know more about some of the items mentioned in the *New Products* and *New Literature* pages of the magazine, but that they do not want to take the time and effort to write to each one of the sources individually to get all the information they need. As a matter of fact, in an average issue there are usually ten items in the *New Literature* column, and between ten and fifteen on the *New Products* pages. It is conceivable that the average reader might want information on at least ten of these items, since they are selected with the interests of most of AUDIO's readers in mind. Thus one would have to have ten envelopes, ten sheets of paper, and ten three-cent stamps, together with the need for writing the ten letters and inscribing each with name and address. We do it all for you, assuming that you are willing to circle the items about which more information is desired and to write your name and address once. We will forward your inquiries to the organization involved, and you will receive the data you want with only one inquiry. Isn't that as simple as A B C?

In just the same way you can get more information about any product that is *advertised* in the pages of AUDIO. But there is a little more work involved in this, since you must indicate the item in which you are interested and the name of the manufacturer. However, you still have to write your name and address only once for all the information you want about advertised items from a single issue—unless you want to know all about everything. If your cards indicate that this is likely to be the case, we will make them larger to fit your requirements. In the meantime, if you do need more space, you might subscribe to two copies.

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