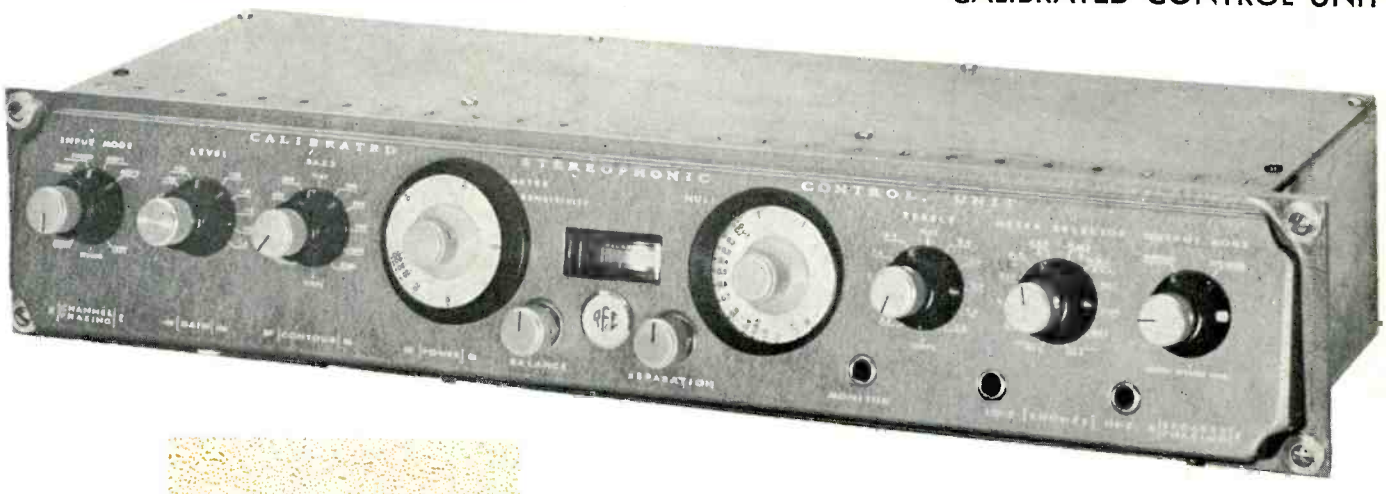
AUDIO

...the original magazine about high fidelity!

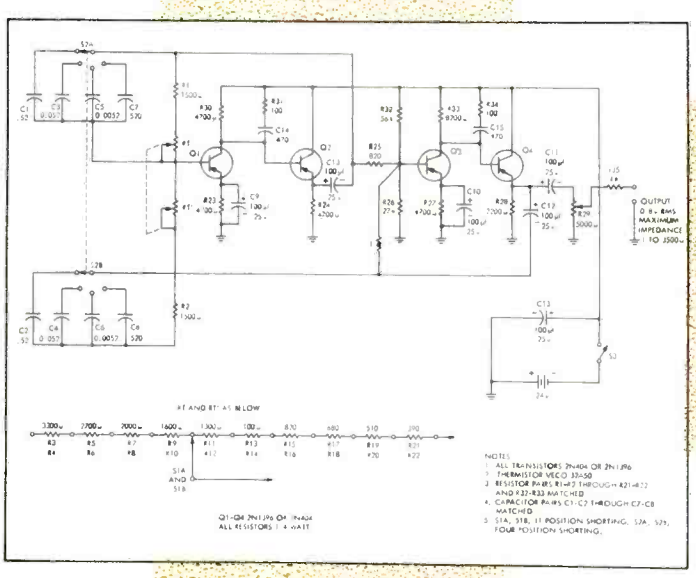
JULY/1965

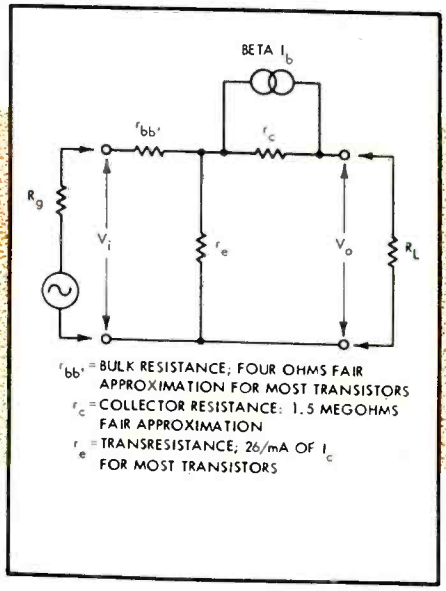
60¢

CALIBRATED CONTROL UNIT



SOLID-STATE OSCILLATOR





TRANSRESISTANCE METHOD

This is the *only* tube you need for Scott's new 80-Watt solid state amplifier kit!

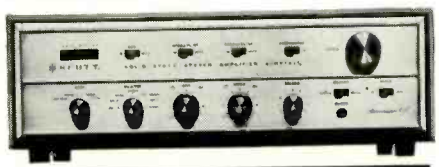
An ordinary light bulb? For a transistor amplifier kit? It's part of a new system Scott engineers have developed so that even a novice can successfully build a professional solid state amplifier.

The electric light bulb is an ingenious part of Scott's exclusive "fail-safe" circuit. You connect it to the back of your completed amplifier just before you first turn it on. A dim glow means you're A.O.K. A bright glow means the light bulb has absorbed excess power *before* it can burn out valuable silicon transistors, and that you must recheck your wiring.

Actually, a mistake like this is highly unlikely. The unique Scott instruction book with its life-size full-color charts . . . the fact that touchy circuits come factory-tested on preassembled modular circuit boards . . . allow even a novice to build a solid state amplifier that is in every way equal to a Scott factory-wired unit.

When you're ready for final adjustments, there is a precision test instrument, the Scott Circuit Monitor, that allows you to actually set the balance and bias of the output stage for absolutely minimum distortion without external test equipment.

When completed, your 80-watt LK-60 will have all the features of the most expensive Scott factory-wired amplifiers; heavy duty rugged silicon output stages that will drive the most inefficient speakers, military-type heat sinks to assure long operating life, Power Level Indicator, and the complete professional Scott control panel.



The LK-60 is kit-brother to the superb factory-wired Scott 260 solid state amplifier. Hi Fi/Stereo Review tested the 260 in April, and stated that it has ". . . no sound of its own. The listener hears the music . . . not the amplifier. (It) will reproduce anything that is fed into it with well-nigh perfect exactness, and without adding any sound coloration of its own . . ." Now that the LK-60 kit is at your dealer's, you can share with Scott the satisfaction of building a perfect solid state amplifier.

Specifications: Frequency Response, 10-40,000 cps; Power Band Width 20-20,000; IHFM Music Power, 80 watts; Distortion, 0.8%. Less than $189.95.

SCOTT® HOUSE OF STEREO

FEATURING ANGEL RECORDS

H. H. SCOTT, INC., 111 POWDERMILL RD., MAYNARD, MASS.

Export: Scott International, Maynard, Mass. Cable HIFI. Prices slightly higher west of Rockies. Prices and specifications subject to change without notice.

Circle 100 on Reader Service Card

AUDIO

July, 1965 Vol. 49, No. 7

Successor to RADIO, Est. 1917

DAVID SASLAW • *Editor*

JANET M. DURGIN
Production Manager

C. G. MCPROUD
Publisher

SANFORD L. CAHN
Advertising Director

EDGAR E. NEWMAN
Circulation Director

Representatives

Bill Pattis & Associates,
4761 West Touhy Ave., Lincolnwood, Ill. 60646

James C. Galloway,
6535 Wilshire Blvd., Los Angeles, Calif. 90048

Warren Birkenhead, Inc.,
No. 25, 2-chome, Shiba Hamamatsu-cho, Minato-ku, Tokyo, Japan

Contributing Editors
EDWARD TATNALL CANBY
JOSEPH GIOVANELLI
HAROLD LAWRENCE
CHESTER SANTON
HERMAN BURSTEIN
BERTRAM STANLEIGH
LARRY ZIDE

AUDIO Articles

AUDIO Reviews

AUDIO Profiles

AUDIO in General

MEMBER INSTITUTE OF HIGH FIDELITY INC.

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., C. G. McProud, President; Henry A. Schober, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S., Possessions, Canada, and Mexico, $5.00 for one year, $9.00 for two years; all other countries $6.00 per year. Single copies 60¢. Printed in U.S.A. at Blanchard Press Inc., Garden City, N.Y.

Second Class postage paid at Mineola, N.Y. and additional mailing offices.

AUDITED PAID CIRCULATION ABC

RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.
Postmaster: Send Form 3579 to AUDIO, P. O. Box 629, Mineola, N. Y.

COMING

ANNUAL PRODUCT PREVIEW

This year the product preview is the largest ever presented. More products are listed with full specifications so that a truly comprehensive view of available component high fidelity products is presented. Trends will be easily discernible. The reader can avail himself of the latest equipment with the features that he wants.

For added convenience, the product listings are presented in tabular form, thus enabling the reader to find a particular product quickly. This method of tabulation, in addition to being convenient for the reader, permits more listings in less space. That is the basic reason that more listings are presented this year; thus the reader gains in two ways.

The product listings are really a bonus for the AUDIO reader since the usual complement of AUDIO articles will be presented.

If you are in the market for high fidelity components, you can't afford to miss August AUDIO!

AUDIO CLINIC

Joseph Giovanelli

Send questions to:
Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn, N. Y.
Include stamped, self-addressed envelope.

Sound Sequencing of Two Movie Projectors

Q. A friend of mine has a small motion picture projection room in his basement. As audio is my hobby, I would like to improve the sound, which can use it. The immediate problem is electronic. My perusal of books and magazines yields no suggestions.

He owns one projector and borrows another. He flips one on and the other off quite smoothly. Sound comes first from one mediocre speaker system and then from another different sounding one. We would like to have one much improved speaker system fed by either projector. We can modify his project or but not the borrowed one. This means no high-impedance mixing. What kind of reasonable-cost, low-impedance system is possible?

Outputs are either 8 or 16 ohms. Mixing is preferable to switching, mainly because he already has each hand on a switch. Could a relay be used without making "pops?"

What suggestions have you? William G. Horton, Edmonton, Canada.

A. There is little point in improving the sound of movie projectors in all too many instances because the film run through them are often of such a poor sound quality that any improvement in the amplification or speaker equipment is meaningless. It might even make things worse by accentuating hiss and other distortion.

Some movie projectors employ amplifiers of the a.c.-d.c. type. These amplifiers are hard to connect to other appliances unless they are fed via isolation transformers. If an insolation transformer cannot be used because of the drain of the motor and the lighting, then you will have to make sure that the line cord is inserted into the wall socket so that the chassis of the amplifier in on the ground side of the line.

As to your problem of connecting the projectors so as to obtain a smooth continuity of sound from one to another, it would be hard to perform any kind of mixing if little or no loss of sound level can be tolerated. About all I can suggest is that you connect the output of the two projectors in parallel and let them operate that way throughout the film. Possibly this connection can be made to a common speaker through small series isolating resistors from each projector. The sound levels will have to be adjusted for equal loudness in the common speaker. This is not the theoretically best or most elegant solution, but it will work better than one might suppose.

If you do not like this approach, you can use a relay in conjunction with the switching of the projectors. The contacts of the relay will perform the switching between the speaker outputs of the two projectors. These should be few if any clicks produced in the process.

Again a common speaker or amplifier-speaker combination can be used. If the speaker outputs of both projectors are to be fed into an amplifier, their outputs should be terminated with resistors whose values are equal to the impedance of the speakers usually used with the projectors. This will keep the feedback at a level normal for the projector and will prevent dam-*voltage measurements seem to be correct* lack of loading.

Shorted-Output Transformer

Q. My amplifier starts clipping according to the pattern on my oscilloscope, at about three or four watts, although the rating is 10-12 watts. IM distortion is about 12 per cent before clipping begins. The distortion is approximately the same when measured at the plates or the output stage or at the plate of the driver stage. However, a clean signal appears at the output of the first stage.

When feedback is connected to the output transformer, the distortion increases at the driver amplifier stages but decreases at the output stage. Recommended VTVM voltage measurements seem to be correct within 10 percent.

Finally, not being able to determine the difficulty with my amplifier, I stripped the chassis clean and rewired it with all new components, resistors, capacitors, tube sockets, and tubes, using the same circuit diagram.

Because rebuilding made no significant change in amplifier performance, I concluded that the problem may reside in the basic circuit wiring or in the design values of the components. Harry B. Boller, Pasadena, California.

A. Ordinarily I would have suggested that you check the various components, especially tubes and capacitors. Because you have rebuilt the entire circuit, how-

How does the Garrard® LAB 80 transcription turntable...

The value of automatic play can hardly be overstated. The automatic shut-off feature alone adds an entire area of pleasure. But the problem has been to provide this convenience without impairing the distortion-free performance demanded by modern music systems. Today, with a fine tone arm (as exemplified by the dynamically balanced, low geometry arm of the Lab 80), the maximum variation in stylus pressure between one record and a stack is a negligible 0.2 grams (two-tenths of a gram). Therefore, the question of whether it is preferable to play only single records on a turntable, has been obviated.

Now, the same principles which established Garrard as the pre-eminent name in automatics have been designed into the Lab 80 automatic spindle. It is the safest, most positive device of its kind. A stack of 8 records is securely supported on widely extended arms.

become the finest automatic record changing unit?

The arms retract and the next disc is gently released. It drops quietly to the turntable, cushioned by air. The tone arm is absolutely free of the automatic mechanism through the entire performance of the record.

But this is only half of the story. At the end of the record —and not before—the tone arm must engage the trip to activate the automatic operation. Friction or drag must be infinitesimal. In the Lab 80, this problem is brilliantly solved. The trip assembly is molded of Delrin®, the remarkable new Dupont "slippery" material. The tripping cycle is unique. It works through magnetic repulsion. Mechanical contact has been eliminated!

These principles, ingeniously combined for the first time in an automatic record playing device, are Garrard's answer to the stringent requirements of the latest ultra-sensitive cartridges. Use the cartridge of your choice, no matter how feather light the tracking specifications may be. You will find they are all compatible with the Lab 80.

Just switch spindles!

Both spindles included with the Lab 80—$99.50—less base and cartridge. All the Garrard features are explained in the new 32-page Comparator Guide. For your copy, write Garrard, Dept. GG-15, Port Washington, N.Y.

CANADIAN INQUIRIES TO CHAS. W. POINTON, LTD., 66 RACINE ROAD, REXDALE, ONTARIO. TERRITORIES OTHER THAN U.S.A. AND CANADA TO GARRARD ENGINEERING LIMITED, SWINDON, WILTS., ENGLAND.

CIRCLE NO. 103 ON READER SERVICE CARD

ever, the likelihood that small parts are the cause of the trouble is not great. I must conclude, therefore, that either the circuit was poorly designed or that the output transformer has an internal short.

For purposes of this discussion, let us assume that the transformer is shorted. The short need not be complete, enabling you to measure it with an ohmmeter. Rather, one turn might be shorted in either the primary or the secondary winding. You would not be able to measure this directly unless you had access to an impedance bridge, but the performance would be seriously affected.

If you have access to an impedance bridge, measure the impedance of each winding when they are loaded with proper terminating resistors. A shorted turn will result in a sharp reduction of the inductance of the transformer, and hence, a sharp drop in the impedance of the windings.

If you do not have access to an impedance bridge, load the primary and secondary of the transformer with resistors equal in value to the impedance of their respective windings. Feed a low-voltage a.c. signal into the secondary. Then measure the voltage across the primary. If the transformer is working properly, the voltage ratio between the signal applied to the secondary and the signal measured at the primary should be equal to the turns ratio between the windings, or equal to the square root of the impedance ratio of the windings. If the transformer is not working properly, the measured primary voltage will be considerably lower than predicted.

Fusing Loudspeakers

Q. I would like to find the best way to fuse my speakers. I have a 60-watt power amplifier, but my speakers are only rated at 30 watts. So far I have heard of three ways to prevent damage to the speakers:

1. A 16-ohm resistor in parallel with my 16-ohm speaker, with the fuse in series with the speaker. This is connected to the 8-ohm tap of the amplifier. I understand that with this procedure the damping of the speaker is better. I know the resistor will use half the power. I think this will allow the output tubes to run cooler, giving longer life. I don't think the output noise will be as great at low levels of listening.

2. Using Zener diodes back-to-back will short out the output of the amplifier at their breakdown voltage. Does this hurt the amplifier any?

3. A resistor 10 times the speaker's impedance in parallel with the speaker, and with the fuse in series with the speaker. If number three, what value and type of fuse should be used? Robert C. Knosalla, Riverside, California.

A. For part one of your question, you are correct in that you could use a resistor in parallel with the speaker and fuse the speaker. Because the resistor is still connected across the amplifier when the fuse opens, this would give protection to the amplifier. You are right again when you say that the amplifier will deliver half the power into the resistor. Let us say that it requires 10 watts to drive the speaker to a satisfactory listening level. In order to

(Continued on page 47)

CONCORD "R" SERIES: FIRST TRULY NEW PROFESSIONAL TAPE RECORDERS IN 5 YEARS!

Several years ago, Concord engineers began design of a tape recorder to incorporate all the recent advances in electronic and electromechanical technology in a professional instrument without regard to cost.

The four basic considerations in the design of the "R" Series instruments were: 1. The recording quality, 2. The operating features, 3. The reproduction quality, 4. Rugged, reliable performance for heavy duty use. Here's how these objectives were achieved:

TAPE TRANSPORT MECHANISM: Three-motor design of the tape-transport mechanism provides fast tape handling (45 second rewind speed for standard reel).

Reliability: there are no rubber drive rollers or mechanical linkages which may be subject to deterioration. Reverse-play operation shows no measurable increase in wow and flutter.

All three motors are hysteresis synchronous, ensuring tape-speed accuracy regardless of line voltage fluctuations. The 24-pole slot-wound capstan-drive motor combines an electronically balanced rotor and newly designed double-thrust bearings to minimize motor end play and eliminate cogging.

The flutter-free performance of this new capstan-drive motor is in itself an engineering achievement of considerable magnitude. A dual winding allows the motor to operate at 3,600 rpm at 7½ ips and 1,800 rpm at 3¾ ips, permitting pushbutton speed change without mechanical rollers or idlers.

TAPE. Tensioning is achieved on the Concord "R" Series without pressure pads, using hyperbolically ground heads for maximum tape wrap. An electronic holdback tension circuit for each reel motor ensures optimum holdback in either direction of tape travel.

The tape path incorporates a precision-ground ball bearing flutter filter with a 30 oz. dynamically balanced flywheel. This system dampens minute amounts of mechanical flutter, preventing it from being recorded. The dynamically balanced 1.5 lb. capstan-drive flywheel is machined on a tape-controlled lathe for extreme dimensional accuracy. A special steel alloy (modified 17-4PH) was formulated to provide maximum flywheel mass and shaft strength as well as the hardness necessary for close-tolerance machining and grinding of the capstan.

The pressure roller consists of a precision-ground metal core with a molded-rubber facing designed for maximum tape friction and minimum wear. Pressure roller is easily removed for lubrication, cleaning, or special cueing.

"R" Series recorders feature automatic tape lifters, which remove the tape from direct contact with the heads in the fast-wind modes.

BRAKING. Solenoid-operated, self-equalized brakes gently but firmly stop the tape from the fast-wind positions without stretching or tearing. These self-compensating brakes do not normally ever require adjustment.

CONTROL FUNCTIONS. The transport mechanism controls are all-pushbutton and operate the mechanical functions electronically. In the R-2000, an electronic memory circuit permits the user to push the fast-wind or play button in sequence which causes it to fast-wind, stop, automatically pause, and proceed to the play mode without further attention, either at the recorder or at the remote-control station. In the record mode, the R-2000 provides an automatic rewind safety function at the end of the reel to prevent accidental erasure. The recorder shuts off automatically after completion of rewind.

In the play mode, "R" Series tape recorders automatically reverse at reel end, play the tape in the opposite direction, and then automatically shut off.

CONCORD MODEL R-2000 with full remote-control — under $800.

A remote-control console, included with the R-2000, provides full remote-control of all functions. R-1000 Series recorders have remote start-stop control for both play or record modes.

Cueing and editing is fast and convenient. The supply and take-up reels are readily rotated by hand with the recorder in the stop mode, and the heads are easily accessible for editing.

HEADS. All "R" Series recorders use professional low-impedance heads with laminated cores of a new mu-metal alloy, permitting minimum playback-head gap width and maximum frequency response. The record head has a wide gap for recording maximum signal. The erase head is of a new design, with a double gap and ferrite core to ensure maximum noise-free erasure.

"R" Series heads are selected in matched pairs with a tolerance of 1 db difference in channel output over the entire frequency range. A new, improved type of shielding has been developed, which reduces cross-talk to extremely low levels. The R-2000 has a plug-in head assembly, making possible use of ½- or ¼-track configurations.

CONCORD MODEL R-1100 with optional start-stop remote-control plus solid-state power amplifiers and speakers — under $500.

CONCORD MODEL R-1000 with optional start-stop remote-control — under $450.

ELECTRONICS. All "R" Series recorders contain four preamplifiers, two for recording and two for playback. This design permits monitoring from the tape while recording as well as separate equalization adjustments for each of the record and playback preamplifiers. Recording amplifiers are easily adjusted for optimum record bias for the particular tape and tape speed. Bias adjustments are readily accessible.

All components and electronic assemblies are equivalent to MIL Spec requirements. Advanced-design circuitry permits professional quality recording with superior signal-to-noise ratio and frequency response. The R-2000 has facilities for plug-in microphone transformers with −90 db shielding for either high- or low-impedance, balanced or unbalanced line.

ELECTRONIC CONTROL. Separate controls for both line and microphone permit mixing of line and mike levels. A monitoring control provides immediate source-tape comparison at the same sound level while recording. Recorders have front-panel provision for creating sound-on-sound or multiple recording by pushing a button or moving a knob. No need to change inputs or outputs.

Reverberation and echo effects are created similarly. Record levels may be adjusted without tape movement, and safety interlocks prevent accidental recording.

PRECISION MANUFACTURE. Produced on a custom basis (two R-2000's and six R-1000's a day), each recorder undergoes 68 inspection checks *during* assembly *before* final inspection. Every "R" Series instrument undergoes a 72-hour continuous heat-run test with all controls continuously operated by an automatic programming device. After successful completion of this severe test, each unit is again 100% inspected before shipment.

The "R" Series Recorders are available now at Concord professional audio dealers throughout the United States and Canada.

For Connoisseurs of Sound

CONCORD

CONCORD® ELECTRONICS CORPORATION 1935 Armacost Avenue, Los Angeles, California 90025
IN CANADA: Magnasonic Industries, Ltd., Toronto/Montreal

THE SIGNATURE OF QUALITY ■ *Tape Recorders/Industrial Sound Equipment*
Dictation Systems/Communications Devices/Closed-Circuit Television

Circle 105 on Reader Service Card

LETTERS

KLH 16 and 4-Ohm Speakers

SIR:

First of all, I would like to thank you for the reviews of the Model Eighteen and Model Sixteen in the June issue of AUDIO. These were extremely objective and flattering.

There is, however, one small point that I think should be clarified.

Although the Model Sixteen can deliver only 15 watts rms per channel, within IHF distortion specifications and with both channel driving 4-ohm loads, the available peak power, into 4-ohm loads, with music, speech (or for that matter short duration pulses), is in the order of 200 watts per channel when only one channel is used, or 150 watts per channel when the amplifier is used stereophonically. Since the average-to-peak ratio of music is so large, it can be seen how the Model Sixteen can reproduce musical waveforms at very loud subjective levels without clipping or exhibiting any serious overload.

It is for this reason that, when the Model Sixteen is used with 4-ohm, high-quality loudspeaker systems, it has an apparently fantastic power output and is so difficult to overload. We have received many reports from people using Model Sixteens to drive 4-ohm loudspeakers and their comments indicate that they are extremely satisfied.

Incidentally, the manufacturer of an extremely popular and respected, low-efficiency loudspeaker system recommends the Model Sixteen for use with their product.

C. VICTOR CAMPOS
Manager, Customer Service
KLH Research and Development,
30 Cross Street,
Cambridge, Mass. 02139

Back to Binaural?

SIR:

In this age of integrated, solid-state, compactness it would appear that a relatively simple approach to realism in audio reproduction has been all but forgotten.

I am referring to binaural recording as developed by Emory Cook. Surely with the widespread popularity of stereophonic headphones and two-channel playback systems, the equipment for binaural reproduction is already in the hands of most audiofans.

All we require now is that some enterprising record company dust off its dummy head (if the pun fits, . . .), update the microphone and recording technique, and proceed to treat the listener to his favorite artists performing in the world's finest concert halls, complete with the original architectural acoustics.

How about it, should I dismantle my Bauer circuit and put the components to use in some worthwhile circuit or must I, like the car rental agency, be content with second best?

ROBERT L. FITTS
7 Cindy Street,
Peterborough, Ontario,
Canada

Another Boston Tea Party?

SIR:

As a listener to WQXR AM I resent the efforts of Mr. Meyers *et al* to cause changes in that station's programming.

We in the wilds of Ontario are out of range of FM stations and the only "good music" station which comes in loud and clear consistently is WQXR AM.

I realize that the heavy advertising is wasted on me (although I would gladly spend my vacations in Sunny Italy and buy my second hand mink coats in New York if I had any money) but I still say "hands off WQXR AM." What are you colonists trying to do, start another Boston Tea Party?

NORMAN FINNEY
Box 293,
Haliburton, Ontario
Canada

Acoustic Damping Not New

SIR:

The article "Acoustic Resistance Damping for Loudspeakers" by John L. Grauer (March, 1965) was very interesting to me because I own a 12-in. speaker, as illustrated in *Fig.* 1, which is acoustically

Fig. 1

damped by the same technique as proposed in the referenced paper.

This loudspeaker has not found wide distribution. Based on an invention by Eckmiller in Germany, it was first described in a trade magazine in 1939 and produced in small quantity for commercial users such as radio broadcasting studios. During World War II production was discontinued. In 1947 Konski & Kruger in East Berlin resumed production. Due to material shortages these speakers were again sold only to selected customers.

Another unique feature is a coaxial horn tweeter whose 2-in. voice coil uses the same magnetic air gap as the voice coil of the low- and middle-range speaker. The Alnico V magnet weighs five pounds.

An individually-recorded frequency response curve was supplied with each unit.

HERBERT P. RAABE
7 Thompson Lane,
North Oaks,
St. Paul 10, Minnesota

Fig. 1 = Fig. 3

SIR:

I wish to thank you for the very fine presentation of Robert Hazelleaf's article "Recording Without Microphones" which appears in your May, 1965 issue. Being,

(*Continued on page 37*)

The AR-4—$51 to $57, depending on finish

Excerpt from a column by Robert Marsh, music editor of the ***Chicago Sun-Times.*** *A reprint of the complete AR-4 review is available on request.*

The AR-4 is a best buy in any comparative shopping survey. It is going to attract a lot of interest in the low-price bracket, but, more than this, it is going to raise a big fuss in the next bracket up, competing with its own big brothers the AR-2 and the AR-2a.

Development work on the AR-4 has made possible an improvement in the AR-2 and AR-2a speakers as well. The AR-2a has a new mid-range unit of improved smoothness and dispersion, and has had its name changed to AR-2a^{X}. The AR-2, with the same new unit installed as tweeter, has become the AR-2^{X}.

These new models are entirely compatible in stereo with the original speakers. The grille cloths are new, but the older grilles are still available. The AR-2 and AR-2a speakers are also still available for those who want exact matching, or the owner of either of these speakers can convert to the corresponding new model for $15 and about half an hour of his time. Conversion kits are available at your AR dealer or direct from Acoustic Research.

The AR-2a^{X} is $109 to $128, depending on finish, and the AR-2^{X} is $89 to $102. These prices are the same as for the original models. AR's five-year speaker guarantee (covering all costs including freight) applies, of course.

ACOUSTIC RESEARCH, INC., ***24 Thorndike St., Cambridge, Mass. 02141***

☐ Please send me_____conversion kits ☐ AR-2a to AR-2a^{X} ☐ AR-2 to AR-2^{X} with complete instructions. I enclose_____in cash or check ($15 postpaid per kit), and/or

☐ Please send me literature on AR products.

NAME _____

ADDRESS _____

Circle 107 on Reader Service Card

LIGHT LISTENING

Chester Santon

Do I Hear a Waltz? (Original Broadway Cast)

Columbia KOS 2770

The question in this title could easily be followed by a more frustrating one. Why do original cast recordings of the bigger musicals of the season invariably arrive a few hours before the deadline of this column as I'm stuffing material into a Mineola-bound envelope? The brevity of this review should not be considered a true reflection of the worth or importance of this latest Richard Rodgers show. Since Rodgers is easily the smartest showman of the diminishing crowd of old timers still practising on Broadway, "Do I Hear a Waltz?" is a smart show with fortuitous casting and solid lyrics by Stephen Sondheim. The casting in this story of a romance in Venice, particularly in the important role of the male lead, would not have been possible if RCA Victor had not imported several years ago an unknown Italian tenor by the name of Sergio Franchi. It is one of the many ironies of show business that Franchi is now the leading attraction on a show album that may well make millions for Columbia Records. He plays the part of a Venetian shopkeeper portrayed in the movies by Rossano Brazzi some years ago when Katharine Hepburn appeared as the American tourist Elizabeth Allen plays in this musical. Despite a few lighter moments, the story of this show reveals little of the headlong gaiety found in the typical Broadway musical. In this setting, a penetrating Rodgers song such as *Stay* has great effect when handled by a fully-trained voice such as Franchi's. Among the surprises in the production is the appearance of Carol Bruce as the native owner of an Italian inn and, more unexpected, a vitriolic attack on the much advertised comforts and pleasures of air travel. When Elizabeth Allen joins the group of visiting Americans in *What Do We Do? We Fly* the fur soars as high in the lyrics as any mortal in a plane. "Do I Hear a Waltz" is not the greatest Rodgers show in his long career but it does wonders for the 1965 Broadway season.

Baker Street (Original Broadway Cast)

M-G-M Tape STA 4288

Considered strictly as a case for record and tape reviewers, "Bakers Street" is a joy to handle. There was skepticism expressed when the news first came out that a musical was being fashioned from the adventures of Sherlock Holmes. Cases tackled by Baker Street's most famous citizen have served as vehicles for countless plays and movies but it remained for producer Alexander H. Cohen to create a musical adventure for Sherlock Holmes. A love interest so de rigeur in any self-respecting musical is attained, however indirectly, from the pages of the Conan Doyle story called "A Scandal in Bohemia." In devising the book for "Baker Street, author Jerome Coopersmith has used atmosphere and ideas from two other Holmes stories, "Final Problem" and "The Adventure of the Empty House." Those who haven't seen the stage production can be assured at the outset that "Baker Street" has a score and a cast on a very high professional level. It is, in fact, one of the very rare musicals within hailing distance of the best shows of the past decade. It's hard not to go overboard in reviewing "Baker Street" because of the obvious skill and poise in the performance of Fritz Weaver as Holes, Inga Swenson as Irene Adler and Martin Gabel as the infamous Prof. Moriarty. Much of the credit for the success of the show as a whole goes to the young Canadian team responsible for the music and lyrics. Marian Grudeff and Raymond Jessel were discovered by the producer north of the border when he was visiting Toronto on business. The team's distance from Broadway may be the factor that places them apart from our own budding composers who seem to feel they're doing us a favor when they set aside a week end for the creation of a musical.

Bob Newhart: The Windmills are Weakening

Warner Bros. W 1588

If Newhart has demonstrated anything in his half dozen releases in the past few years, it is the durability of gentle satire. Starting with his first recording displaying the workings of a "button-down" mind, Newhart set forth a style of humor that seems to keep going indefinitely. His latest release finds him as sly as ever, some of the material a bit farfetched, other digs unerring in their aim. The longest episode is "Ben Franklin in Analysis" which reflects the ponderous virtues of the colonial hero in a new and hardly flattering light. Most Newhart fans consider their idol at his best when he directs his mild but penetrating barbs at some of our contemporary institutions. The real estate business will hardly beam at the attention it receives in "Buying a House." Perhaps the choicest bit in this lineup of sketches recorded before an audience at the Ice House Theatre-Restaurant in Pasadena, California concerns the maze of rules and regulations Newhart has to plow through as a nightwatchman at the Empire State building telephoning his superior that King Kong has just gone up the outside of the building with Fay Wray in tow. This is diverting stuff that goes down very easily with this listener.

Juan Serrano at the World's Fair

RCA Victor LSP 3328

Guitars—Fantastic and Flamenco

Philips PHS 600-153

These two discs devoted to Flamenco guitar music happened to arrive at the same time. Their subtle contrast in sound is more apparent than it would be if reviewed months apart. The Spanish guitar is not the easiest instrument to assess in recorded form now that all discs, stereo and mono, easily encompass its strings' frequency range. The guitar has a tendency to sound pretty much alike on most labels since bottlenecks in the accurate handling of transients have been virtually eliminated in both the cutter head and latest models of stereo pickups. Just about all that remains by way of distinguishing factor is mike placement and room ambience. In most cases, placement of mikes is so close that normal studio ambience hardly comes into play. One superbly engineered exception to the rule could be mentioned at this point as an illustration of distant miking with a guitar swimming in a startling amount of room ambience. Such a disc is RCA's non-Dynagroove release (LSC 2606) with Julian Bream playing music for classical guitar in the spacious library at Kenwood, Hampstead, London. The acoustics of the room are mellow enough to permit a far-off miking that would sound harsh and hollow in a recording studio.

The two recent recordings being considered in this review follow the more conventional approach in mike placement. Juan Serrano's Flamenco Dynagroove release was recorded at the Spanish Pavilion of New York's World Fair. The young Spanish guitarist, a native of Cordova, the home region of Flamenco, is fortunate that the early excesses of Dynagroove have been quietly dropped by the wayside. In its handling of the guitar, Dynagroove is now virtually indistinguishable from any other current recording process. The highs are crisp and normal in presence. Serrano's program leans in the direction of Flamenco's somber side. In the Philips release, recorded in Spain, Richardo Modrego and Paco De Lucia are heard in a far-apart stereo setup. This may account for the fact that their Flamenco recital is somewhat more transparent in sound than Serrano's.

Roar of the Greasepaint (Original Broadway Cast)

RCA Victor LSO 1109

The more nebulous some of the new musicals get in plot structure, the tougher it is to figure them out on records—even with the help of the original cast. A strong

(*Continued on page 37*)

NATION-WIDE SOURCE STOCKED IN DEPTH

HARVEY RADIO CO., INC.

103 West 43rd Street / New York, N.Y. 10036 / (212) JUdson 2-1500
Federal Electronics, Inc. (Subsidiary) / Vestal Parkway, Vestal, N.Y. / (607) Pioneer 8-8211

Whatever you need, wherever you are, Harvey is **stocked in depth** with the top brands in the business. As America's oldest supplier of professional broadcast and studio recording equipment, Harvey can be counted on to have what you want on hand—and deliver it, anywhere. As your single source of supply—from studio tape decks, image orthicons and cables to the smallest replacement parts—Harvey can save you time, eliminate hunting around. We do it for the major networks right now. To order write or call collect today.

ALWAYS ON HAND: A.D.C. • AMPEX • AMPHENOL • A.P.I. • BELDIN • CANNON • CBS LABORATORIES • DAVEN DELCO • LANGEVIN • NEUMANN • R.C.A. • SENNHEISER • SHURE • SWITCHCRAFT • UNIVERSAL AUDIO

Circle 109 on Reader Service Card

ABOUT MUSIC

Harold Lawrence

New Frontiers in Audio: Talking Dolls

The squawk of an automobile horn followed by giggling came from the small shop on Madison Avenue. The sign read: "Amel Gallery—Exhibition—Marina Stern." We walked in, looking for the sports car. Instead we found a room full of people listening to paintings. Yes, listening. For Mrs. Stern's paintings are meant both for seeing and hearing. They are, in fact, the latest thing in pop art: canvases that talk, roar, squeal, or simply make noise, a sort of Vox Pop.

The audio-visual painting that first attracted our attention (*Fig.* 1) is titled *Judgment Day II* and costs $450. In the upper left-hand corner an angel is seen trumpeting the day of judgment; attached to the canvas is an old curved car horn with a rubber bulb, which visitors are encouraged to honk—and do. As the blare resonates in the undamped room, Mrs. Stern smiles at the surprised reactions of the gallery-goers. Nearby, scrambled sonics poured out of a painting called *Tape Sound and Fury,* for which an electronic composer had written an original tape based on 'found' sound. Price: $500.

The silvery tones of a music box tinkled from another audio-visual painting, *The Mirror,* which went for $450. Probably the most popular work of the exhibition was *Election Day,* which depicted a politician waving at the crowd, a montage of faces clipped from newspapers and magazines. Dangling near the top of the canvas was a white plastic ring. When pulled downward, the ring activated a stream of explosive statements, such as: "Gee Willickers. . . . I'm a rootin' tootin' ding-dong daddy . . . I'm Bozo the Clown, a one-man circus!"

We asked Mrs. Stern to tell us about her audio-visual art. "It all started when I bought my daughter a talking doll. She grew tired of it after a while and sold it back to me for 25 cents. It occurred to me that it might be interesting to use the sounds the doll made in one of my paintings. So I took it apart to see how it worked. Months later, I incorporated it in my painting, *Hay Day.*"

We checked the catalog. "Oh, you won't find it there," the artist said, whereupon she handed us a reprint of a story that appeared in *Time* last summer. Following is *Time's* description of Mrs. Stern's first audio-visual painting:

"The canvas is a bright Mediterranean blue with a narrow upper band of black. On the line dividing the two colors reclines a pasted-on paper-cutout reproduction of Goya's nude *Maja.* From the nude's hand dangles a string with ring attached. The viewer pulls the ring, and the nude says teasingly, 'Will you play with me?' Another pull and I'm sleepy.' A third: 'Please change my dress.' It's really baby talk. Built in behind the painting is the voice box of a Chatty Cathy doll."

Now that someone has done it, it seems like such a natural idea. But it took more than four years for the talking doll to break into pop art. Whether or not the talking canvas will have the same effect on the world of painting as Chatty Cathy has had on the toy market remains to be seen. At its birth in 1960, Chatty Cathy spoke eleven different complete sentences and completely revolutionized the doll business. Suddenly dolls that said nothing were as outmoded as silent pictures.

But talking dolls are not new. Mattel, Inc., the leading manufacturer of toys that sound, points out that as far back as 1890, Edison introduced the Edison Phonographic Doll, which was on exhibit among the "Wonders of Electricity" at the Lenox Lyceum in New York. Made of metal, the doll recited nursery rhymes, which presumably had been recorded on small cylinders. Like other Edison inventions, the Phonographic Doll was ahead of its time, and soon disappeared.

Until 1960, when Chatty Cathy was first manufactured, dolls could say little more than "Ma-aa." Now there's nothing they can't say. So far, the average talking doll is limited to some twelve different phrases, reproduced by what is essentially a miniaturized phonograph 5 inches long, 3 inches wide, 1½ inches deep, and weighing 7 ounces. The mechanism operates without batteries or wind-up key. Here is a sampling of the world of the talking doll.

Singin' Chatty. The first singing doll. Repertoire consists of nursery tunes and rounds such as "Row, row, row your boat."

Baby Cheryl. Mattel's catalog describes this doll as "a precious, precocious little baby doll who recites nursery rhymes in baby talk. Little girls will want to hug her, play with her . . ."

Chester O'Chimp. "Soft, huggable and talkative . . . He says 11 different things at random in a catchy Irish brogue—and his mouth moves while he talks."

Tatters. "An adorable, ragged waif who will creep into your heart when she says things like 'nobody ever loved me before.' She's soft and cuddlesome and says 11 touching phrases."

(*Continued on page 46*)

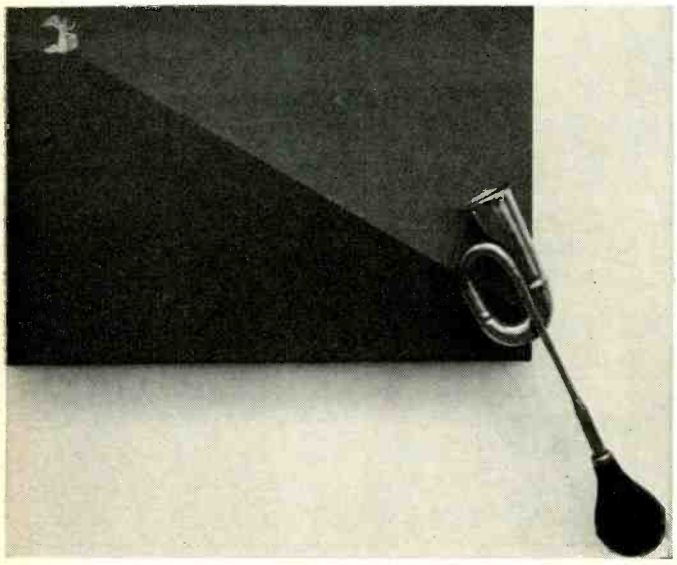
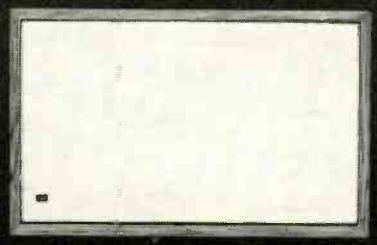


Fig. 1. Marina Stern's Judgment Day II.

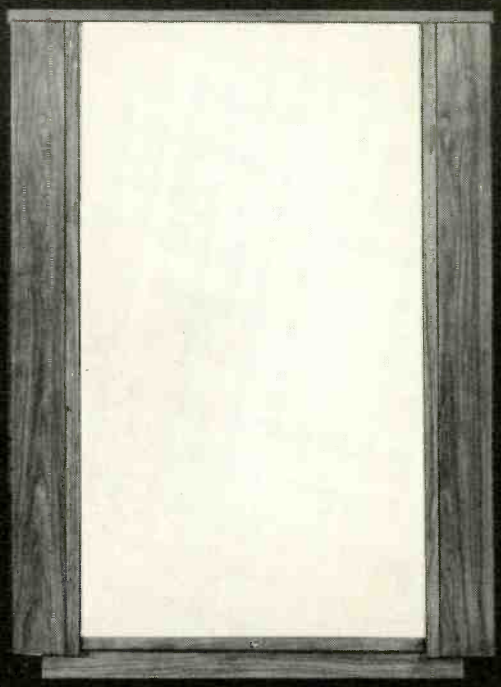
This Bozak Speaker Costs $97.50*



Is It The Best?

Yes. Where limitations either in budget or in space will not permit the broader sound source of a more complete Bozak system, Sonata No. 2 provides the best value obtainable for realistic re-creation of music.

This Bozak Speaker Costs $778*



Is It The Best?

Yes. Where there is no limitation imposed by space or budget, a Bozak Concert Grand provides the most realistic re-creation of music possible.

ARE ALL BOZAK SPEAKERS "BEST"?

Yes.

All Bozak speaker systems are built from the same basic components. And all Bozak components are built to the same electrical, acoustical and tonal standards — the highest.

To achieve the broader, more realistic sound sources of its larger systems, Bozak simply combines the same component speakers used in more modest systems.

Because Bozak maintains but one quality standard, your speaker system can grow with you — without obsolescence or loss of original investment. You simply add components as your musical taste, space or income grow.

Start today to enjoy Bozak for the best of your life. Our free catalog will show you how.

Bozak

Darien Connecticut

*Prices shown are subject to change. All prices slightly higher in the Far West and Deep South.

Export: Elpa Marketing Industries
New Hyde Park, New York

Circle 110 on Reader Service Card

AUDIO ETC.

Edward Tatnall Canby

FM-AM— PERSONAL HISTORY

This separate but equal argument about FM and AM is, of course, as old as FM itself. There's a familiar ring to it for an old hand like me, who was very much involved in FM back in the pioneer "old band" days during the Second World War, when FM made its first broadcast beginnings. (Not counting Major Armstrong's amiable emanations from Alpine, N.J., which quite often featured records loaned by one E. T. Canby. I'd send 'em up in the morning and they'd be thrown on the air that evening, casual-like.)

From 1943 on I worked in an FM station of more serious program intent, as music adviser and general air-time filler-up. I have barrels of scripts I wrote in those years, all of them aired —for those who could hear them. I had two programs of my own as well; for I had a true FM voice, lousy on AM. (It depends on the higher highs for intelligibility.) I still have. Hate to hear myself on AM. Sound like a voice in a sofa cushion. On FM I'm fine.

I worked for three years in FM, full-time. In 1946 I was fired. So was everybody else on our staff, some 16 if I remember. All that remained of our modest layout of penthouse studios, grand piano, control rooms, offices, reception lobby, was a turntable in the engineering room and an announcer to go with it. That's what happened to FM in 1946.

The bogy that almost killed FM in those postwar days was, of course, TV. We had put all our hopes into an expected great new expansion of radio via the splendidly improved FM medium, when at last it would be possible to resume the manufacture and sale of radio receivers. (No new radio or TV sets during the war years.) We were happily sure that FM radio was so superior to AM that it would quickly branch out—given those new sets—to take advantage of enormous opportunities, all over the place. (More on these later.) At this late date, my mind goes slightly fuzzy when I try to recall those shining arguments we once spouted, to convince our doubtful friends that this obscure new kind of radio was set for an astonishing future.

Early TV

Our station, to be sure, was nominally a TV outlet, or wanted to be. We had "and Television" added to our corporate name, after "Radio," plus a brace of pending applications before the government. We also had a wishful symbol in our front lobby, a fine old RCA TV console, one of those massive affairs with a ludicrous little screen in the middle. That was as close as we ever got to the TV bandwagon.

But on that receiver, running day in and day out, I watched many of the pioneer experiments in video broadcasting that were then going on, like our own enthusiastic experiments in FM radio. I remember writing in to one CBS program to say that I had enjoyed some fancy camera work where two singers and an old upright piano had been given ingenious black-and-white depth-effects at odd camera angles. I got back a positively ecstatic letter from the producer, all about how it was through the support and encouragement of people like me that their faith in TV's future was kept alive in such difficult times. Phew! Obviously, he hadn't had a fan letter in months. He was even worse off than we were in FM.

We never did get on the later TV bandwagon ourselves, and what happened to CBS-TV and the rest is well enough known. But I found out from that old receiver in our lobby that wartime TV in the improvised, low-budget studios of the day was much like our own FM operation, full of experiments on pin-money or less, overflowing with hope and idealism, clumsy as all get out but trying very hard. We all shared the great vision of post-war success, in TV and FM alike. And none of us had more than peanuts to spend. It was pretty much a labor of love, in both areas.

TV, you see, was playing for time and so was FM. Both were required by the government to keep programs on the air, so many hours a day, or quit. Neither TV nor FM could set hands on any revenue in return. There simply was no audience to provide it. The whole thing was a gamble for the future, a holding action for the present—and not even a "public service" commercial to help fill the oceans of time we had to cover, somehow or other, beaming our hopeful experiments out to a few dozen or maybe a few hundred receivers, off in the gloaming.

I remember all too well the ineptitude of most of the early TV fare. After all, it was a brand new medium. They had nothing on which to build, whereas we in FM could at least take off from AM practice and (so we hoped) improve upon it. TV then boasted a great deal of "live" drama, its staple fare aside from canned movies. Most of it was dreadful. I can still see those two-dimensional flat scenes, cardboard-like, set up straight in front of the one camera, on which in thirty seconds you could figure out where the actors were hiding or changing costumes and on which side they would reappear. Every so often an accidental steam pipe or part of a window would heave into view by mistake, a bit off to the left or right of "safe" camera range.

After fifteen minutes of this high drama you knew the entire TV studio set-up by heart and even how to get to the men's room or the fire exit, just over behind that backdrop. It was most pathetic in its way, this early video. I was right in praising the CBS director for an unusual bit of genuine TV skill, forecasting later times.

The Audience

I suppose that in those war years TV and FM had about equal audiences, both infinitesimal compared to AM radio. I have no figures; but I did have my own programs on the FM air and I practically got to know all our listeners by their first names. For they *did* write in about our work. They were privileged and they knew it. They felt a personal interest in all that we did; they knew that they belonged to a tiny band of pioneer souls who actually owned FM receivers and they knew also that we on our side were trying to pioneer in a new medium. And so they showed a spirit of helpfulness that was inspiring to all who worked in FM, and TV as well, in the years of suspended commercial animation.

I should interpose here, for the young, that the war-time FM and TV audiences were there almost by a freak. During the brief period just before everything closed down for the Duration, both television and FM had been launched in public with actual commercial sale of receivers. The broadcast bands were not those we use now. The

Jensen Model HS-2 Stereo Headphones bring an exciting new dimension to your favorite recordings. Unusually smooth full range undistorted output set these headphones apart. Soft foam cushions provide feather weight comfort and preserve the undistorted bass response without pressure. Response is true, complete, distortion-free from below 20 to 17,000 cycles!

HAVE YOU HEARD ?

HS-2 Stereo Headphones may be connected to any stereo or mono system. A full 8-foot input cable is conveniently located to the rear of the left phone. Of course, it carries the Jensen 5 year hi-fi guarantee. Suggested resale price $24.95. See your Jensen hi-fi dealer.

JENSEN LOUDSPEAKERS

JENSEN MANUFACTURING DIVISION / THE MUTER COMPANY 6601 SOUTH LARAMIE AVENUE, CHICAGO, ILLINOIS 60638

Canada: Radio Speakers of Canada, Ltd., Toronto • Argentina: Ucoa Radio, S.A., Buenos Aires • Mexico: Fapartel, S.A., Naucalpan, Mex.

Circle 112 on Reader Service Card

whole operation had to be started all over again after the war. But in that short time enough sets of both sorts had been sold so that at least a minimum audience for FM and TV actually existed in a few high-density population areas such as New York City.

That audience had to suffice, and did for the formative years of FM and TV broadcasting. It kept both FM and TV on the air and allowed both media to gain experience and knowhow (in engineering as well as programming, of course) towards the great anticipated expansion of the future. Without *any* audience, both media would have ceased to exist.

Curious to think of TV and FM as equals! But they were. Equals in newness, equals in the then existing tiny and non-commercial audiences and, most of all, equals in idealism, in high-purpose experiment towards the future. That is the way it was, in both media. And who but a few canny businessmen could have guessed that TV, not FM, would be the future colossus?

Well, I suppose a lot of people in advertising and publicity knew very well and could say, later on, "I told you so." Also a good many business-minded engineers, broadcast officials and what-not. The people who didn't know, alas, were those who worked most directly in the FM and the TV media, each crew dedicated to its own shaping-up of the techniques of the future. They were alike, these crews, in their industrious, selfless dedication to their own new medium. They were equally sure that their own area was to be the coming promised land.

Boom-bust

Television won. FM lost. I know what happened to *us* poor souls in FM. I wonder how many of our comrades over in TV were tossed out on their ears too, as the big guns took over and TV went really commercial?

It took just about six months of "commercial" operation for our FM station to see the handwriting on its wall. Our great moment had come, we had thought, when at last the war was over and we began to blossom out. New FM sets actually on the market! Or promised soon. The bars coming down everywhere. Production resuming, new cars appearing on the streets after four whole years (they were 1942 models renamed 1946), and we in the very vanguard of it all! What excitement! We were ready, too. For years we had worked towards this day. We would revolutionize radio. We were all set with our shining new FM ideas, very far removed, of course, from anything on stuffy old AM. That was the whole point. And so we began happily to ex-

pand in anticipation – a new studio, new equipment, new personnel. Terrific.

That spring we were all fired and the turntable took over. (And that in spite of a brace of full-page ads heralding "expansion" and a new day in FM broadcasting. Mere wool-pulling for the advertising eye. It *was* a new day—for the turntable.) From that moment on, FM on its own was so nearly dead that it is miraculous to find it alive today.

I hate to say so, but my very strong feeling is this: that if FM had not saved its skin by attaching its programming (with government permission) to existing AM, there would be no FM today. It was a case of desperate artificial respiration, an essential blood transfusion, for better or worse, to keep the patient alive. And it worked.

Hooked into AM in parallel, FM transmission got its breath again, after a fashion. Program blood once more flowed in its veins, even if alien programming was unsuitable. And so *the manufacture of FM receivers continued.* FM therefore stayed alive.

It was dead wrong, in many engineering and aesthetic ways, to merge the two programs into one, and it still is wrong. FM and AM were *not* alike in their capabilities. They are even more unlike today, after so many years of development and innovation. It was an arbitrary thing, that merger, which left the few FM stations that held out for independence in a precarious state, depending on the ever-helpful turntable for their very existence, unable to afford any sort of original or "live" programming.

We who had worked in FM, and had been dropped, were bitter. We felt a betrayal that brought all our work over those years to exactly nothing. We were right—for awhile. FM *was* dead, as far as the program end was concerned. FM was merely an alternative channel, another route for the same old stuff.

The only way that FM could have continued to exist in the face of the great television boom was, paradoxically, by denying that it existed at all, by attaching itself onto AM in a sort of broadcast emergency car pool. For, don't forget, AM radio itself, with all its networks and all its millions of home receivers, was in serious trouble thanks to TV. If FM latched onto AM, then in a way, AM latched onto video, or rather, the bigger AM interests got hold of TV for themselves and so were able to maintain AM radio in spite of the vast changes that put most of AM's former commercial empire into the video camp.

One of the emergency means by which life was kept pumping away in the old radio system was the simulcast, TV and radio combined. One program, two media. (Or should we say one and a half media?) If the simulcast could be swallowed as a prime necessity in radio programming, then surely the AM-FM combo was irreproachable! After all who could tell the difference between AM and FM in those days. Splitting hairs.

Frequency What?

How many people had a chance to *hear* the difference? How could we "sell" a new kind of radio to millions of people, or even thousands, sound unheard, by description alone? It wasn't easy and we weren't convincing, as I well remember.

Many, many dozens of times I found myself trying to explain that I had been working in FM—"Oh you mean that new high-frequency thing . . .?" Frequency modulation, I'd repeat. "Frequency *what*—?" Frequency *modulation*. You know, the opposite of Am-

(*Continued on page 46*)

EDITOR'S REVIEW

IT ALL STARTED WITH POTASH

JULY 31 is the 175th Anniversary of the first patent issued in these United States of America, some four months after the basic patent law was passed.

In the patent granted to Samuel Hopkins of Philadelphia, Pa. for a process for making potash and pearlash, (see reproduction below) we note that is was granted "in pursuance of the Act, entitled 'An Act to promote the Progress of useful Arts,'—."

This wisdom on the part of the founders clearly demonstrated their belief that man strives and invents much more with self-interest as the incentive. In fact, the entire Constitution of the United States is based on the philosophy that self interest in the form of "checks and balances" is the basic safeguard for individual rights. We recommend that all who are in doubt about this point read the Federalist Papers, as well as the Constitution.

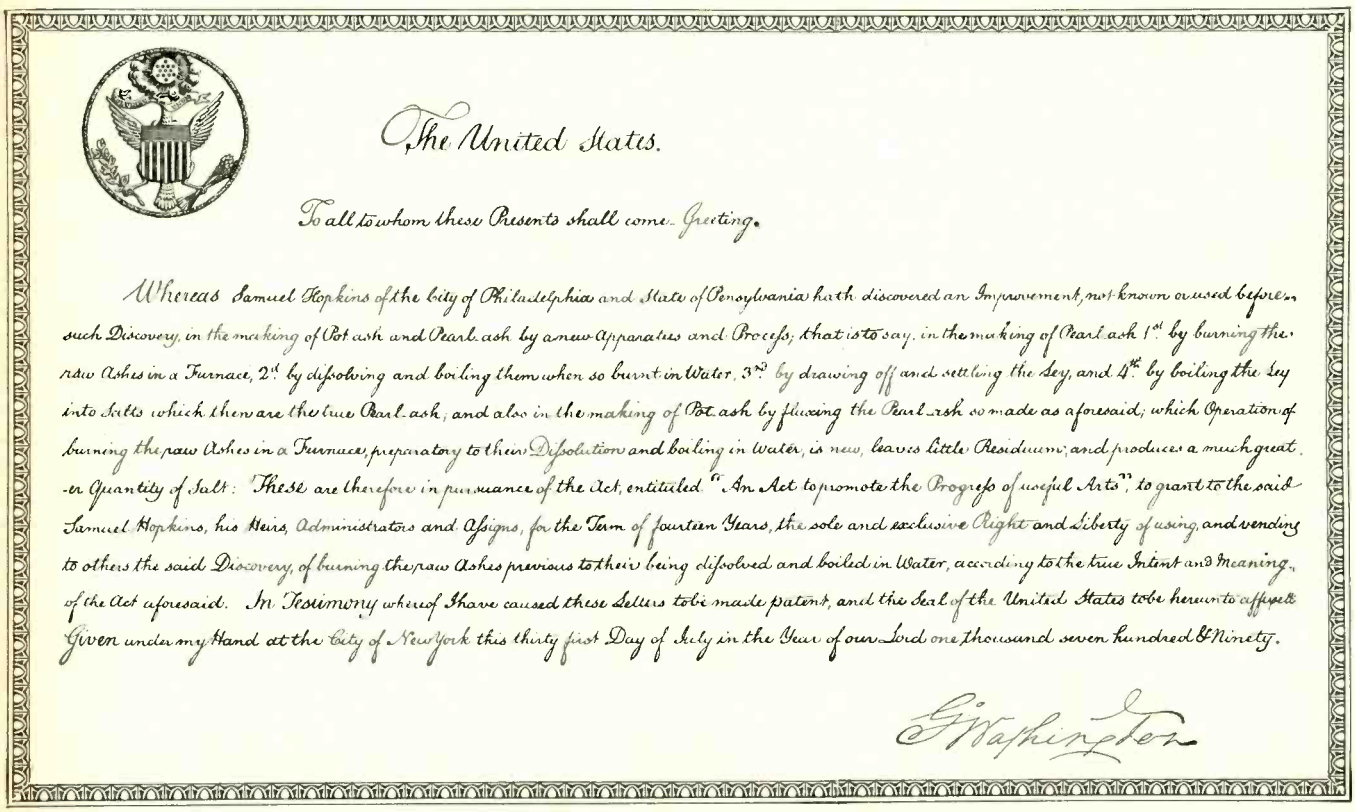
Of course no one can say for sure whether some other system of promoting invention would have stimulated more inventions, but the fact is that there are an enormous number of inventions patented in the United States; in the millions. Thus we can say that this system of patents has probably played an important role in encouraging invention, justifying the understanding of the founders of this scheme.

The importance of invention to the welfare of all might be inferred from the extraordinary plethora of products and devices available. Certainly the entire field of electronics is based on patented devices; electron tubes, transistors, and so on.

Our reason for this reminder about the patent system is to add our word of encouragement to those of our Founding Fathers. AUDIO readers will recall our editorial note exactly one year ago wherein we invited those who had conceived new or different methods for solving audio problems to share with all of us. Now we call again, and promise to present your inventions or patents to other readers. We have in file a number which were sent to us over the past year, we hope to add many more.

Let us celebrate this 175th Anniversary of the patent by making it a banner year for invention, especially in the audio field. We all will gain therefrom. But the inventor will gain most.

And to think it all started with potash!



The United States.

To all to whom these Presents shall come Greeting.

Whereas Samuel Hopkins of the city of Philadelphia and State of Pensylvania hath discovered an Improvement, not known or used before such Discovery, in the making of Pot ash and Pearl ash by a new Apparatus and Process, that is to say, in the making of Pearl ash 1st by burning the raw Ashes in a Furnace, 2d by dissolving and boiling them when so burnt in Water, 3d by drawing off and settling the ley, and 4th by boiling the ley into salts which then are the true Pearl ash, and also in the making of Pot ash by fluxing the Pearl ash so made as aforesaid, which Operation of burning the raw Ashes in a Furnace, preparatory to their Dissolution and boiling in Water, is new, leaves little Residuum, and produces a much greater Quantity of Salt: These are therefore in pursuance of the Act, entituled "An Act to promote the Progress of useful Arts", to grant to the said Samuel Hopkins, his Heirs, Administrators and Assigns, for the Term of fourteen Years, the sole and exclusive Right and Liberty of using, and vending to others the said Discovery, of burning the raw Ashes previous to their being dissolved and boiled in Water, according to the true Intent and Meaning of the Act aforesaid. In Testimony whereof I have caused these Letters to be made patent, and the Seal of the United States to be hereunto affixed. Given under my Hand at the City of New York this thirty first Day of July in the Year of our Lord one thousand seven hundred & Ninety.

G. Washington

Nine out of ten musical people prefer the sound of Pickering.

Nearly all musical people prefer *natural* sound. And natural sound begins with Pickering. Right where the stylus meets the groove.

Any of the new Pickering V-15 stereo cartridges will reproduce the groove, the whole groove and nothing but the groove. That's why a Pickering can't *help* sounding natural if the record and the rest of the reproducing equipment are of equally high quality.

To assure compatability with your stereo equipment, there are four different Pickering V-15 pickups, each designed for a specific application. The V-15AC-1 is for conventional record changers, where high output and heavier tracking forces are required. The V-15AT-1 is for lighter tracking in the newer automatic turntables. The even more compliant V-15AM-1 is ideal for professional-type manual turntables. And the V-15AME-1 with elliptical stylus is the choice of the technical sophisticate who demands the last word in tracking ability.

No other pickup design is quite like the Pickering V-15. The cartridge weighs next to nothing (5 grams) in order to take full advantage of low-mass tone arm systems. Pickering's exclusive Floating Stylus and patented replaceable V-Guard stylus assembly protect both the record and the diamond.

But the real payoff is in the sound. At least for those who can *hear* the difference.

Pickering
Plainview, L. I., N. Y.

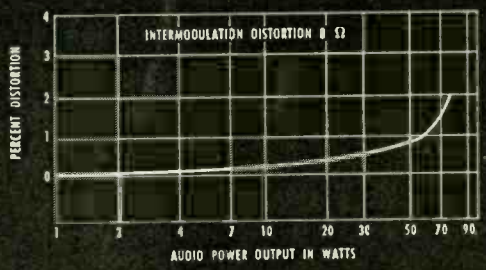
For those who can hear the difference.

WIN a $1000 stereo system or any of 125 other prizes! To become eligible, simply identify the musical people pictured above. See your hi-fi dealer for entry blanks and full details.

Circle 117 on Reader Service Card

Compare these Sherwood S-9000 specs! Power output for both channels is 150 watts at ¾% I.M. distortion. Continuous sine-wave power output (two channels) is 100 watts at ½% distortion. Power band width: 12-25,000 cps. at 1% distortion. Hum and noise: Phono—70db, Tuner—80db. Sensitivity: Phono 2.5 mv, Tuner 0.35v. Other Sherwood ALL-SILICON Solid-State amplifiers are the S-9900, 90-watts music power (features ctr. channel mono power) @ $229.50 and the S-9500, 50 watts music power @ $179.50.

0.1% distortion



. . . and *All-Silicon* too!

Chart reprinted from test lab report, May, 1965, High Fidelity.

Are you ready to step up to a Sherwood? You are, if what you seek is the "transparent", "life-like" reproduction resulting from 0.1% distortion previously obtainable only in bulkier, more-expensive basic amplifiers. And, did you know that *only* Sherwood features *ALL-SILICON* solid-state circuitry in every amplifier to earn the industry's most enviable reliability record? This is why experts confirm again-and-again . . . *Sherwood is the best!*

Paired in "Gemini" walnut cabinet @ $39.50 is Sherwood S-9000 Solid-State 150 watt amplifier, $299.50, and S-3000V FM Stereo tuner, $165.00.

Sherwood

Sherwood Electronic Laboratories, Inc., 4300 North California Ave., Chicago, Illinois 60618 Write Dept. 7A

Circle 118 on Reader Service Card

Solid-State Wien-Bridge Audio Oscillator

I. C. ZERO

The resistance-tuned Wien-bridge oscillator was adapted to solid-state design over five years ago by P. J. Baxandall. Here's how to construct one inexpensively:

THE VACUUM TUBE, resistance-tuned Wien bridge oscillator has been a standard tool in audio work for many years now. Although there have been some published and, one suspects, many unpublished attempts to adapt it to solid-state circuits, most of these have not been overly successful. The low input impedance of the usual transistor amplifier stage is one of the principal stumbling blocks. An elegant solution to this problem has now been evolved by the ingenious P. J. Baxandall, whose dual tone control circuit is currently used in many high quality amplifiers. The circuit, on which Baxandall has applied for a patent, was first described in the arcane pages of the British *Royal Radar Establishment Journal* (No. 45, Oct. 1960). As the oscillator uses only four inexpensive transistors, covers a four decade band from 20 cps to 200 kc, has less than 0.25 per cent distortion and is flat over the entire band within plus or minus 0.5 db., it certainly deserves to be better known.

We built one of these oscillators about two years ago. It has proved such an excellent performer that it has been in constant use ever since and the number of times that it has been borrowed and copied is legion. *Figure* 1 shows the front panel of one version of it, while *Fig.* 2 shows the interior.

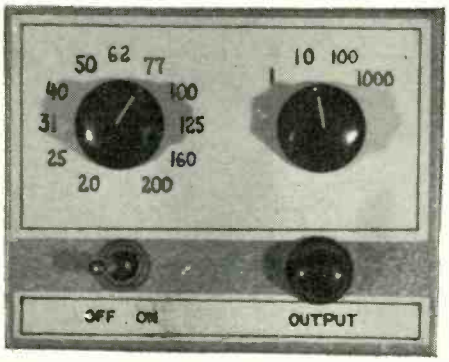


Fig. 1. Front panel of the oscillator.

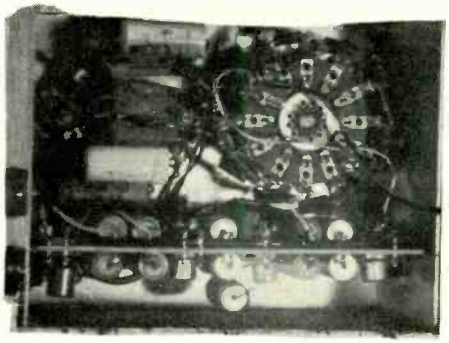


Fig. 2. Interior view.

How It Works

The trick which makes it tick is shown in block form in *Fig.* 3. Two operational amplifiers are used in cascade. One branch of the frequency determining RC network, R_T and C_T, is used as the feedback arm of the first operational amplifier. The second branch of the network, RT' and CT', becomes the input arm of the first amplifier and is connected between its summing point and the output of the second operational amplifier. The latter employs a linear resistor, LR, as its input arm and a non-linear resistance, (thermistor) T, as its feedback arm. Oscillation results, at a frequency determined in the usual manner by the RC tuning network, and the thermistor adjusts the loop gain to stabilize the amplitude of the oscillation.

The principal advantage of all this jiggery-pokery is that the feedback arm of this type of operational amplifier "sees" a very high impedance when it "looks" toward the points in the operational amplifier to which it is connected. By using the shunt RC branch of the RC frequency determining network as the feedback arm of one of the amplifiers, Baxandall very neatly avoids loading it with the low input impedance of the usual type of transistor amplifier.

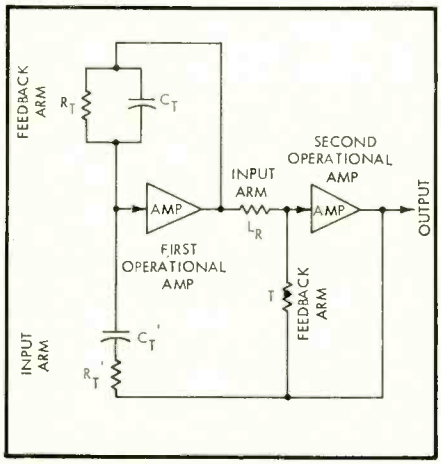


Fig. 3. Block diagram.

Figure 4 depicts the entire circuit. The first operational amplifier comprises Q_1 and Q_2; the second, Q_3 and Q_4. Note that a single voltage divider, R_{26} and R_{34}, economically provides bias to both amplifiers. The feedback arm of the first amplifier is provided by R_T, R_{32} and one of the range determining capacitors, C_1, C_3, C_5 or C_7. The input arm of this amplifier comprises R_{T1}, R_{33} and one of the capacitors, C_2, C_4, C_6 or C_8.

In Baxandall's original circuit the bridge capacitors were switched, as shown in *Fig.* 4, to obtain four ranges, (20 to 200 cps, 200 to 2000 cps, and so on) while a dual 15k potentiometer provided continuous coverage of each range. To avoid possible difficulties with the notoriously poor tracking of inexpensive dual potentiometers, we used a slightly different arrangement in our original version. A two-section, eleven-position, shorting-type rotary switch, switches appropriate fixed resistors into each leg of the network to provide eleven fixed frequencies logarithmically spaced through each decade. In the lowest decade the frequencies are: 20, 25, 31, 40, 50, 62, 77, 100, 125, 160 and 200 cycles per second. These are multiplied by 10, 100 and 1000 respectively on the succeedingly higher ranges. In our original oscillator, the switched resistors were carefully matched in pairs to an accuracy of about 1 per cent. More recently we have found that the performance of the oscillator is only slightly degraded (mainly in amplitude stability) if ordinary stock 5 per cent tolerance resistors are used without any attempt at matching them. The builder thus can

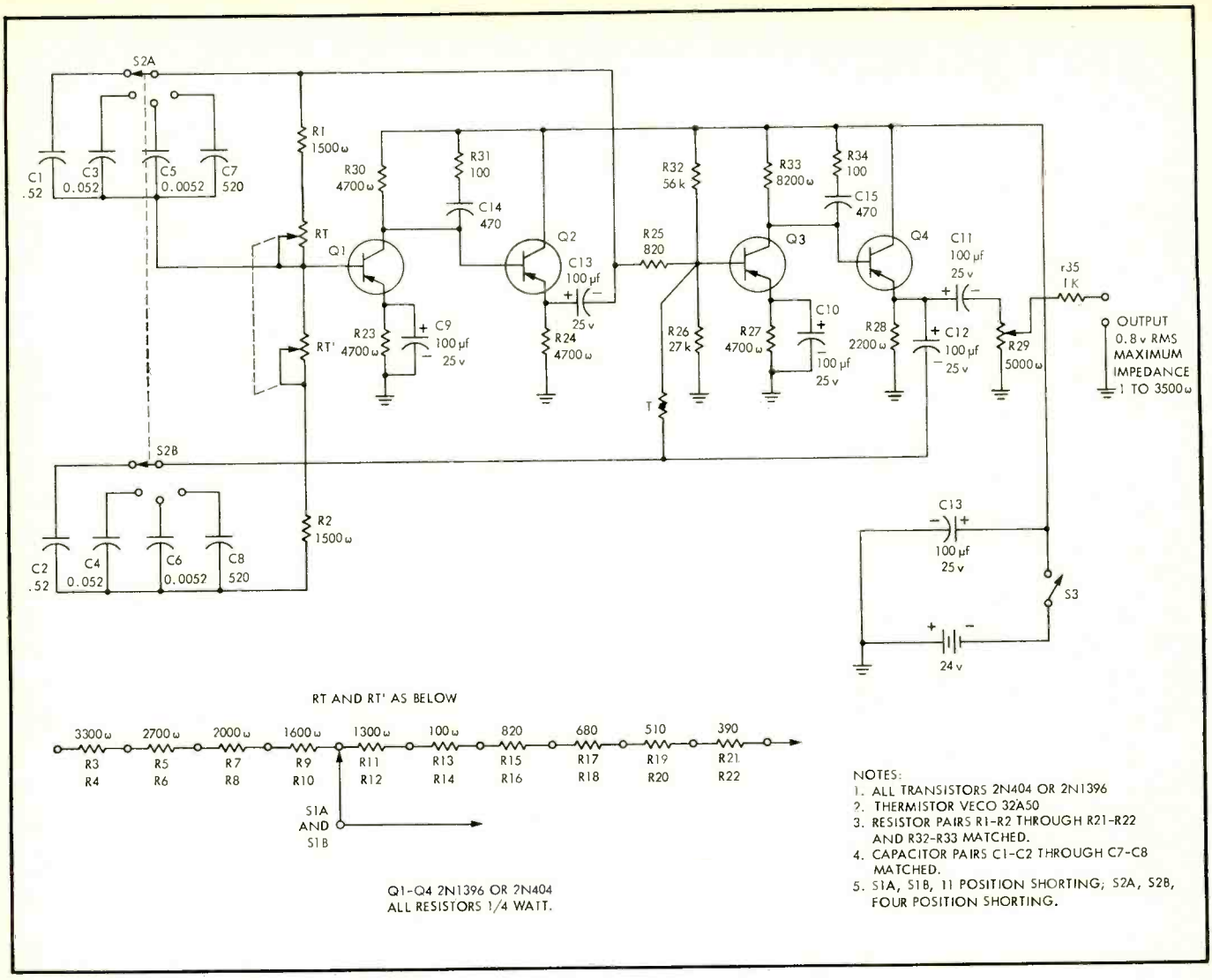


Fig. 4. Schematic diagram.

exercise an option here, depending on his inclinations and pocketbook.

Nominal values of the range-determining capacitors, C_1 through C_8 are given. As capacitor tolerances are usually somewhat wider than resistor tolerances unless expensive units are used, these should be matched in pairs. The usual way of accomplishing this is to start with a capacitor slightly smaller in value than that called for in the circuit and pad it up to the correct capacitance by shunting it with low value units. Further, each pair must differ from its neighbors by a factor of precisely 10 (except possibly for the pair used on the highest range where strays become more important) if the end of one range is to coincide properly with the start of the next. A capacitance bridge and a frequency measuring device of some sort are indispensable in lining up the oscillator, unless one takes the plunge and simply purchases 1 per cent components for the frequency-determining capacitors. Another possibility would be to make an individual calibration for each range.

The excellent amplitude regulating properties of the oscillator are due to a combination of a very low power thermistor, and the circuit configuration used which results in virtually the entire output voltage of the oscillator (about 1 volt) being developed across the thermistor. Note that the thermistor is connected from the output of operational amplifier no. 2 to the summing point of the same amplifier. As the summing point is a "virtual earth" there is little signal at this point and it is almost as though the thermistor was connected across the emitter resistance, R_{28}, of Q_4.

Construction

No particular problems arose in constructing the device. We fitted it into a 3 x 4 x 5 in. "Minibox", batteries and all. Ours runs on three Mallory TR-146 8.4-volt mercury cells, but, as will be shown later, the supply voltage is not at all critical; anything between 12 and 24 volts may be used. The battery specified will run it about 75 hours. As far as can be determined the layout is not at all critical and may be freely varied to accommodate available parts or individual preferences. Ours was wired up on a piece of perforated phenolic board using push-in "flea clips" as tie points. The networks, R_{31}, C_{14} and R_{36}, C_{15} were shown in Baxandall's original paper and are presumably intended to control the loop gain of the amplifiers in the high frequency region. Apparently they are not required with all transistors, as we could detect no difference in performance with them disconnected. It is, perhaps, safer to include them as shown.

One word of caution concerning the thermistor. The unit specified, VECO 32A50, is very tiny, hardly larger than an anemic flyspeck. Handle it with care. Further, due to its miniscule mass and consequent low thermal inertia, if one operates the oscillator with the

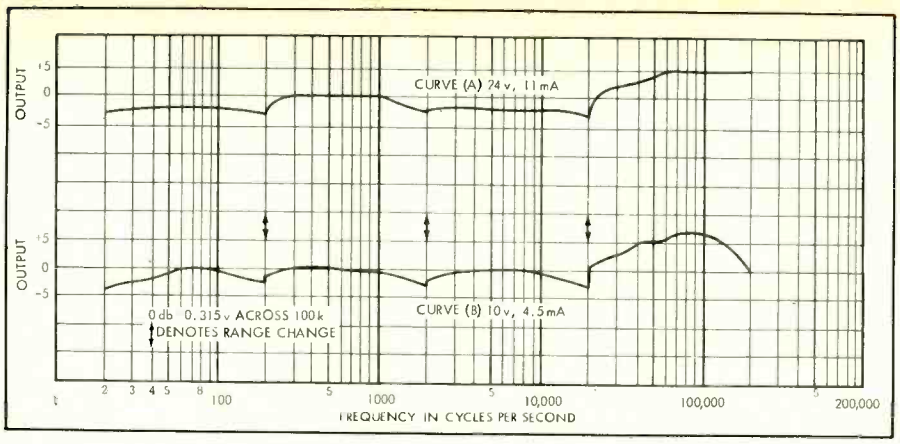


Fig. 5. Oscillator response using 2N247 or 2N1396 transistors at two different supply voltages.

case open, random fluctuations in the output amplitude may be observed. These are due to variations in the temperature of the thermistor caused by air currents in the room. The effect will vanish completely as soon as the box is closed. Blow gently on the thermistor while watching the output, if you find this hard to believe.

Thermistors, like all components have tolerances too, 20 per cent being typical. It is barely possible that if one by chance got a thermistor with a cold resistance a little on the low side, the oscillator might fail to start. If this happens, R_{25} may be reduced to 750 ohms, or even to 680. Use the highest value that will produce reliable starting. Under no circumstances attempt to substitute a light bulb for the thermistor. First, there's not enough power available to run it hot enough. Secondly, a light bulb has the opposite sense of resistance change with temperature and thus cannot be used in this circuit configuration. A light bulb would make the amplitude regulating mechanism regenerative rather than degenerative.

The completed oscillator is capable of really first class performance. Using a Hewlett-Packard, Model 302A wave analyzer, (filched from a more fortunate friend) the measured second harmonic distortion at 1000 cps was 0.03 per cent, in our original version of the oscillator (matched resistor pairs). This was accompanied by 0.02 per cent third harmonic. No higher harmonics were measurable. At 100 cps the wave analyzer revealed 0.03 per cent second and 0.14 per cent third, the increase in the latter presumably being due to the thermistor. At 10kc there was again 0.03 per cent second, but only 0.01 per cent third. No measureable higher harmonics could be found at either of these frequencies.

Figure 5 depicts the amplitude stability of the oscillator. Note the curve, (A). The output is constant within 0.5 db. over the entire four decade band. Lowering the supply voltage to 10 volts (just before the onset of visible distortion in the output waveform) produced curve (B). This is almost as good as (A). These curves were obtained with either of two types of "drift" transistor, the early 2N247 or the current 2N1396.

Recently, another version of the oscillator with unmatched resistor pairs (5 per cent tolerance units) was checked similarly. Its output was constant within plus or minus 1 db over the band. This is to be expected, as the principal effect produced by the unmatched resistors is to cause slight changes in the attenuation of the frequently-determining network as one switches from one frequency to another. The distortion was approximately the same as our original version on the three lowest ranges.

Figure 6 shows the performance of the original version with inexpensive 2N404 transistors in the sockets and a battery voltage of 15 volts. Again, the output is flat over the band within 0.5 db. At the time this test was made, the wave analyzer was not available (its owner churlishly insisted on having it back). No distortion figures are therefor available for this configuration, though we doubt that they are very different. The measured betas of all transistors used were in the 80 to 100 region.

Note also that the distortion will be constant at all settings of the output control, as there are no amplifiers following it. The output impedance varies with the setting of this control, being about 1000 ohms at either end and around 2000 ohms in the center. Maximum output on ours is about 0.8 volt rms, but this may vary somewhat depending on the thermistor. Don't be tempted to omit the 1000 ohm resistor, R_{35}, in series with the output. If you do, the oscillator will bitterly resent being asked to drive some types of capacitive load.

Using this oscillator is a real pleasure. Though the frequencies chosen may seem peculiar, when one uses them in plotting curves on the usual semilog audio paper, the points will come out equally spaced along the horizontal axis of the paper. This makes for neat and effortless curve plotting. The switched frequency controls also provide unbeatable reproducibility. There's never any doubt about returning to a given frequency. The excellent output stability means that for all but the most hypercritical work, the output control can be set once and then ignored. The only objectionable feature which we have been able to find, is a perceptible transient when switching from one frequency to another. As yet this has never proved serious, but it is, perhaps, well to keep this fact in mind when running near the overload point of a device connected to the oscillator.

The battery supply is also a convenience. There's no hum at all and no ground loop problems arise. The unit may also be used to drive a balanced device (push-pull), or operated off ground for dc. Hats off to Baxandall. Like the star of a currently popular childrens' TV program, he's "done it again". Æ

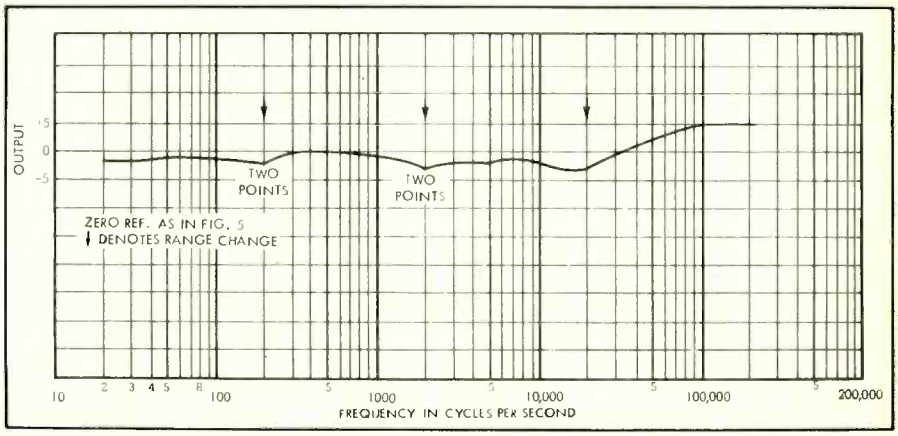


Fig. 6. Performance of the original version with 2N404 transistors and battery voltage of 15 volts.

Calibrated Stereo Control Unit

RAPHAEL F. EHAT

PART FOUR CONCLUSION

Synthesizing the Standard Stereo Test Signal

Figure 10 diagrams the equipment layout employed to produce an artificial but true stereophonic signal with known separation ratio. The three sine wave generators have low harmonic content so that their relative amplitudes may be brought to unity very closely by means of a single VTVM switchable between them. Three frequencies are chosen within the band of high S. R. significance, separated enough so no beats are low enough in frequency to produce meter fluctuations. The generators are highly isolated to eliminate any tendency for frequency correlation between them. The $U_{(L)}$ and $U_{(R)}$ generators are sources for the uncorrelated components of the left and right signal channels respectively. The equal amplitude of these two components is retained throughout the experiment. The HP model 205 AG signal generator was chosen for the monophonic M generator because of its ability to provide a balanced push-pull output. This facility is essential for the synthesis of S. R.'s > 1, as both phases of M are then required. The M signal is split equally between both channels with the resistors $R_{M(L)}$ and $R_{M(R)}$, which are adjusted accurately to the same value each time they are set for a new S. R. reading. Thus, a known S. R. is obtained by controlling the magnitude of the denominator of its corresponding correlation ratio U/M, the numerator remaining fixed.

The internal impedance of each phase of the M generator was measured by a method[21] which does not disturb the impedance being measured, and found to be 148 ohms. The 196-ohm shunts across the U generator outputs are to equalize their effective source impedance to this same value. The 27 db isolation from the generator proper is sufficient to avoid the error mentioned in the footnote. The accuracy of the matrixing of signal components is retained by interposing stabilized AC-VTVM amplifiers between the outputs and the matrix. The 11-megohm inputs of the two HP 400C VTVM's are substantially open circuits to the matrix, and the outputs are sufficiently low in impedance to drive the S. R. detector circuit properly. Slight voltage unbalance from the VTVM's and slight impedance unbalance from the S. R. detector was swamped out with the adjustable light shunt across the right output. It may be of interest to learn that the equipment borrowed for this setup had a market value of about $2625.

[21] The conventional method of shunting the source to half its open circuit voltage changes the source impedance drastically if an active network is part of the source, as in a signal generator, giving a positive error.

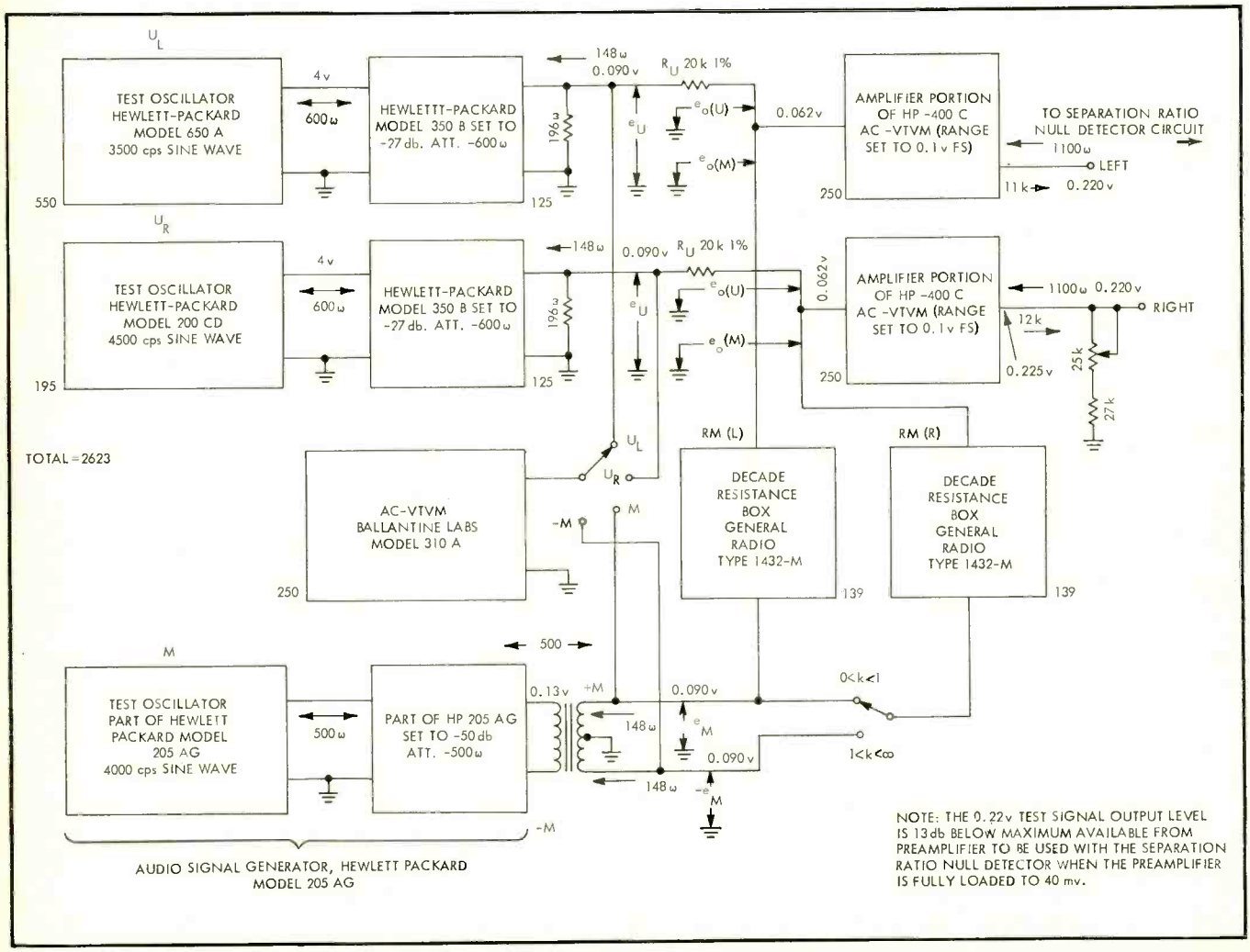


Fig. 10. Set up for dial calibration of separation ratio detector (standard stereo signal generator).

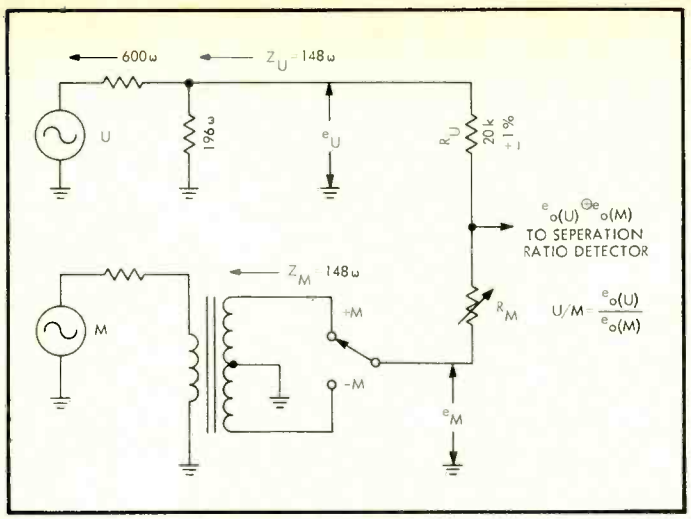


Fig. 11. Test signal generator stereo/mono signal component mixer (one channel).

Specifying the Test Signal Matrix

One more job remains in setting up the stereo test signal, namely the value of R_M required for each value of S. R. to be used. The calculation is derived from an analysis of *Fig.* 11, which shows the circuit essentials for one side. This analysis defies simple solution unless our stipulation of a balanced signal and equal source impedance is brought in:

Let e_o = output signal to be fed to one channel of S. R. det.

$e_{o(M)}$ = component of e_o contributed by M generator.

$e_{o(U)}$ = component of e_o contributed by U gen. (either U_L or U_R).

U/M = the given desired ratio $\frac{e_{o(U)}}{e_{o(M)}}$.

e_u and e_m = the uncorrelated and correlated source voltages respectively.

Find R_M to give this ratio.

$$e_{o(U)} = e_u \frac{R_M + Z_M}{R_M + Z_M + R_U}.$$

$$e_{o(M)} = e_m \left(\frac{R_U + Z_U}{R_U + Z_U + R_M} \right).$$

$$U/M = \frac{[e_u]\,[R_M + Z_M]\,[R_U + Z_U + R_M]}{[e_m]\,[R_M + Z_M + R_U]\,[R_U + Z_U]}.$$

Now, e_u ($e_{u(L)}$ or $e_{u(R)}$) and e_m are constantly monitored by the VTVM and adjusted for equality, so $e_u/e_m = 1$. The sources all have equal impedances, so $Z_{U(L)} = Z_{U(R)} = Z_M = 148$ ohms. Thus,

$$U/M = \frac{R_M + Z_M}{R_U + Z_U} = \frac{R_M + Z}{R_U + Z},$$

so,

$$R_M = U/M(R_U + Z) - Z,$$

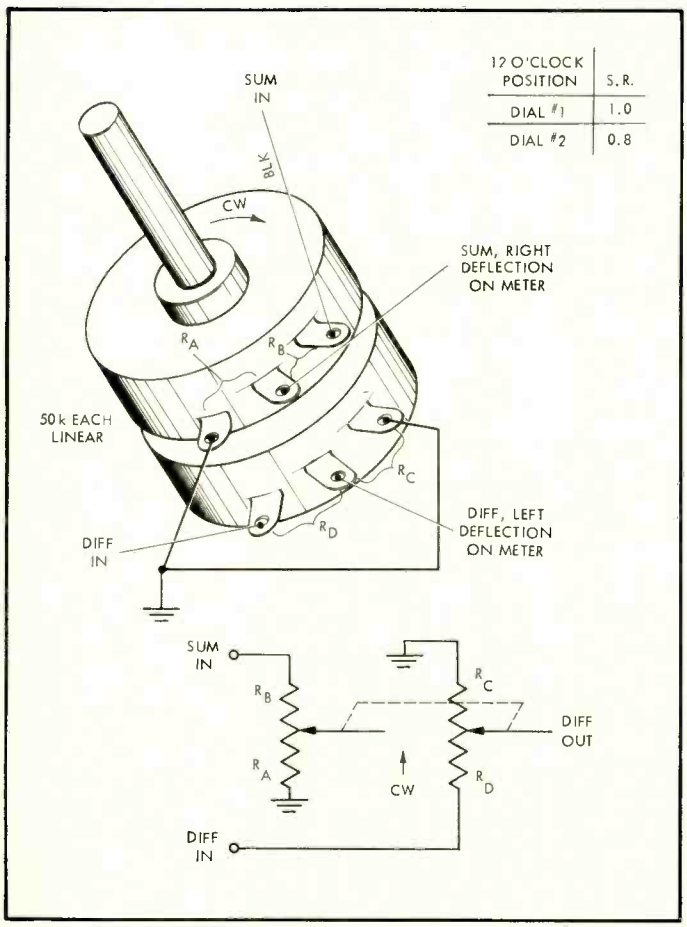
where

$$Z = 148 \text{ ohms}$$

and

$$R_U + Z = 20,148 \text{ ohms}.$$

The necessary values of R_M are tabulated in Table I for S. R. values of 0.05 to 20. After constructing and calibrating the S. R detector circuit it was found the practical range of measurement using the components specified is throughout a S. R. range between 0.1 and 10. The other two values are included for completeness.



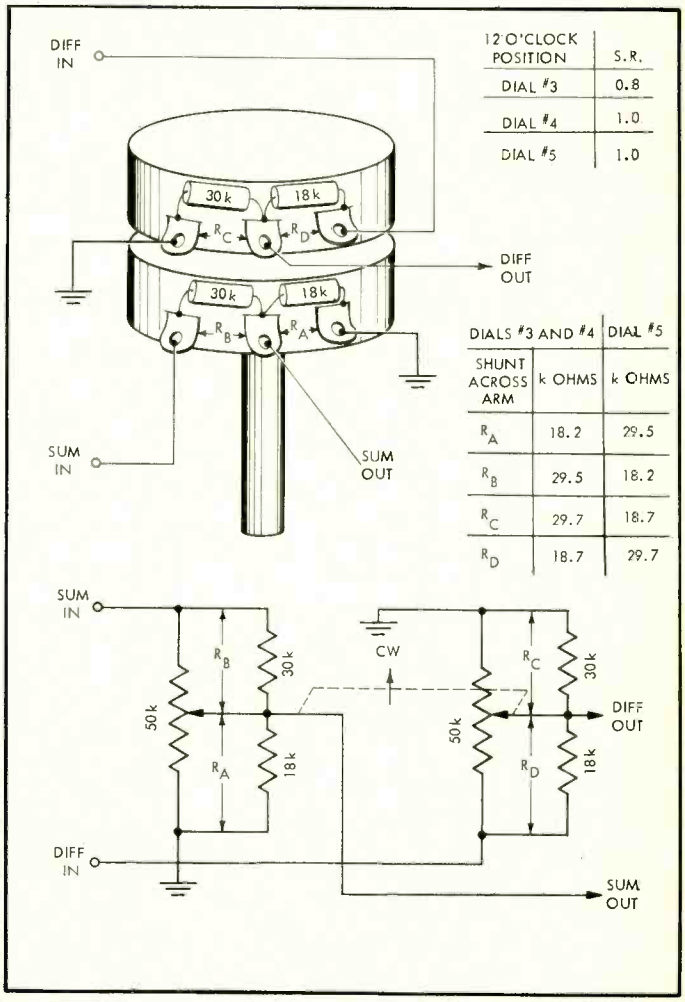


Fig. 12. (left) Calibration control for separation ratio detector. Fig. 13. (right) Calibration control for separation ratio detector dials No. 3, 4, and 5.

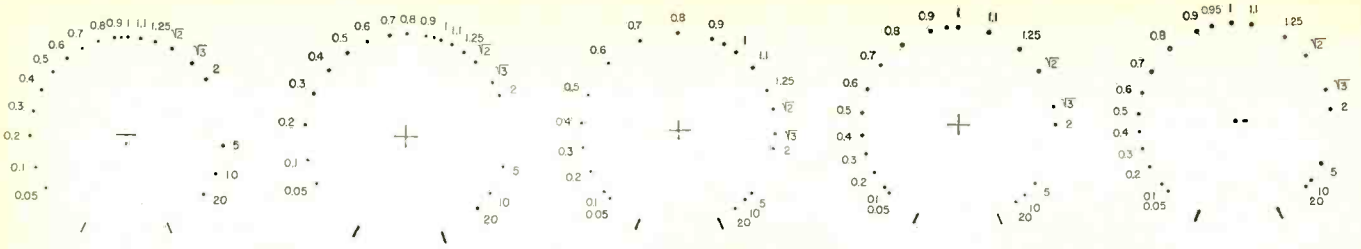


Fig. 14. Separation ratio calibration control panel scale.

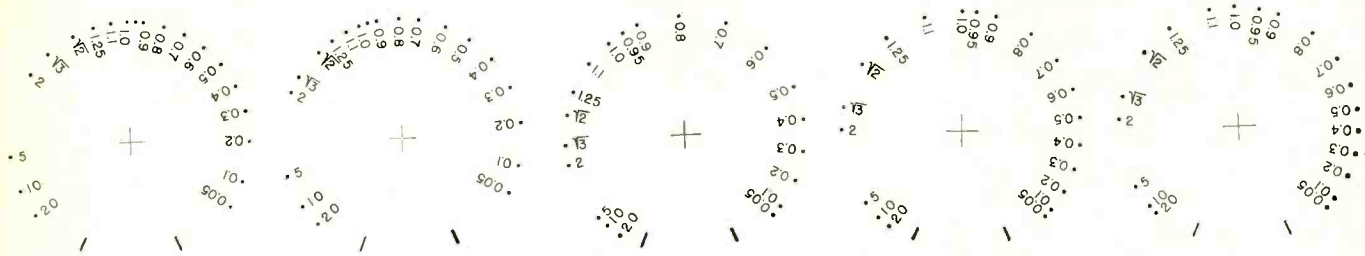


Fig. 15. Separation ratio calibration control dial scale.

Accuracy of S. R. Calibration

It is evident that a large amount of time and effort went into the calibration of this S. R. detector circuit. However, the author feels that there is enough need for this information to justify the added effort required to insure that this data is disclosed so as to have practical value to fellow stereophiles. The main stumbling block to this ambition is, of course, the fact that 99.44 per cent of the readers will consider the information useless unless the special stereo test signal generating system is eliminated for them. The author feels confident that this has been accomplished by the manner in which the data were gathered, a description of which follows.

The accuracy of the stereo test signal was certainly greater than control of the null by the S. R. Calib. Control, P_{17}, could be unless a precision ganged potentiometer were used, hardly justifiable for this type of measurement. When the actual nulls were taken into the prototype detector circuit, a 3 in. diameter knob was used to determine the angular position of each reading. This furnishes markings positioned more precisely than can be read using the smaller knob used on a practical control unit panel. After each null was obtained, and the dial position marked, the calibration control was temporarily removed and the divider arm resistance ratios were measured with a digital ohmmeter to an accuracy of about 0.1 per cent. The divider arms are identified in *Fig.* 9, 12 and 13 as R_A and R_B on the sum pot and R_C, R_D on the difference pot. Another slight source of error was eliminated by reporting the total pot resistances for each reading as $R_A + R_B$ for the sum pot and $R_C + R_D$ for the difference pot. A variation of about 2 per cent was noted due to the shunting effect of the finite width of the slider contacts in the pots. The calibration was accomplished using an Allen-Bradley type JJU dual-ganged potentiometer (linear taper) giving very stable and easily controlled resistance ratios for a component of the size practical for preamp use. When the circuit is duplicated using another brand of control, there will be a lack of confidence in the accuracy expected due to differences in taper and tracking. The reader will be shown a method for avoiding this error without resorting to the special signal generator.

Separation Ratio Detector Calibration Scales

Five complete calibration runs were made using the dual 50 kilohm pot for P_{17}, with variations of the method employed to produce a variety of scale characteristics. The five scales are shown in *Fig.* 14 and 15. Any scale shown in *Fig.* 14 may be duplicated and used on a preamp panel. The mirror-image scales in *Fig.* 15 are provided for reproduction on a round dial for attachment to the P_{17} control knob.

Scale No. 1 is marked with the basic scale obtained with the Allen-Bradley *U* (linear) taper, and with S.R. = 1.0 located at the 12 o'clock position. This dial is recommended for those who wish to construct the circuit but have access to no test instruments of any kind. They can feel assured of satisfactory accuracy in the most used range between S. R. = 0.5 and 2 without any calibration other than the following set-up adjustment.

Mount P_{17} on the panel so that its rotational center corresponds to the S. R. = 1.0 mark, feed a test record tone or equivalent to either or both preamp inputs, and adjust to average operating level (13 ± 3 db from preamp maximum undistorted output). Set the meter selector switches for dynamic balancing (S_{10} to "MB" or monophonic balance, and S_{11} to "DBA" or dynamic balance adjust), which insures identical signals in each metering channel. With P_{17} set to the 1.0 mark, adjust P_{18} (Dynamic

Table II. Separation ratio nulling circuit used as output meter circuit.

SEPARATION RATIO	VOLTS RMS AT T4L OR T4R PRIMARY	CONDITIONS
0	0.29	S10: OUTPUT METER NORMAL, "OM1"
(IN-PHASE MONO)	0.29	S11: BOTH CHANNELS
0.05	0.285	SENSITIVITY READINGS
0.1	0.28	CORRESPOND TO METER
0.2	0.28	CURRENT = 160 μA
0.3	0.28	METER READS FORWARD
0.4	0.28	FROM LEFT SCALE ZERO
0.5	0.29	
0.6	0.30	
0.7	0.33	
0.8	0.36	
0.9	0.365	
0.95	0.37	
1.0	0.27	
1.0	0.27	
1.1	0.255	
1.25	0.24	
$\sqrt{2}$	0.215	S10: OUTPUT METER REVERSE, "OM2"
$\sqrt{3}$	0.21	S11: BOTH CHANNELS
2.0	0.21	METER READS BACKWARD
5.0	0.21	FROM RIGHT SCALE ZERO
10.0		
∞		
(OUT-PHASE MONO)	0.21	

Transresistance Method for Approximating Linear Transistor Circuit Operation

R. R. MOORE

A simple method for determining the a.c. condition of a transistor amplifier without the complexities of "h" parameters

A NUMBER OF ISSUES BACK (April 1964), Frank Brands showed us a good set of rules-of-thumbs (thumbs because I often seem to have ten of them) to use to determine the d.c. operating point of a linear transistor amplifier. It occurred to me that many AUDIO readers would like to go a little further, and have some simple methods for determining the a.c. condition of the amplifier, as well. Mr. Cooper and Mr. Aschinger, to name but two AUDIO contributors, have demonstrated that the use of "h" parameters gives insight into a.c. operation, but have also demonstrated that the calculations are rather involved, especially when one wishes only a casual analysis of circuit operation.

A little over a year ago, several friends of mine introduced to me the idea of transresistance, and I've been using it like it was going out of style ever since.

The idea of transresistance is neat, because it allows quick and easy computation of various circuit parameters through the use of just two knowns: the d.c. collector current at zero signal, and the d.c. *beta* of the transistor at this current. Since the base-emitter junction is a forward-biased diode, let's use this idea on a diode to see how it works.

The Diode

Figure 1 shows, that from the d.c. standpoint, a diode is simply a pair of resistors; one fixed, and one variable. The fixed resistor consists of various ohmic resistances of the device: lead resistance, lead-to-pellet contact, and so on. For most decent signal diodes, this bulk resistance is on the order of three or four ohms. The variable resistor's magnitude is dependent upon the current through the junction, and is

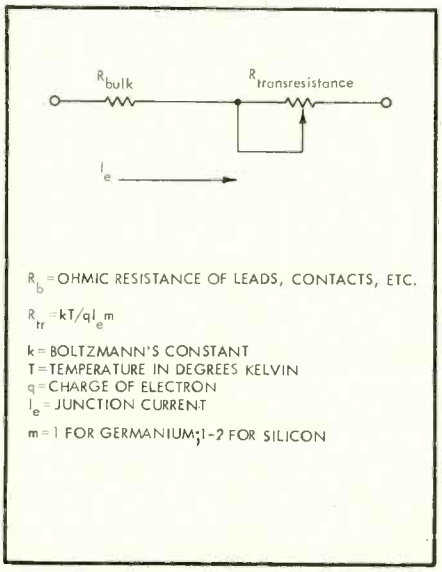


Fig. 1. Forward-biased diode equivalent circuit.

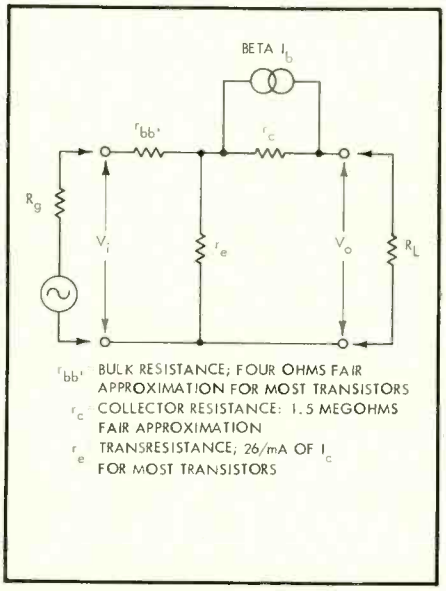


Fig. 2. T-equivalent circuit for transistor in common-emitter configuration.

calculated from the equation: kT/qI_em, where k is Boltzmann's constant; T is the junction temperature in degrees Kelvin; q is the charge of an electron, and m is a constant whose value is one for germanium, and between one and two for silicon. Calculation of this equation shows that at room temperature, this resistance has a magnitude of 26 millivolts divided by the junction current, I_e, in amperes; or 26 ohms/mA, since $R=E/I$. Now, to calculate the resistance of the diode, add the two resistors. As you can see, at 10 mA the variable resistor looks like 2.6 ohms, and the bulk resistance three ohms or so; the total resistance is about six ohms. Now let's plug this diode into a transistor, and see what happens.

The Transistor

Figure 2 shows the T-equivalent of a transistor in the common-emitter configuration. We make our diode the base-emitter diode, and add the other elements. The two resistors of our diode become $r_{bb'}$ and r_e, and the back-biased collector-base diode, r_c. And since a transistor has current gain, we need a current generator *beta* (i_b). Now, since we've gone to the trouble to find out what the *G. E. Handbook* has told us before, let's use our transresistance idea to see how *Fig.* 2 works in a circuit. Oh, before I start, I need an approximation. Let's say that collector current and emitter current are the same. Since almost no one uses low-*beta* transistors in linear amplifiers, I think that this approximation is valid.

Now, the three things that one normally cares about in linear circuits, at least initially, are voltage gain, input impedance, and output impedance.

Voltage Gain

Voltage gain is defined as output voltage, V_o, divided by input voltage, V_i. Looking at *Fig.* 2, we see that V_o is developed across R_L, *and* V_i across $r_{bb'}$ in series with r_e. V_i develops a current in $r_{bb'} + r_e$, and since we've agreed to neglect base current, the same current is developed in R_L. This makes a voltage divider, and you can see that the output voltage, V_o across R_L is proportional to the input voltage V_i, as R_L is proportional to $r_{bb'} + r_e$. Therefore, the voltage gain $A_v = R_L/r_{bb'} + r_e$. Remembering our diode, we know that r_e is equal to 26 divided by I_e, where I_e is in milliamperes. The value of

(Continued on page 38)

Educated Audio System

GERALD STRANG

Audiofans interested in music, audio, and education in these areas will be delighted to learn of the excellent audio facilities at San Fernando Valley State College in California.

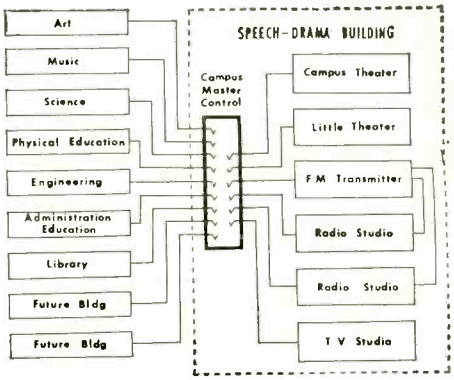


Fig. 1. Campus audio system, San Fernando Valley State College.

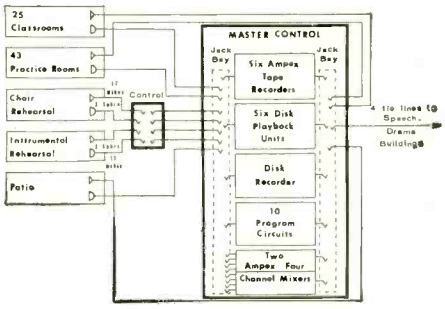


Fig. 2. Music building audio system.

SAN FERNANDO VALLEY STATE COLEGE was founded in 1958, as a member of the expanding system of California State Colleges. In the ensuing years it has grown to a student enrollment of over 12,000.

Among the first structures built were Art, Music, and Speech-Drama Buildings, intended to meet campus needs when the enrollment reaches 20,000. (The music building, for example, was planned to serve the equivalent of 750 full-time music students.)

A campus-wide audio system was established, with provisions for later installation of closed-circuit TV. The central switching and control center in the Speech-Drama Building coordinates program and order lines connecting all buildings. Each building has a local distribution center appropriate to its function (*Fig.* 1.)

The Speech-Drama Building contains three theaters (one of which employs extensive recording and playback equipment), two radio studios, and a TV studio. The radio studios supply live and recorded programs for the campus FM station, KEDC, 88.5 mc. The station is operated by students under the direction of Dr. Bertram Barer, of the Department of Communication. A major in Broadcasting is offered.

Master Control

The Music Building contains an integrated sound distribution and recording system (*Fig.* 2). A comprehensive network of low-impedance microphone lines and 70-volt playback lines culminates in a Master Control Center, which is a large room (26′ x 60′) with plenty of room for expansion and additional equipment. It is located adjoining the departmental record library.

Jack fields in Master Control give access to microphone and program lines connecting all 25 classrooms and about two-thirds of the 68 practice rooms (*Fig.* 3). A selective ringing, common talk intercom phone system, divided into three networks, joins the entire system. There is also a connection to the campus audio center in the Speech-Drama Building. A three level gutter system assures a minimum of crosstalk and noise accretion, and facilitates rewiring.

Master Control contains five two-channel (Ampex 351-2) tape recorders and six disc playback units which can be used as program sources, and two AM-FM tuners (*Fig.* 3). Ten program circuits (preamplifier, booster, and power amplifier, normalled through input and output jacks) can be fed on 70-volt lines to any combination of classrooms and practice rooms, and to the central patio of the building. A five-step line transformer controls the level at the destination.

Additional facilities include a Neumann disc recorder, equalizers, a limiting amplifier, two four-input two-channel stereo mixers, level setting and test equipment. All equipment inputs and outputs appear on jacks. All program sources are supplied with cuing speakers and headphone jacks.

For research and experimentation in electronic music, a remote control patching system makes it possible to control any combination of the tape recorders from a single remote unit. As many as five may be started or stopped simultaneously. A three-channel tape recorder (Ampex 300-3CSS, with Selsync) is available for sound-on-sound recording, and the superimposition of separately recorded elements required in synthesizing electronic music.

Remote recording is, of course, possible from any point in the system, using the recorders in Master Control. In practice, however, most of the actual recording is done either in concert, or in one of the two large rehearsal studios which are equipped with an

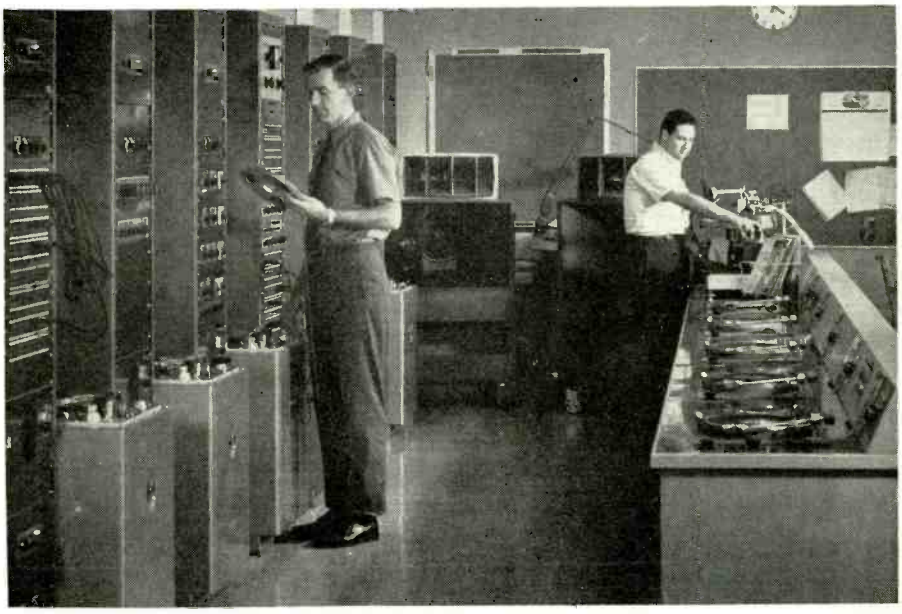


Fig. 3. Music building master control.

Fig. 4. Music building control room number 2, looking into instrumental rehearsal room.

Fig. 5. Music building control room number one. John Bartley technician in charge.

independent recording and playback system.

Listening Facilities

Each classroom has a built-in speaker (Altec A7, 500 cps crossover) which can be fed directly from Master Control, or switched to a local program source. Playback carts containing a record player, a tape player, and power amplifier, may be plugged into a wall receptacle, giving them access to the built-in speaker. An input jack at the back of each room also permits connecting the sound output of a motion picture projector. Existing conduit and blank junction boxes are provided for anticipated closed circuit TV. Additional speaker outlets are provided for stereo reproduction, but the quality of the present sound is such that there is little or no demand for stereo.

Since it is utterly impractical to offer individual listening facilities for student use (about 450 non-music majors are enrolled in fifteen sections of Music Appreciation, without considering the needs of music majors!) extensive group listening is made possible, originating in Master Control and remotely distributed to classrooms or practice rooms. Instructors frequently prepare special tapes for student listening, or place discs from the instructional record library on reserve in Master Control. Over twenty hours a week of such service, employing up to six channels, is now available.

As the listening program grows, additional self-contained program sources will be added, probably of the cartridge variety (if adequate quality can be maintained).

Acoustical Design

Acoustical design was a primary concern of the architects, Allison and Rible, who employed Donald P. Loye and the writer as consultants. Maximum sound isolation within the limits determined by State financing was sought. The isolation varies with the function. Between practice rooms it is 45-50 db. In the vicinity of classrooms, it is about 65 db. And between the main rehearsal and recording studios it is better than 85 db. The isolation in general seems adequate, though a higher isolation level would be desirable for certain classrooms dealing with theory, ear-training, and composition, and in some of the practice rooms which might be used by students in these areas. Effectively complete isolation exists between the two main rehearsal halls, though they are located back-to-back.

Internal reverberation varies with the size and use of the rooms, but has been kept somewhat higher than normal studio practice because musicians work best in an acoustically warm and responsive environment. Every effort has been made to damp out resonances and peaks through the use of non-parallel surfaces and polycylindrical diffusers.

Anticipating the growth of recording activities in the future, five of the larger classrooms are provided with small control rooms and the necessary conduit. They can be converted, as needed, to small self-contained recording systems; or mixing and monitoring can take place in these booths while recording remotely in Master Control.

Rehearsal-Recording Studios

The two main rehearsal halls, each enclosing about 50,000 cu. ft., comprise a self-contained recording complex. The instrumental room (*Fig.* 4) has a flat floor and movable risers. The choral room has built-in upholstered theater seats on risers, separate risers for placing a choir in standing position, and a small platform area. It doubles as a recital and lecture hall seating 200. Each has a heavy acoustical curtain which can cover one entire wall if a shorter reverberation time is desired.

At second floor level, between the large halls, are two connected recording control rooms of sufficient size, and with adequate visibility, to act as TV control centers when necessary. Each control room is equipped with an Altec 250B console, supplying six preamplifiers and four line inputs. Twelve microphone lines for each studio appear on jacks, of which ten are normalled to the console

(*Continued on page 29*)

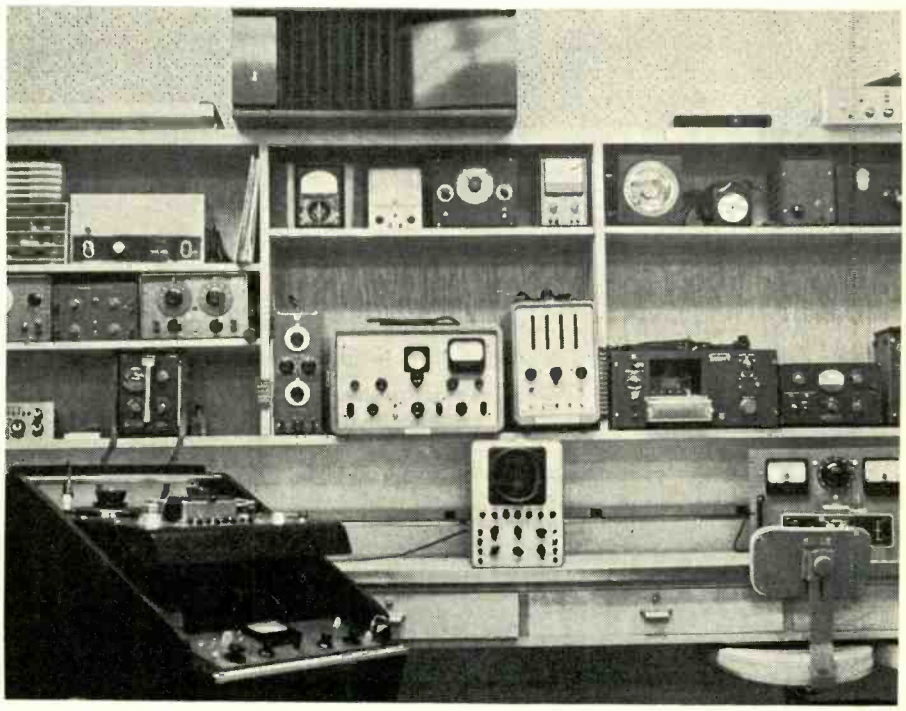


Fig. 6. Part of acoustical laboratory.

VARIETY

Haydn: Sonatas for Flute and Piano, Op. 87, Op. 90. Jean-Pierre Rampal, Robert Veyron-Lacroix.
Nonesuch H-71045 stereo

These two superb works are transcriptions for flute and piano of two well known late-Haydn string quartets, Op. 74, No. 1 and Op. 77 No. 1, out of the 1790s, the last period in Haydn's work. If you ask me, I like the flute versions even better than the original quartet music—though this is a matter of choice and circumstance. The transcriptions are beautifully made; the music could as well be original flute-piano music.

Haydn did not make them, though he may well have authorized the job. There was then still a big "market" for such useful transcriptions as this and plenty of highly competent musicians to do the job. The second of these is by the then Cantor of Bach's church in Leipsig. He may also have done the first one.

Absolutely superb flute performance by Rampal, backed by excellent piano from his habitual partner Robert Veyron-Lacroix. Together, they make this a memorable disc.

Sing Joyfully. A Recital of Anthems from Tallis to Britten. Choir of St. Michael's College, Tenbury (England), Lucian Nethsingha.
Argo ZRG 5423 stereo

Westminster is handling a splendid collection of extremely British recordings from this company, worth any Anglophile's acute investigation.

This is a refreshingly different, if typically British choir. Different because the earnest, hooting little-boy choir singers are balanced—for once—by grown-ups with similar voices, minus professional vibrato. (The "big" British choirs, of the famous cathedrals and chapels, tend these days to use a very wobbly species of solo tenor and high countertenor along with the little boys' massed voices.)

The choir isn't as polished as the fancier British outfits, but its music is just as earnest, just as heartfelt in diction and just as persuasive in expression. I played the first side—excellent. The second side takes you through the nether regions of British anthem music, on to the late Sir C. Hubert H. Parry (what a name!) and Charles Villiers Standord, whose music I can skip. The end comes out into musical sunlight again with Vaughan Williams and Benjamin Britten.

Maggie Teyte, Vol. II. (Berlioz, Chausson, Ravel, Duparc).
Angel COLH 138 mono

This great exponent of the French tradition in singing was, oddly enough, an English girl, originally named Tate. Like Walter Gieseking (and our own George Copeland, pianist), she got the French bug early—and outdid the French themselves; Claude Debussy praised her singing of his music. Listening here, you'd never know she was British. (She also sang superb Mozart, etc., but the French in her has won out.)

These are late recordings, the second side made after the war, in her sixties. On Side 1, early wartime, she is more youthful and full voiced. Lovely music of Berlioz, Chausson, with orchestral accompaniment. Oddly, the older recordings are clearer too, thanks to the then-prevalent close-up miking of the solo voice. The later jobs are more distant but not really "sharper" in sound; she is somewhat lost in the murk.

Bartok: The Six String Quartets. Juilliard String Quartet.
Columbia D3S 717 (3) stereo

Some like it fat, some lean; one man's meat . . . You'll find two extremes in this music. The first two quartets and to some extent the third are of a post-Romantic persuasion that sends many a listener into ecstasy. Whereas the quartets beginning with No. 4 are typically late Bartok, violent, dissonant, highly original and full of the most extraordinary rhythms and tricks — like the fire-siren slides up and down in No. 4. As for me—I can't take the early quartets at all, but I'm crazy about the later ones.

The Juilliard Quartet shows itself too cool, too academic-minded, for this music. They play with a top professional skill, but they keep their shirts on. To play this Bartok you must, to be sure, have superlative skill; but there must be a passionate conviction, too, born of an inner sympathy and understanding. I don't hear it here. They go through the right motions, ever so expertly, but it ain't Bartok. Even the Fine Arts Quartet, a suave group if there ever was one, does better (in No. 4).

This criticism is, of course, purely relative and on a very high plane. Those who play Bartok at all must operate in the musical stratosphere.

BAROQUE INTERNATIONAL

Music of the Italian Baroque. (Albinoni, Vivaldi, Califano, Bononcini, Sammartini, Frescobaldi). Baroque Trio of Montreal.
Vox SVCX 565 (3) stereo

Baroque music is coming out of my ears these days—incredible how much of it is being dug up, edited, performed, recorded —and bought! In its energetic way, Vox has collected six whole sides of Italian music here, five of them for various melodious and colorful small combos (they record exceptionally well, these works), with harpsichord, flute, oboe and recorder. The remaining side features earlier music by the somewhat neglected Frescobaldi, upon a home-constructed brand new "portative" organ of authentic Baroque styling.

Can't take too much of this at a time (why should you?) and I didn't go all the way through. But I can say that you'll find Albinoni first rate and easy, Califano and Bononcini not so exciting, Sammartini (an Italian who worked in England, brother of the better-known Giovanni Sammartini) rather glib and just faintly Handelian. As for the older Frescobaldi, he shaped up the fugal instrumental style which we so enjoy in Bach and this music shows how. It's a nice, ploppy organ with plenty of *chiff* and in some of the music it is joined by flute and obe for a very Baroque sound, considering the early date.

Geminani: Twelve Concerti Grossi, Op. 2, Op. 4. Gli Accademici di Milano, Dean Eckertsen.
Dover HCR 5230/31/32 mono

Three big records (available separately) with four concerti on each, two to a side. A healthy slice of this Italian Baroque composer, another one who settled in England during the Handelian period. His English-made music, however, might as well have been composed at home; it is pure Italian, a bit softer and more decorative than the strong music of Handel, less intense by far than that by Bach or even Telemann. A first-rate second-rank composer, this man, which puts him a long way above many of the minor Baroque writers now being recorded.

I'd suggest one of these discs at a time; the music is lively enough, but like most of its type, reasonably, it doesn't lend itself to continuous-play background listening. Play maybe two concertos, then quit for awhile. Give the guy a chance.

The Milan performances under the American Eckertsen are rather old-fashioned in sound, somewhat massive and heavy, the fast movements chopped out, rather objectionably. Funny how some people are always right up to the minute in style, while others remain blissfully oblivious! A kind of modern-day isolation, easy enough if you ignore records and radio.

Bach: Concerto in D Minor for Two Violins; Sonata in C for Two Violins. Vivaldi, Concerto Grosso OP. 3, No. 8. Nathan Milstein, Erica Morini; anon. (U.S.) orch.

Angel S 36006 stereo

This is one of those heady collaborations of two virtuoso artists and it's not a happy one for the Baroque music.

Milstein's own previous Vivaldi recordings have been absolutely superb on Angel, not only highly musical but well informed and impeccably styled. Morini's elsewhere, have shown little awareness of current thinking. In combination, the un-awareness seems to have won hands down. Much of the playing is out of style (including the orchestra's contributions) and the two-violin Bach sonata uses a piano—unthinkable these days! I thought I heard a harpsichord in the orchestral numbers but none is mentioned.)

These two *are* fine violinists, both of them, and so this is far from an inept recording. If you don't mind a bit of zany styling, you'll enjoy two strong violin personalities.

Telemann: Sonatas, Trio Sonata, Concerto, for Flute and Harpsichord. Jean-Pierre Rampal, Robert Veyron-Lacroix.

Nonesuch H-71038 stereo

Here's that French team again in a brace of superbly listenable German works played via flute and harpsichord (though some are optionally playable in other ways). Two sonatas for flute and continuo, one trio sonata (two parts played on the keyboard) and even a "concerto", which sounds like one even in this form. (Nobody in those days thought of a form as a literal thing—a concerto was a piece that sounded and acted like a concerto for the ears.)

Telemann is more and more an ideal composer for the new Baroque taste today. He combines the general sound of a Bach with a great deal more suavity and polish (if less profundity), à la Handel, to make listening easy. But he is never weak, always positive and invariably enormously expert. Good man.

Eighteenth Century (French) Flute Sonatas. (de la Barre, Blavet, Anne-Danican Philidor, Couperin) Jean-Pierre Rampal, Robert Veyron-Lacroix.

Dover HCR ST 7001 stereo

French Baroque is now pouring out of the libraries in France and flooding over here in quantity. I found the first side of this collection rather dull but enjoyed Side 2, Philidor and Couperin.

The gent with the odd name of Anne (*not* a female) was one of a big musical family, like the Couperins. He is lively, a bit gauche but fresh and original in his expression. The great Couperin is represented by one of his less well known "Royal Concerts", a multi-movement sonata playable to taste with various instrumental combinations. It works out well for flute and harpsichord. Subtitled "the styles united", this music was intended as the answer to the war between "French" and "Italian" styles of the period. As we hear it, the Italian wins out, which merely means that the music sounds to us more like other and familiar Baroque than do the highly French little harpsichord pieces of Couperin which are so much better known. Æ

AUDIO SYSTEM

(*from page 27*)

keys. The two channel consoles have been modified to provide an additional A+B output.

Two tape recorders (Ampex 251-1 and 251-2) are rack mounted in the choral control room. Both are accessible to each console on remote control (*Fig.* 5). Three power amplifiers and a program equalizer are available on jacks, and two moveable Altec A-7 speakers are provided for each studio. (Four additional A-7's on casters are kept in Master Control for special programming.)

These studios have proved acoustically ideal. Not only are they in constant use for the regular music program. They have also been rented by commercial recording companies (Capitol, Warner Bros.), and have been used to record sound track for award winning films prepared by the College Anthropology Department, under its chairman, Dr. Edmund Carpenter.

Experimental Music Facilities

The Acoustical Laboratory not only offers resources for classes in acoustics of music, but also doubles as a sound generating center for experimental work in electronic music.

In addition to the usual acoustical demonstration equipment, the lab provides several sine and square wave generators, a white noise generator, octave-band and continuously adjustable hi-lo pass filters, a counter, electronic switch, oscilloscope, graphic recorder, and so on. With an Ampex 351-1 tape recorder and appropriate amplifiers and monitoring equipment, the basics of an electronic music studio are available (*Fig.* 6).

Work in progress includes a variable speed recorder, mixing and echo provisions and some automatic switching and pulsing gear.

Composers Ernst Krenek, Aurelio de la Vega, and Beverly Grigsby have already constructed widely played tapes using the equipment available. Plans call for offering graduate work in the area of electronic music in September, 1965.

Curricular Repercussions

The Music Department's curriculum is essentially that of any large College or University. The existence of fine facilities makes high standards of performance readily achievable. Easy and frequent recording enables students and faculty to study performances thoroughly and to correct weaknesses quickly.

Experimentation with improved methods of teaching based on current technology is going on at an ever accelerating rate. Students are also given a chance to become familiar with the equipment and its operation. Since a majority of the students are taking teacher training, they will eventually help to modernize music teaching in the field.

It is recognized that no audio system is better than its maintenance. A full-time technician is therefore assigned to supervise its operation and maintenance. It is his job to see that the system always meets or exceeds the design objective—that every unit, and every operative system, equal or exceed the FCC standards for FM broadcasting. Æ

About the Author

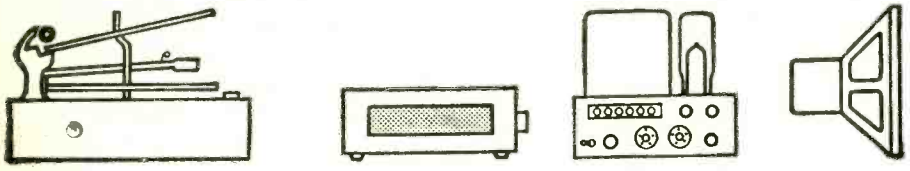
Gerald Strang is Professor of Music at San Fernando Valley State College, Northridge, California. He was educated at Stanford University, University of California, and the University of Southern California (which awarded him the Ph. D. in Musical Composition).

Dr. Strang studied under Ernst Toch and Arnold Schoenberg. He has written many works, mainly of an advanced or experimental nature. He spent the summer of 1963 at Bell Telephone Laboratories, working on computer composition, a field to which he is devoting his current sabbatical leave.

He pioneered in the acoustical design of College music plants, beginning in 1948 with the design of the Long Beach City College music building, which already incorporated a building-wide audio system.

Since then he has contributed as an acoustical consultant to many West Coast buildings, including those for several of the California State Colleges.

EQUIPMENT PROFILE



KENWOOD MODEL KW-550 AUTOMATIC FM-STEREO TUNER

One of the normally present attributes of the old-school audiofan is the desire to have components which not only perform satisfactorily, but which also *look* impressive—a characteristic that seems to be retrogressive in this day of solid-state tuners and amplifiers which are shrinking in size so rapidly that one should soon be able to carry his entire hi-fi system around with him like teen-agers do their inevitable transistor radios—except that he would be dragging a long extension cord behind him.

Not so with the new Kenwood KW-550 tuner. It looks impressive, it is large enough to provide an imposing panel to grace your equipment cabinet, and its performance should satisfy most users.

Circuitry

The antenna input is unbalanced, and is provided with a local-distance switch which introduces a loss of some 22 db when in the local position, thus reducing the possibility of strong input signals introducing cross-modulation effects in the presence of high field strengths. To reduce this effect still more, feedback is applied around the first section of the cascode input amplifier, and a still-further deterrent is the application of a.g.c. voltage to this same first section, a 6CW4 Nuvistor This tube, in conjunction with one half of a 6AQ8 forms the cascode r.f. amplifier section, with its output being fed to the second half of the 6AQ8 as the mixer with a tuned circuit between the sections. Another 6AQ8 serves as local oscillator and a.f.c. stage, the latter fed from the ratio detector but provided with a disabling switch.

A total of five stages make up the i.f. amplifier—two 6BA6's, two 6AU6's as limiters, and a 6BL8, with its pentode section an additional limiter and muting stage. The triode section of this tube controls the muting and a panel-mounted variable control sets the threshold. Two diodes comprise the ratio detector, and their output is then fed to the grid of a 6AU6, whose plate circuit serves to extract the 19-kc pilot, while the audio signal is available from its cathode. This signal is then split to two channels—one with SCA filtering to a band-pass filter for the subcarrier, and the other through a low-pass filter to the dimension control, an under-chassis potentiometer which adjusts the amount of L + R signal that is mixed with the detected sub-carrier to set the amount of separation to its optimum value.

Sub-carrier detection is achieved by a balanced diode bridge energized by the 38-kc oscillator, which is the triode section of a 6BL8, which is synchronized by the 19-kc amplifier employing the pentode section of the same tube.

The first section of another 6AQ8 further amplifies the 19-kc pilot signal and feeds it to a filter combined with two more diodes to provide a d.c. potential which is applied to the grid of the second section of the tube so as to actuate a relay in its plate circuit. The relay has three sets of double-throw contacts—one set switches the indicator lights, and the other two switch the output amplifier sections to the appropriate stereo signal channel or together to the mono bus. One feature which is apparently unique to the Kenwood is the stereo-monitor switch—in the off position, stereo reproduction is normal on a stereo station, but when the switch is operated, the L + R signal is eliminated, leaving only the L − R signal. Since there is no L − R signal in a mono transmission, operation of this switch will give an immediate indication of the presence of a stereo signal—if the program is mono, the sound will cut out all together.

The output amplifier of each channel comprises one half of a 12AX7 as an anode follower driving the volume control, which in turn feeds one half of a 12AU7 as a cathode follower. Parallel outputs are provided to feed an amplifier and a tape recorder simultaneously.

In addition, a separate output jack provides a mono signal at all times, regardless of whether the station is broadcasting in stereo—a useful feature to feed another amplifier for driving a remote speaker, or for center-speaker fill.

Operation

Listening tests show the set to have a minimum of hum and noise, bearing out the specifications of –60 db satisfactorily. In A-B listening with other tuners, the KW-550 appeared to be a little brighter in response, and stereo separation excellent. In fact, the over-all operation gives the impression of smoothness and sharp tuning with adequate rejection of interference from alternate channels. Switching between mono and stereo was precise and effective, and since the switching was performed by a relay, there was never any hesitancy about the changeover—it was either one or the other, and with no fringing.

With the stereo/auto/mono switch in the stereo position, of course, there was no switching, but the attendant advantage of remaining in the stereo mode avoids the annoyance of continually being switched in and out of stereo on fading signals, as is the case in fringe areas with some tuners.

We were especially pleased with the fact that the instruction book for the KW-550 included a schematic—in our opinion most important, since many component buyers are their own service men and need the schematic, and furthermore even if an outside service man is called in, he is not too likely to have ready access to a schematic if service should become necessary. Fortunately, the history of component equipment is comparatively free from instances of failure, but inevitably there are times when one of the several hundred bits and pieces which go into a device as complex as a tuner

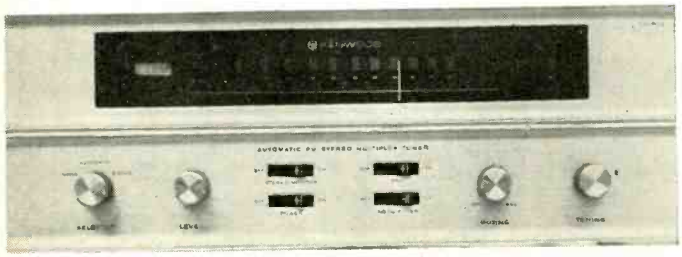
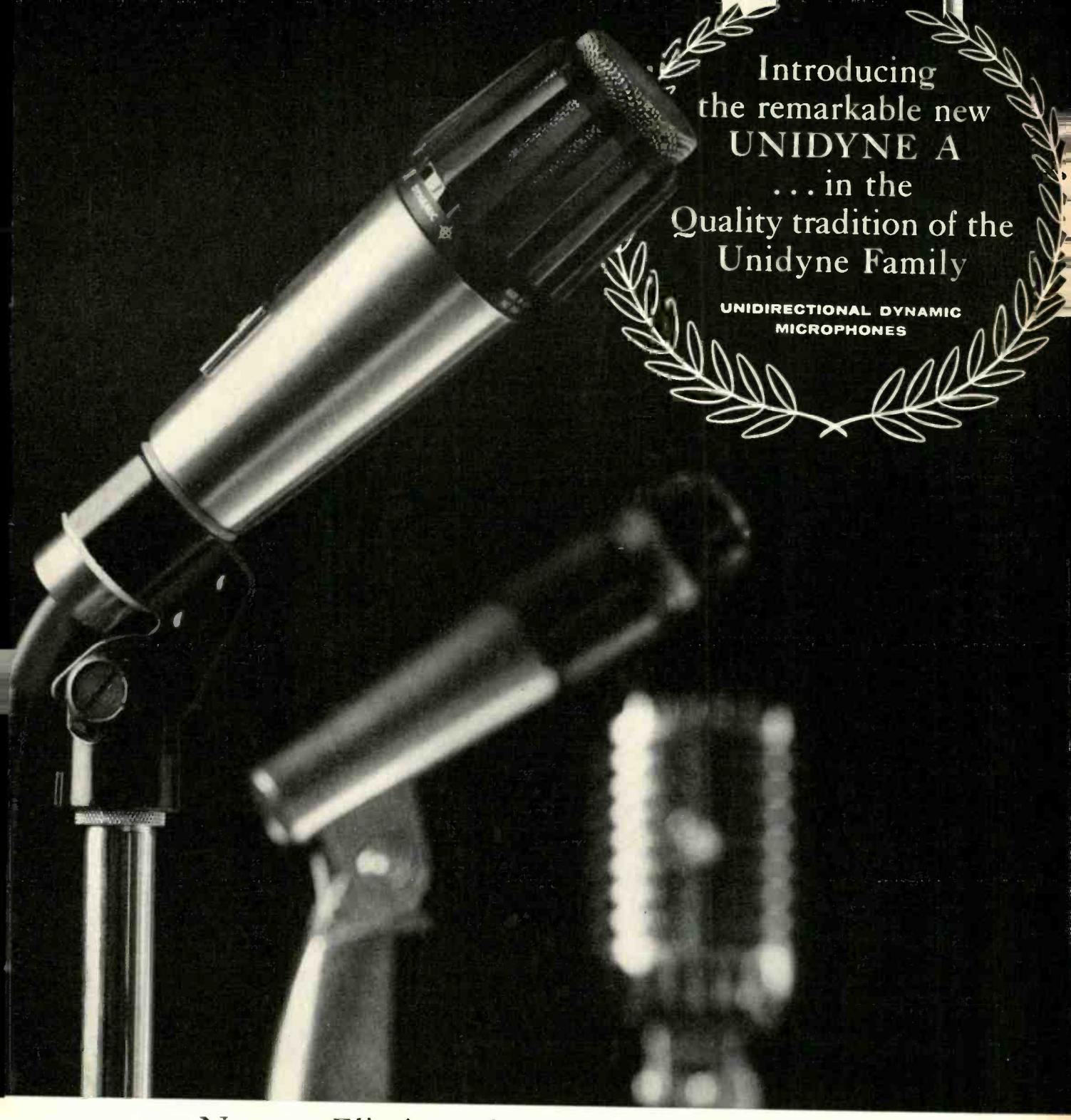


Fig. 1. Kenwood Model KW - 550 FM-Stereo Tuner.



Now . . . Eliminate feed-back problems in
low budget sound systems with the new

SHURE UNIDYNE/A

UNIDIRECTIONAL PROBLEM-SOLVING ABILITY AT AN OMNIDIRECTIONAL PRICE

only **$52.00** list

Low impedance model 580SB

High impedance model 580SA only $59.00

Write for complete specifications and technical data:

Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois

Circle 131 on Reader Service Card

does give up the ghost. Then a schematic is most essential.

Also commendable are the diagrams for interconnecting the KW-550 with other components to complete a home system. These should enable the novice with minimal knowledge of the art to put together a finely workable system which can give him the untold hours of pleasure he has a right to expect.

Circle No. 220

OKI 333 STEREO TAPE RECORDER

It is intriguing to see the new tape recorders being issued by manufacturers. Two trends are evident. One is transistors. More and more units are all solid state. The second is price-versus-quality. Price is on a good downslide, while performance characteristics go up.

This latest unit from the Japanese firm Oki is an outstanding example of the preceding; it offers a measure of musical sound that is well ahead of its modest price of $300.

The Oki 333 is a four-track stereo record and play unit, complete unto itself. It contains built-in amplifiers and outrigger speakers. The entire unit packed-to-go looks very much like a super-sandwich. Two speaker slices fit on front and back of the transport mechanism. They are mounted on slip-hinges for easy removeability. Each speaker carries its own plug-in cord so that it may be set at some distance from the transport.

Five mechanical slide switches control all transport functions. Above the head covers is to be found the speed selector. Two speeds are provided; 7½ and 3¾ ips.

Two switches are on each side of the covers. To the left is REWIND and PAUSE. Swinging over to the right, we find RUN and FAST FORWARD. These are so interlocked that it is not possible to activate two simultaneously.

Just below these controls is a strip that contains three pilot lights. Two, towards the left are record indicators. The one to the right, accompanied by the power on/off button, is the power pilot.

The lowest panel is the electronics. The 333 provides completely separate control, both record and play, for the two channels. There are two volume controls. And, there are two record buttons. Finally, there are a pair of playback buttons. One additional solitary button sets the preamp equalization for the chosen speed. One knob is a tone control; only for playback and only in the amplifier speaker output circuits.

The final attributes of the front panel are a pair of vu-type indicators. They are calibrated in decibels. Upon examination, we were delighted to find that this calibration was accurate. 10 db down from maximum recording level was 10 db down. Further, the meters, while it must be admitted that they *look* like the usual inexpensive kind put on home recorders, are very close to professional in quality. They are reasonably non-frequency-discriminatory, at least over the range of operation required by the recorder. And, they are well damped so they do offer a good *average* level.

Listening and Electronic Checks

We have noted previously that the Oki 333 is complete unto itself. The two speaker wings each contain a 6½ and a 2½-inch speaker. The smaller driver is fed through a series capacitor so that it acts as a tweeter.

We did a considerable amount of listening to commercially-recorded tapes. The over-all sound quality was surprisingly good. While these speakers, and the internal amplifiers in the recorder, are no serious threat to high-priced components, they, nevertheless, will provide good listenable sound at a room-filling volume.

Recordings made on the 333 at the higher speed, were close in sound to the original and, again, in excess of what is to be expected in this price league.

Total flutter and wow at 7½ ips met the published specification on the nose, 0.12 per cent. No spec is given for the slow speed. We measured a highly satisfactory 0.25 per cent.

NAB response using Ampex test tape was as follows:

frequency (cps)	*db*
12,000	–4.0
10,000	+0.5
7,500	+2.5
5,000	+2.5
1,000	0.0
500	0.0
250	+1.0
100	+2.0
50	+5.0

Over-all record/play response at 7½ ips was ± 2 db from 50 cps to 11,000 cps.

Speed regulation was found satisfactory. Our sample ran 2 per cent fast at 117 volts. Zero error was reached at 95 volts. This means that musical numbers recorded on an accurate speed machine would play slightly sharp on the Oki. Tapes made on this machine, of course, would be pitch accurate.

A tape-activated microswitch is mounted in the tape head slot. It effectively shuts off both mechanical and electronic operation if the tape breaks or runs out. It does this, furthermore, in any mode, play or rewind.

Any product must be evaluated for what it is, not what it might be. The Oki 333 *is* a fine machine—most listenable, readily portable, and likely to be durable.

Circle No. 221

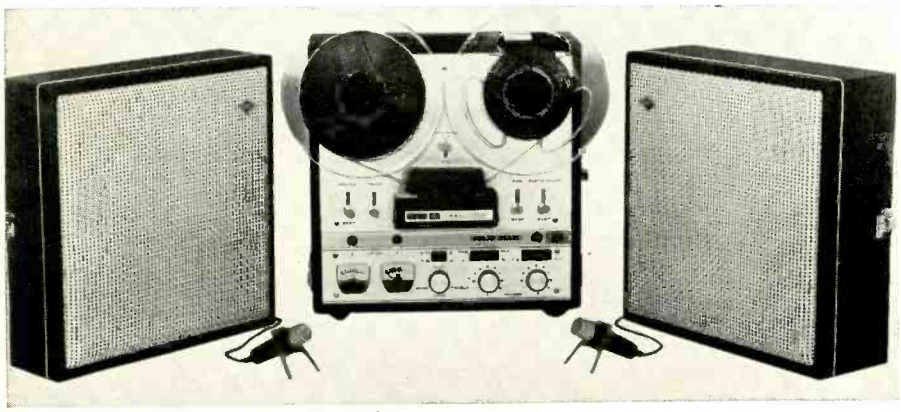


Fig. 2. OKI 333 Stereo Tape Recorder.

KOSS-REK-O-KUT 2-SPEED TURNTABLE/ARM, MODEL R-34

For many years the Koss and Rek-O-Kut names have been highly respected in their individual fields; headphones for Koss and turntables for Rek-O-Kut. Now that these two respected names have been wedded, one would suspect that the products of this union would be worthy of their forebears. Indeed this is true of the Model R-34 turntable and arm.

The R-34 consists of a two-speed turntable, 33 1/3 and 45 rpm, an S-440 arm, and a walnut base. The arm and turntable are mounted so as to eliminate acoustic feedback, and the turntable is belt driven. The result of all these measures is to reduce noise and rumble to an extremely low level. In addition, the hysteresis-synchronous drive motor is sufficiently accurate in speed to permit precise pitch reproduction of properly recorded discs.

This R-34 should not be confused with an earlier model which did not have a plug-in head, as does this model. This change is significant in that arm resonance is reduced. In any case, performance seems to have been improved

Fig. 3. Koss—Rek-O-Kut Table/Arm Model R-34.

somewhat in the latest R-34. (A result of the marriage?)

The S-440 tonearm is all metal with a plug-in head which permits a four-wire connection to the cartridge. A counterweight is provided to achieve static balance and stylus force is applied by means of a spring near the gimbal. Although roughly calibrated, this stylus force "adjuster" is by no means a substitute for an accurate force gauge, and the company doesn't claim that it is.

Speed change is effected by means of a lever towards the rear of the table. It operates easily and does not seem to cause difficulties. In essence, moving the shaft causes the belt to move from one step to another of the two-stepped drive shaft.

The turntable and the arm of the R-34 are mounted on the same platform. The platform presses on the larger surfaces of three conical springs while the apex of the springs are hung from the "deck" of the table by means of a nut and bolt and a large washer. This arrangement provides substantial isolation of the arm and table from the deck, which mounts the motor. The motor is the familiar inside-out hysteresis-synchronous unit made in Germany, and is somewhat isolated from the deck by means of rubber mounts. The isolation of table and arm from motor is completed by the belt drive.

Performance

We have said many times previously that turntables should be seen and not heard. In other words, noise and rumble from the turntable should make no contribution to the performance; a quiet groove should remain quiet even with gain turned up to maximum. (We assume here that the recording itself is free of rumble, an unfortunately difficult condition to achieve.) The Koss—Rek-O-Kut R-34 is amongst the top performers here, producing rumble -39 db below a 1000-cps stereo signal at a velocity of 3.54 cm/sec. Unweighted of course. More important it was as quiet as a tomb is reputed to be.

Wow and flutter were less than 0.1 per cent. Speed was 0.25 per cent fast at 117 volts, and became less than 0.25 per cent slow at 90 volts. Excellent performance in any league.

The arm resonance was 13 cps, which is acceptably low, and it could track well with a stylus force of 1.4 grams using a high quality compliant cartridge.

The Koss—Rek-O-Kut Model R-34 is a good value at $89.95. It answers the needs of those who wish to have a turntable but who also have a limited budget. **Circle 222**

GRADO TYPE A CARTRIDGE

This latest model from Grado Labs is born of a long line of moving coil cartridges manufactured by this firm. Grado is, at this writing, the only remaining American manufacturer who makes moving coil cartridges. He obviously believes that moving a lightweight, but admittedly difficult to wind, coil in a fixed magnetic field is the best way to make the best cartridges. And this is the road he travels.

Moving coils suffer, more than other transducing systems, from relatively low output, especially with the reduction in total moving mass in modern cartridges. For this reason the Grado Type A uses a transformer to provide increased voltage output. Cartridge impedance is very low, so that even with the transformers the output impedance remains low and only the voltage output is affected by cartridge loading, not frequency response.

Using a standard 50k ohm load we measured outputs of 3.2 mv per channel with a 3.54 cm/sec recorded velocity. This is more than enough to drive any quality preamp currently available. If output should be marginal in a given system, the usual 47k ohm terminating resistors in the preamp input may be increased to 100k ohms; this will raise output but not affect other parameters.

Measurements of frequency response and channel separation are appropriate for a top-grade cartridge. The Type A is indeed such a product. The frequency

(*Continued on page 36*)

NEW PRODUCTS

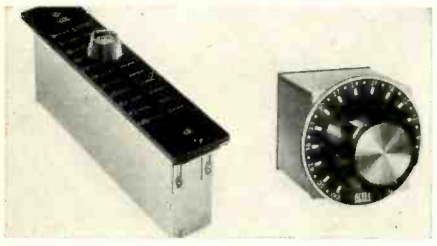
•Professional "Monitor" Speaker System. A new three-way speaker system, the professional version of the University Medallion, is now available. Named the "Monitor" the speaker measures 23 9/16" high by 15¾" wide by 12¼" deep. The enclosure employs University's exclusive Radiation

Resistance Loading (RRL) principle and is finished on all sides in oiled walnut. Response is 28 to 22,000 cps with crossovers at 600 and 4000 cps. Power handling is 40 watts of integrated program material. Price to the consumer is $129. **Circle 200**

•Organ Trim. Owners of Artisan, and possibly other organs, will be interested in a series of distinctive moldings and decorative piece attachments. They may be painted in gold or finished in a natural wood

coloring to match your unit. These decoration, as indicated in the photo, are applied on edges and center panels of the console anl bench. **Circle 201**

•New Attenuators. Designers in all phases of audio transmission circuitry should be aware of a new series of attenuators announced by Altec Lansing. Available in both unbalanced and balanced circuit configuration, and designed in either rotary or straight-line models for mono or multichannel operations, the new series lists over



300 types in ten categories. Included are mixers, calibrated controls, precision decade attenuators, turntable faders and stereo pan pots. Altec offers a 16-page brochure containing all detailed information and specifications. **Circle 202**

Ham Mikes. Electro-Voice has just introduced two versions of a new microphone designed for ham, CB, communications, or paging applications. The model 619 is a dynamic microphone and the ceramic version is tagged as the model 719. Both are identical in appearance and are constructed with rugged, die-cast stands in communications grey and contrasting chrome. A press-to-talk switch, located in the base, may be moved into the upper part of the stand for

convenient grip-to-talk operation. This switch shorts the microphone in off position, providing for easy relay operation. Model 619 lists at $47.50.It is available in Hi-Z or balanced Lo-Z impedance and has an output of -57 db. The ceramic model 719 lists at $27.50, is available only in Hi-Z, and has a -56 db output. Both models weigh just over two pounds and are equipped with 16 feet of cable. **Circle 203**

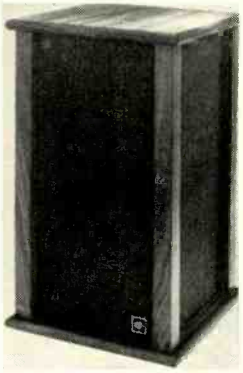
•Wireless Intercom. All solid-state circuit produces three advantages for this new wireless intercom system from Lafayette Electronics: 1. Low current drain; 2. quiet performance, via a built-in squelch circuit; 3. low silhouette styling. The units plug into any 117v ac outlet and transmit along the power lines. They can be used between adjacent buildings providing there are no

intervening transformers. Two channels, 160 and 200 kc, are provided. This makes possible the simultaneous, separate use of two pairs. The units have a locking press-to-talk bar. Other controls include on/off volume and channel selector switch. Power supply is transformer operated. Each unit has a pilot light. Dimensions of the ivory-and-silver trim, high-impact plastic case are 5x6¼x3-in. Price for a two-station set is $39.95. Additional stations may be had at $21.00 each. **Circle 204**

•Modular Compact Tuner Addition. The Benjamin 200 modular phono system has had a solid-state tuner added without any increase in size. This new version, dubbed the Benjamin Stereo 200 FM includes, in a single table-top oil-walnut cabinet, a stereo FM tuner, Miracord 10, four-speed manual or automatic record player with Elac stereo/mono cartridge, and a 14 rms watts-per-channel transistor amplifier. The new tuner features a d'Arsonval center-of-channel tuning meter, manual or automatic stereo switching, afc on/off, and a 3:1 tuning gear drive over the slide rule dial for greatest ease in tuning. An inherent

thermo-compensated design maintains drift-free performance even when afc is off. Usable IHF sensitivity is 3.5 μv. Harmonic distortion is less than 1 per cent. Image rejection is 45 db and spurious rejection is 70 db. Over-all dimensions are 18⅝-in. wide, 16-in. deep and 9½-in. high. Suggested retail for the Benjamin 200FM, less speakers, is $339.50. The unit without tuner, the Benjamin 200, is $229.50. **Circle 205**

•Circling Speaker. A group of speaker systems recently introduced attack the problem of sonic dispersion with a carefully controlled, rotating, mid-high speaker. Thus, it is claimed, a 360-deg dispersion can be achieved. The result is elimination of "dead spots" or problem rooms for speaker set-up. In this patented system, a high-compliance woofer is mounted in the speaker enclosure base pointing directly upwards toward the top. This woofer is in a sealed infinite baffle. Suspended directly above it,



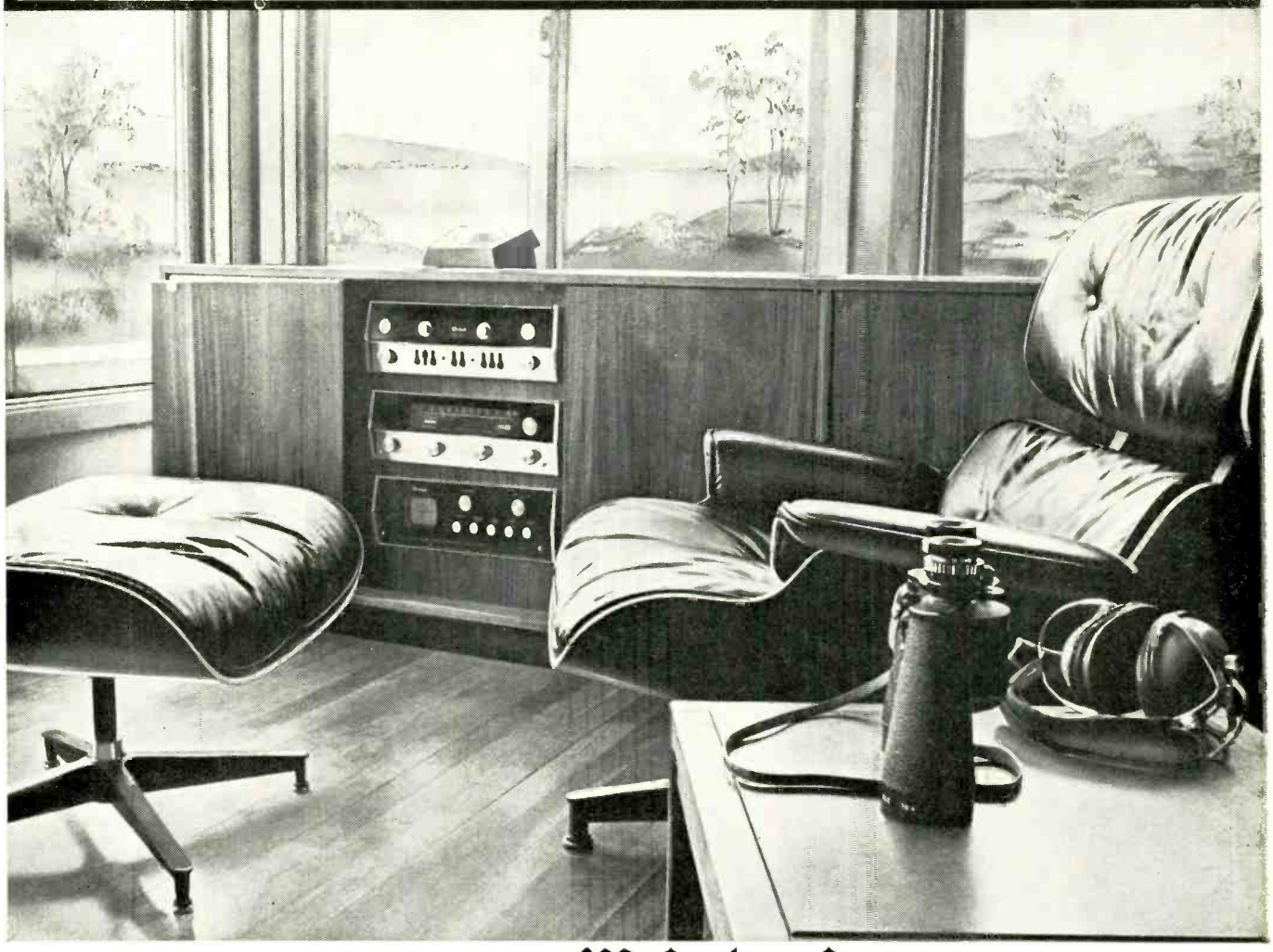
from the top plate of the enclosure and facing outward, is a mid-high range speaker. It is driven by a small electric motor, revolving continuously when the system is turned on. Sound from the woofer, directed upwards into the revolving speaker is blended and transmitted in the full circular pattern. Five basic models of this system are being introduced by the manufacturer. Circle-O-Phonic. Prices begin at $99.00. **Circle 206**

FREE FREE FREE FREE FREE

McIntosh Laboratory, Inc., 6 Chambers St., Binghamton, N. Y.

FM STATION DIRECTORY
EXCITING TEST REPORTS
24 PAGE CATALOG

Name _____
Street _____
City _____
State _____ Zip _____



DON'T ENVY A McIntosh OWNER...

be one!

McINTOSH ONLY COSTS $3 MORE A MONTH THAN A COMMON STEREO

The new McIntosh 24 page catalog is great.
Write for your free copy today.

BUY A McIntosh

McIntosh Laboratory, Inc., 6 Chambers St., Binghamton, N. Y.

Circle 135 on Reader Service Card

EQUIPMENT PROFILE

(*from page 33*)

response is significant primarily because of the absence of the usual specific resonant peak in the audio spectrum. Also noted is the fact that response is the same, even at lowest bass, with or without the transformers. Channel separation is exceptionally *linear* (perhaps more important than the actual amount of db).

IM measurements were not average. The +9 db, 400 cps band of the CBS STR 111 yielded only 2.5 per cent IM,

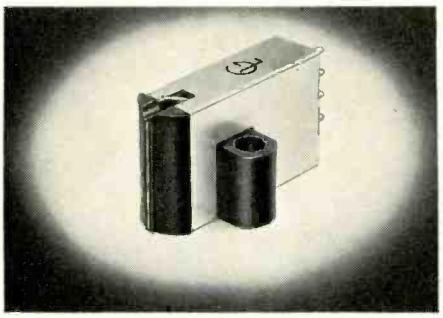


Fig. 4. Grado Type A stereo cartridge.

by a good margin the lowest figure we have seen.

Dynamic compliance was measured at 5 X 10^{-6} vertical or lateral, again using a CBS test record. This is actually a good figure. Most compliance ratings are static, measured on jigs. *Dynamic* compliance is a measure of compliance *after* being deflected by a tracking force. The Grado will track most records at 1.5 grams. A few heavily modulated discs were a bit better at 1.75. This range is well within the capability of a top-grade arm.

Listening Test

Cartridge evaluators usually state that measurements do not tell the entire qualitative story. Subjective listening tests, too, are also insufficient for universal application because the associated equipment used, and the personal prejudices of the listener(s) must enter into any opinion. With this we present our opinion after extensive listening.

The listening tests revealed two facts: The Grado Type A is non-strident and is extraordinarily transparent.

There is no strain to music reproduced with this unit. Nor is there any feeling of sonic masking. Instrumental separation (different from stereo separation) is superb.

Thus, musical listenability must be considered the cartridge's highest point. And, in our opinion, musical listenability is the most important fact about *any* transducer. The Grado Type A is clearly worthy of the finest systems. Circle 223

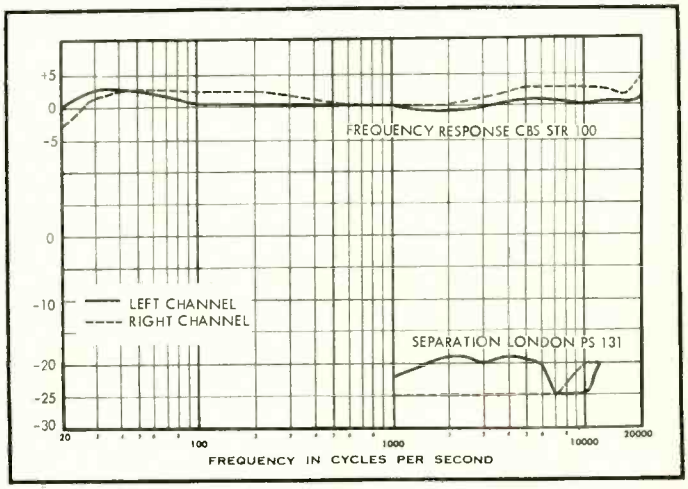


Fig. 5. Frequency response and separation.

LETTERS

(*from page 6*)

as it is, of a revolutionary nature, direct process recording is a rather complex technique when one attempts to describe it on paper. Fortunately, in actual practice, it is a greatly simplified method of recording.

We direct your attention to one error: the captions below *Fig.* 1 and *Fig.* 3 have been reversed.

JOHN BERRY
Repeat Records
5782 East Second Street,
Long Beach, California

LIGHT LISTENING

(*from page 8*)

story line is a rarity these days but this show seems to go out of its way to avoid any suggestion of day-to-day events involving actual people. As the title indicates (if it indicates anything), this is another Game of Life allegory by the authors of "Stop the World—I Want to Get Off." This time Anthony Newley and Leslie Bricusse cannot point to the existence of a hit song such as "Stop the World's" *What Kind of Fool Am I?* to justify production of this show. In this recording there is a lot of activity in front of RCA's microphones involving Newley and Cyril Ritchard, the other star of the show, but I doubt the average listener will recall a single tune in the score once the record is through.

Enoch Light Orchestra: Discotheque
Command Tape RS 873

All the aural ingredients needed to turn a party into a full-fledged discotheque are contained in this one package from Command Tapes. The dimension of the beat is more than matched by the volume of sound maintained by the Command process. It is obvious in this release that Command's style of recording has been waiting all these years for the primitive beat of the dances contained in this album supervised by Killer Joe Piro, the international authority on the Frug, Watusi, Hully Gully, etc. You don't have to be a devotee of these dances to acknowledge that this reel is pretty much the last word on the subject.

TRANSISTOR CIRCUIT OPERATION

(from page 25)

r_{bb}' is harder to get a handle on. For some low-performance transistors, it may be as much as 30 ohms. Conversely for high-power transistors, it may be fractions of an ohm. For most transistors, I simply call R_{bb}' four ohms, and forget about it. If we add external emitter reistance R_e, V_i is developed across it in series with r_e and r_{bb}', and R_e is added into the denominator of the gain equation: $A_v = R_L/r_e + r_{bb}' + R_e$.

Now we realize that it doesn't matter what form our amplifier takes. If we have an emitter follower, for instance, R_L is in the emitter, and V_i and V_o are both developed across all resistors, and are, therefore, the same.

To summarize then, so far we've seen that the use of transresistance allows us to find the voltage gain of an amplifier, when we know the collector current, and the magnitude of the external resistors, if any: $A_v \cong R_L/(26/I_c) + r_{bb}' + R_e$, I_c in ma *(Eq. 1)*

Easy, huh?

Input Impedance

Now we need to know the second thing I said we would need to know: *beta*. When we look into the base of a transistor, *Fig.* 2 shows that we see $r_{bb}' + r_e$. But because our little current in the base, I_b, generates a large current, *beta* (I_b), in the emitter, r_{bb}' and r_e look *beta* times larger than they really are, and input impedance falls out: $Z_i = \beta\,[26/I_e) + r_{bb}']$; and again, since external emitter resistance is in series with the internal resistances, it too looks *beta* times larger. Obviously, any bias resistors in the base circuit will shunt the input impedance, and so we must include them, too. Now we have the complete equation for input impedance:

$$Z_i \cong \beta\,[26/I_e) + r_{bb}' + R_e] \;//\; R_b \qquad (Eq.\ 2)$$

This holds for the common-emitter amplifier. For the common-collector amplifier, or more simply, the emitter follower, the equation is much simpler. The emitter resistor is usually much larger than the other resistances, and so we have: $Z_i \cong \beta(R_e) \;//\; R_b$. The common-base amplifier is a different animal, which is more easily covered when we talk about

Output Impedance

For the common-emitter amp, output impedance is easy, because r_c, which shunts R_L, is quite large: usually one or two megohms. Normally, R_L is less than ten per cent of r_c, and so we can say that $Z_o \cong R_L$.

Output impedance from the emitter is another story. Looking into the emitter, we see our old friends $r_{bb}' + r_e$, now shunted by R_e. In addition, just *as* R_e looks *beta* times larger when seen from the base, R_g and base bias resis-

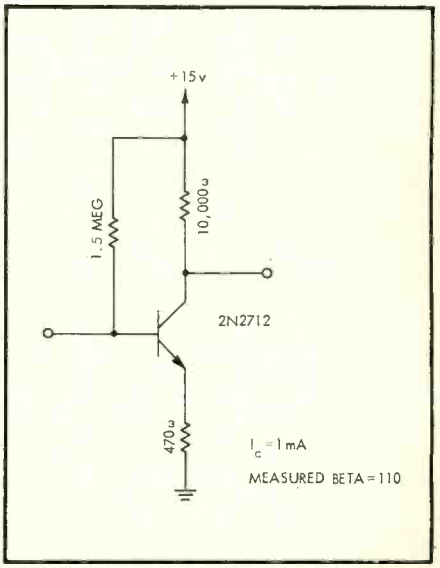


Fig. 3. Common-emitter amplifier.

tors look one *beta*'th as large when seen from the emitter. Lumping R_g and the bias resistor(s), we have

$$Z_o \cong [(26/I_e) + r_{bb}' + (R_g/\beta)] \,//\, R_e \quad \text{(eq. 3)}$$

This equation also describes what we see when we look into the emitter of the common-base amplifier, except for the term for generator resistance, R_g.

And there we are. If you've come along this far, you'd probably like to see a sample. After all, we wouldn't build an amp without seeing the specs. Let's apply our approximate knowledge to the circuit of Fig. 3, and see what happens. First, voltage gain:

$$A_v \cong R_L \,/\, (26/I_e) + r_{bb}' + R_e$$
$$\cong 10\text{K} \,/\, (26/1) + 4 + 470$$
$$\cong 20$$

Next, input impedance:

$$Z_{in} \cong \beta\,[(26/I_e) + r_{bb}' + R_e] \,//\, R_b$$
$$\cong 110\ (\ 500\ ) \,//\, 1.5 \text{ meg}$$
$$\cong 55\text{k ohms}$$

Now, output impedance:

$$Z_o \cong R_L = 10\text{k ohms}$$

A reasonable question I can hear you asking now is, "How do these figures compare with the actual values?"

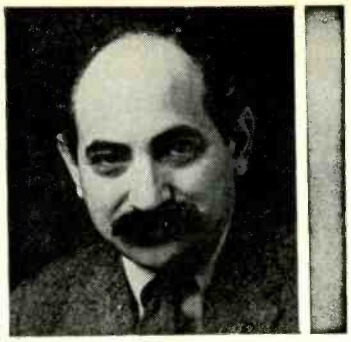
I took the transistor used in the example, and built the circuit of *Fig.* 3 around it. I had obtained the value for *beta* by actually measuring it at 1 mA, with five volts from collector to emitter. The measured values were as follow: $A_v = 18.2$; $Z_i = 62\text{k}$ *ohms;* $Z_o = 10\text{k}$ ohms. Well, not too bad you say, but I thought that the figures should be closer than that, so I measured the resistors. The 10k resistor was 10.5k; not very significant. But the 470-ohm resistor measured 540 ohms, a real junk-box type. Plugging the new values into our equations gives these figures: $A_v = 18.4$, and $Z_i = 62\text{k}$ ohms. Much better. And now, I think, you've got the idea.

Too Simple?

Well, sure. It doesn't take a double-E to see that before we get very far out of the audio range of frequencies, our analysis is going to run into trouble. But careful estimations of device and stray capacitances, when added into our calculations, will keep the answers usable out toward the performance limit of the device. After all, we started this analysis with the intention of obtaining good rules-of-thumb, and the analysis has done admirably so far. The transresistance of the transistor doesn't care what configuration the device is in, and further, we've eliminated reams of transistor specs, and wastebaskets of "h" parameter calculations. Take one good guess at *beta*, and the circuits you see in AUDIO will be a little easier to understand. *Æ*

JAZZ and all that

Bertram Stanleigh



Thanks to the May issue of AUDIO, a mystery that has kept me guessing for about a year has finally been cleared up. In a fascinating article by Robert Hazelleaf called *Recording Without Microphones,* reference was made to a recording called *Gentle Jazz.* Last year I had received a plain black box containing a four-track stereo tape with a hand written label on the reel saying, "Gentle Jazz, Repeat Records, Special Advance Copy by 3 Cats and a Fiddle."

A quick audition of the contents of the plain black box did much to arouse my curiosity, but it left me with so many more questions than answers that it seemed hopeless to try to review the tape without further information. Since my limited reference sources did not provide an address for Repeat Records, I was unable to write them for more details, but my curiosity about this recording had been thoroughly whetted, and I continued to play the tape and speculate about it.

The main reason for my strong interest was the outstanding audio quality, marked by crisp transients, low distortion and remarkable definition in the bass. I was also puzzled by the extreme difference in content between the left and right channels, which suggested a high degree of isolation between channels. What was even more intriguing was the peculiar timbre of the instruments. They had a subtly different character than what one usually encountered on records of the same instruments—or at least what my ears deduced were the same instruments. They had the mellow sound that is generally associated with a somewhat distant mike placement, but at the same time one heard those close-up details (often called *presence*) that are the result of very close miking. And the harsh tonal coloration that results from close mike placement was absent.

Well, the answer to why these special characteristics were to be found in this *Gentle Jazz* recording are all set forth in Mr. Hazelleaf's article in May's AUDIO. I still have a lot of questions, but they are specific ones related to the equipment employed by Messrs. Barcus and Berry of Repeat Records, and in time I am sure that this information will become available.

The music on the recording is definitely more gentle than jazz, but it's all highly agreeable. Selections include *Summertime, Manhattan, A Summer Kind of Love, Linger Awhile, Moonglow, Polka Dots and Moonbeams, She's Funny That Way, I'm in the Mood for Love,* and *I Only Have Eyes for You.* Two different instrumental groupings are heard. In one the guitar is on the left, piano at the right, and the bass is in the center. In the other, the bass is on the left, guitar, right, and piano, center. The fiddle – probably the *Baritone Violectra* described in the article—is heard on only a few of the numbers. Its range seems about that of a viola, but it has a richer resonance and is played with a slower vibrato than one usually associates with that instrument.

To my ear, these instruments all sound somewhat different from the usual piano bass and amplified guitar, but that difference doesn't seem very important. What is important is this new technique that makes it possible to get fresher, crisper sounds than have been accessible to date with microphones. I look forward to hearing lots of new material employing this promising system.

Horace Silver Quintet:
Song For My Father
Blue Note Mono 4185

Although the record is billed as by "The Horace Silver Quintet," there are actually two different groups of musicians on this platter. The earlier group consisting of Blue Mitchell, trumpet, Junior Cook, tenor, Gene Taylor, bass, and Roy Brooks, drums, is heard in two easy, contemplative numbers by Silver, *Calcutta Cutie* and *Lonely Woman.* The latest Silver group features Carmell Jones, trumpet, Joe Henderson, tenor, Teddy Smith, bass, and Roger Humphries, drums. They are heard in four bright, vigorous numbers that offer a substantial contrast to the two pieces by the former group. Silver's piano playing is well suited to the moods of both combos, and the juxtaposition of two widely differing styles makes for a most agreeable collection. Particular credit is due Joe Henderson for the elegant swagger in his solos on *Song for My Father* and *Que Pasa.*

Grachan Moncur III:
Some Other Stuff
Blue Note Mono 4177

Trombonist Grachan Moncur III has come up with four very interesting bits of "stuff" on this latest set of his music. Working with Blue Note mainstay Herbie Hancock on piano, Wayne Shorter, tenor, Cecil McBee, bass, and Anthony Williams, drums, Moncur builds a group of atmospheric, emotionally seething pieces that give each performer abundant opportunity for individual exposure within a well-wrought mood framework. Tony Williams, who is featured in a recent Blue Note set of his own, turns in what almost amounts to a solo performance on *Nomadic.* According to Moncur, he was aiming at a "relaxed drum solo . . . that would be kind of soothing." The result is not only very interesting but comes close to achieving this unusual effect. This is a record to get right away, and it makes clear that Grachan Moncur III is a man who continues to demand our attention as one of the most stimulating creative forces today.

Quincy Jones:
Golden Boy
Mercury Stereo SR 60938

Arranger, conductor Jones provides a variety of instrumental forces in ten numbers that comprise this grab bag containing everything from sticky string versions of the *Theme from Golden Boy* and John Lewis' *Django* to bright, rhythmically sophisticated versions of *Soul Serenade* and the Beatles' *Hard Day's Night.* The album features solos by such outstanding performers as Eddie "Lockjaw" Davis, Jim Hall, Bobby Scott, Joe Newman, Freddie Hubbard and Phil Woods, and the sound is clear, clean and well separated. With the exception of the string arrangements, the set is a listening delight that demonstrates the continued validity of the big band for studio recording. Certainly no other platter shows off the remarkable advantages of stereo in pitting a soloist against an instrumental background.

Woody Herman:
Woody's Big Band Goodies
Philips Stereo PHS 600-171

A set of nine more tunes recorded in 1963 and 1964 by what was certainly an awesomely impressive herd—whether or not it was equal or superior to Herman's great mid-40's gang. The present collection will be of particular interest to those collectors eager to compare Woody's new versions of *Apple Honey, The Good Earth* and *Sidewalks of Cuba* with earlier Herman waxings of the same numbers. But weighing up the strong points of each version seems like very dull pedantry when one can just sit back and bask in the joy of these precision tooled performances. The present set features such latter day Herman stars as Sal Nistico, Phil Wilson, Jake Hanna and Bill Chase. Neither Nistico nor Hanna are with the band at this point. Does this signal the end of the great Herman herds? We doubt it. The next Herman record may even be as good as this one.

Maria Tanase:
Bucharest by Night
Monitor Reprocessed for Stereo MFS 439

An exciting singer with a rich, deep contralto, Maria Tanase performed her music with that combination of folk idiom and dramatic impact that is only encountered in very rare artists. Her death in 1963 at the age of fifty was an untimely loss, but we can take satisfaction in the survival of her art in the present collection which presents her exceptional talents against the colorful background of a Rumanian folk instrument orchestra under the direction of Victor Predescu whose stylish performances of Rumanian folk rhythms are already familiar to many of us from Monitor's *Rumanian Songs and Dances* (MF 416. The original recordings from which this new release derives were made in Rumania on mono equipment. However, monitor has done an exceptionally effective job of reprocessing them for stereo. The voice is forward and well centered while the orchestra appears broadly spread across the area between the two speakers. Æ

CALIBRATED STEREO UNIT

(*from page 24*)

Balance Adj.) for the identical meter reading previously obtained by a no-signal adjustment of P_{19} for static balance.

A more fundamental method is available, requiring more effort, but offering an independent check on the adjustment. Feed your FM tuner interstation hiss to one preamp input and that from a borrowed tuner into the other input. The author prefers to put the tuners in separate rooms with the doors closed, and use little or no antenna. For success the hum level should be 6 db or more below hiss livel in both channels. Center the Separation Adj. (P_1) and Balance (P_2) controls exactly, and have S_2 in the stereo position. Set the meter selector switches for stereo nulling (S_{10}) to "SRC" or "Separation Ratio Calibrate" and S_{10} to "B" or "Both." With level and P_{17} set as before, adjust P_{18} for best average null. Both signals must be monitored for exact equality at control unit inputs, and bandwidth characteristics must be quite similar to make this possible.

If the builder has a simple ohmmeter he can check the accuracy of S. R. calibrate marks at the scale extremes where taper and tracking vagaries in the potentiometers are likely to be felt. This is best done with the pot mounted on a large replica of *Fig.* 14(A) using a large pointer. The few scale marks near each extreme that may give resistance ratios with errors in excess of the ohmmeter error can be repositioned to at least that degree of certainty. This operation is of course done with P_{17} disconnected from the circuit.

Scale No. 2, *Fig.* 14(B), is offered for those who would rather have normal stereo signals nulling closer to 12 o'clock. Mount P_{17} on the panel so its exact mechanical center of rotation and the dial scale marking of 0.8 both fall at 12 o'clock. Adjust the control (after mounting) to the S. R. = 1.0 mark and follow the same steup procedure described for dial No. 1. A different dynamic balance adjustment will be obtained. Unless an Allen-Bradley unit is installed, good accuracy cannot be expected.

Scale No. 3, *Fig.* 14(C), provided for recordists who do most of their work with large ensembles or other program sources easily prone to separation ratio deficiencies. Changes in S. R. of this material are likely to be relatively minor in nature, and it is desirable to stress ease of dial reading in the area of greatest use. This scale spreads readings on the mono side, particularly in the range between S. R. = 0.4 and 1.0.

This scale was obtained by shunting resistors across the P_{17} ratio arms (see *Fig.* 13). The same remarks concerning setup and accuracy of readings apply as do with Scale No. 2.

Scale No. 4, *Fig.* 14(D), uses the same circuit as does Scale No. 3 except that S. R. = 1.0 is at 12 o'clock. This spreads the readings in the useful portion of the augmented stereo side, giving about 30 per cent more spread at S. R. = 1.25 than provided by No. 3. The scale is still a good compromise for the whole range. This dial is provided for the genus *"doctored stereoausorous"* who believe that the whole subject involving unusual stereophonics has been woefully left too long in the realm of guesswork. They will demand the utmost readability in this region for the benefit of posterity.

Scale No. 5, *Fig.* 14(E), provides spreading on both sides of the S. R. = 1.0 center. Moderate spreading is realized between S. R. = 0.8 to 1.25. This is an excellent choice for general purpose use by those who are able to insure the accuracy of the scale as previously described. This scale was obtained by reversing the positions of the padding resistors across the ratio arms of P_{17}.

Table II lists the detector circuit input voltages required for full scale reading when the circuit is switched to its "output meter" mode of operation. An in-phase monophonic signal gives a reading 2.24 db higher than an equivalent with S. R. = 1.0 gives. (An outphased monophonic signal gives no reading.) Æ

HERMAN BURSTEIN

Send questions to:
Herman Burstein
280 Twin Lane E.
Wantagh, N. Y.
Include stamped, self-addressed envelope.

Converting for Overseas Use

Q. I am contemplating the purchase of an American tape recorder for use abroad, where it will have to operate on 220-volt, 50-cps a.c. The 220-volt supply can be stepped down to 117 volts, but of course, the 50-cps a.c. cannot be changed. Will operating the machine on 50 cps affect its performance?

A. I do not know whether the motor of your particular tape machine will operate on 50-cps a.c. without overheating. A motor for 50-cps operation requires more iron than one for 60-cps operation. If the motor is barely adequate for 60 cps, it is likely to get excessively hot and perhaps burn out when run on 50 cps. I suggest that you ask the manufacturer of this machine. In changing from 60- 50-cps operation, it will be necessary to change the capstan drive mechanism, probably by a fitting on the motor shaft. You can probably get the necessary mechanical details from the manufacturer.

Use Computer Tape?

Q. I have access to a good deal of computer tape that is used but still looks in very good shape. It seems to be of top quality and is selling at quite a low price. It had been used on magnetic reading machines for several IBM computers. Would this tape be usable on a home high fidelity tape recorder without any ill effects?

A. It is difficult to give a specific answer to your question. Computer tapes, because they deal with pulses, generally have accentuated high-frequency response compared with audio tapes. Hence you may find that treble response is excessive. An adjustment of bias current will probably be necessary; I don't know whether this will entirely dispose of the problem of treble peak. Furthermore, I don't know whether you will be able to get the same recorded signal level for a given amount of harmonic distortion, thus assuring as good a signal-to-noise ratio as when using audio tape.

On the other hand, computer tape is generally made to conform to highest standards, so that it should be more dropout-free and more accurately slit than ordinary audio tape.

In general, audio tape is "optimized" for home recording, whereas computer tape is "optimized" for computer purposes, and you are usually best off by using the tape which the manufacturer has designed for a given purpose.

Correct Head Gap

Q. My friends and I have had considerable disagreement on the proper gap for playback and record heads. I maintain that the playback head must have a considerably wider gap than the record head in order to realize full fidelity. Some of my friends, however, say that there is a large loss in fidelity if the record and playback heads do not have exactly the same gap. Could you give us your views on this?

A. For adequate treble response, the playback head must have a very narrow gap, and increasingly so as tape speed is reduced. But as gap width is reduced, the efficiency of the head is reduced. Therefore heads designed solely for recording have a relatively wide gap compared with playback heads. When you refer to the record and playback heads requiring exactly the same gap, I am sure that you are thinking of azimuth alignment; that is, the gap of each head should be exactly at the same angle, 90-deg., with respect to the tape in order to preserve full treble response.

Are Pressure Pads Harmful?

Q. I am considering the purchase of a tape recorder which doesn't use pressure pads but instead employs chrome guides that move in on either side of the heads to provide good tape to head contact. I would like to know if you consider this type of "pressure guide" system favorable to long tape head life?

A. I can't comment on the pressure

guide system employed in the tape recorder you mention because this would require a technical evaluation over a period of time and there is no opportunity for me to do so. Generally speaking, the omission of pressure pads is considered favorable to head life; at the same time, omission of pads can be just as important or more important with respect to reduction of wow and flutter. If there are no pads but the tape is subjected to excessive tension, this can accelerate head wear. Head wear further depends on the area of the head contacted by the tape, which is determined by the tape path and the shape of the head. Distributing the pressure of the tape against the head over a large area helps reduce gap wear. Hence you can see that it is possible for a skillfully employed pressure pad system to result in less head wear than a clumsily executed tension system.

Print-through Increases with Age

Q. It worries me to read that print-through tends to increase with storage time and that a tape which initially seems to be free of print-through may show an appreciable amount a year later. Does this mean that it is impossible to keep one's recordings intact longer than one year? What about recorded tapes. Are they subject to print-through too? Would you please give me some pointers as the kind of tapes and the method of recording which would help in this direction.

A. If you buy a standard brand tape of 1.5- or 1-mil thickness, I doubt that you will have significant trouble with print-through provided that you avoid recording at exaggerated levels. By this I mean that you should stay within the permissible recording level as indicated by the record level indicator of your tape machine. At the same time I assume that the indicator is properly calibrated: that it closes at the 3 per cent harmonic distortion level if it is a magic eye tube; that it fires at this level if it is a neon lamp indicator; or that it reads 0 VU at the 1 per cent (not 3 per cent) harmonic distortion level if it is a VU meter.

Print-through may become a real problem if you use the very thin tapes, such as half-mil. Print-through tends to be less of a problem in home recording than in commercial applications for two reasons: (1) Commercial studios and the like tend to over-record in order to maintain a suitable signal-to-noise ratio through several generations of tape duplication (from master to the pre-recorded tape sold in the store); (2) home machines generally have signal-to-noise ratios inferior to those of professional units, and the noise of the former machines tends to mask print-through. Æ

INZIDE AUDIO • LARRY ZIDE

Sony-Superscope has long been a name to reckon with whenever tape recorders are discussed. They've also delved, with considerable success, into the peripheral business of microphones and other accessories. Superscope is the American distributor for the Japanese firm, Sony.

Sony, perhaps more than any other firm, has played a major part in establishing a healthy respect in this country for the electronics industry of Japan. Sony is involved in many fields; their popular miniature solid-state television sets, just to name one, are a prime example. But, these products are distributed in this country by Sony itself. Superscope has nothing to do with them.

Still, Sony's greatese reputation in this country probably has come from the Superscope tape recorder line.

Thus it is no real surprise that Sony has selected Superscope to distribute their recording tape.

It is inevitable, I suppose, that Sony would become involved in the highly sophisticated field of tape manufacture. Ultra-high standards of precision are required. The emulsion must be applied to the base with extreme evenness. And, it must be absolutely uniform in spread and dispersion. The emulsion must possess magnetic characteristics of equally high uniformity, not only within each box, but from box-to-box. Each quarter-inch width must be slit from the master roll which is several feet in width. It is imperative that the cut edges be absolutely parallel and even or trouble will result in the tape recorder.

I've seen a group of photos of the manufacturing plant. They seem to have an elaborate, modern setup which does them credit. Sony has proved amply, in the past, that they do not lack for technical skills.

Superscope's initial distribution of a Sony tape, meeting their high standards, is called PR-150. This is a 1.0 mil polyester-based tape. It is available on 7, 5, and 3¼-inch reels. Length of tape on these reels is, respectively, 1800, 900 and 300 feet.

The 3¼-inch reel is unique in that it is designed to be used on three-pin-drive professional machines in addition to the usual home types. The advantage of this feature is obvious to radio stations. Now they can purchase economical short reels for commercials and the like that will fit their recorders just as the 5-and 7-inch reels do.

Sony has also made available a tape mailer. This is a 3-inch reel with 300 feet of PR-150 tape.

As an introductory promotion, Superscope (8150 Vineland Avenue, Sun Valley, California) is offering a purchase discount book to anyone requesting it. The 12 coupons are redeemable at Superscope tape dealers at a discount of approximately 50 per cent off list.

I can't, at this time, offer a definitive evaluation of this tape. However, the reels that we received in the office performed professionally in all respects. Response was uniform, there was no shedding of oxide, or squeal.

Industry News and Notes

Mattes Electronics, Inc. whose solid-state designs make use of unique, patented amplifier circuits, is pushing ahead full steam with production of those designs. But, production is for naught unless you can distribute the product. Distribution requires a team of salesmen factory reps to cover the country. I can report receiving a national list of reps appointed to that purpose. And, that list represents some of the top names in the field.

So, there is reason to believe that the considerable interest expressed in this company's radical designs will soon be gratified.

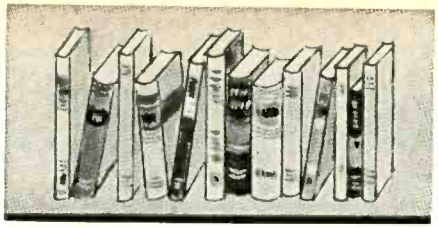
Standards on the Way

A recent announcement by Daniel von Recklinghausen, chairman of the standards committee of the Institute of High Fidelity, indicates that we will soon have a new, complete set of standards for the measurement of stereo amplifiers. This will, at last, supercede the present standards in effect since 1959, written, of course, for mono amplifiers.

Meaningful standards are always needed. The IHF is to be commended for its continuing efforts in this direction.

It is expected that tuners, last done in 1958, will occupy the efforts of the committee next. What is really most encouraging, however, is the indication that they will not stop here, but will move on to establish new measurement standards for other components as well.

I, for one, will welcome some order in the method of presenting specifications for transducers. It will be a difficult task for the committee. I rather suspect that they will not please everybody in this tricky area, and may end up satisfying no one. But, *any* standards will be better than the present hodgepodge of specifications for speakers and cartridges. Æ



A convenient service to AUDIO readers.

Order your books leisurely by mail — save time and travel, we pay the postage.

Maintaining Hi-Fi Equipment
Joseph Marshall

A valuable reference for anyone whose living ar hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electronic, mechanical and acoustic problems. 224 pages.

No. 58 Paperback $2.90*

Designing and Building Hi-Fi Furniture
Jeff Markel

Written by a professional hi-fi furniture designer who has taught furniture design at leading colleges, this book is an authentic reference of value to the hi-fi fan and professional custom builder. Covers everything from types of woods ta furniture finishing for the mechanically adept; design principles, styles and arrangements far the decar minded. 224 pages.

No. 79 Paperback $2.90*

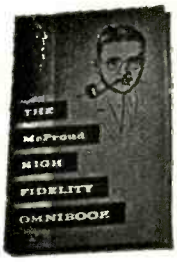
"The AUDIO Cyclopedia"
Howard M. Tremaine

- 1280 pages
- 3400 topics
- 1600 illustrations

Here is one single volume with the most comprehensive coverage of every phase of audio. Concise, accurate explanations of all audio and hi-fi subjects. More than 7 years in preparation—the most authoritative encyclopedic wark with a unique quick reference system for instant answers to any question. A vital complete reference book for every audia engineer, technician, and seriaus audiophile.

No. 123 $19.95*

McProud High Fidelity Omnibook



Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable context. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfecr guide.

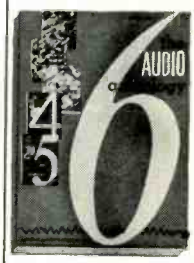
No. 115 $2.50*

The 5th AUDIO Anthology

Edited by C. G. McProud, publisher of AUDIO. An anthology of the most significant articles covering: stereo recording and reproduction; stereo multiplex; measurements; stereo technology, construction and theory — which appeared in AUDIO during 1958 and 1959. The 5th is truly a collectors' item and a valuable reference for the professional engineer, teocher, student, hobbyist and hi-fi fan. 144 pages.

No. 125 $3.50

The 6th AUDIO Anthology



Edited by C. G. McProud, publisher of AUDIO. Includes articles on the two most significant milestones in the field of high fidelity: FM STEREO and TRANSISTORS IN AUDIO EQUIPMENT. A meaningful reference for everyone in the fields of audio engineering, recording, broadcasting, manufacturing and servicing of components and equipment. A necessary book for the high fidelity enthusiast. 144 pages.

No. 130 $3.95

Tape Recorders and Tape Recording
Harold D. Weiler

A complete book on home recording by the author of *High Fidelity Simplified*. Easy to read and learn the techniques required for professional results with home recorders. Covers room acoustics, microphone techniques, sound effects, editing and splicing, etc. Invaluable to recording enthusiasts.

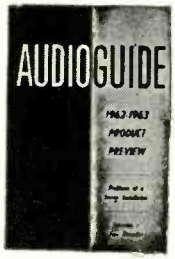
No. 112 Paper Cover $2.95*

"the best of AUDIO"—
edited by C. G. McProud

A new compendium of AUDIO knowledge. Here is a collection of the best of AUDIO — The AUDIO Clinic by Joseph Giovanelli . . . noted audio engineer and the original high fidelity answer-man — EQUIPMENT PROFILES edited by C. G. McProud . . . Editor of AUDIO. Here is a wealth of hi-fi and audio information. Answers to the most important issues in high fidelity and a valuable reference.

No. 124 Volume I $2.00*

AUDIOGUIDE



By the editors of AUDIO, *the original magazine about high fidelity*. A 1962-1963 product review of stereo high fidelity components. Valuable reference for the high fidelity enthusiast and hobbyist. Part I contains a thorough discussion of the *Problems of a Stereo Installation*; Part II is a complete treatise on *Selecting a Tape Recorder*. Indispensable to the prospective buyer of stereo components and tape recorders. Includes a section on where to buy various stereo hi-fi components and accessories. 156 pages.

No. 127 $1.00

• MONTHLY SPECIAL! SAVE $5.00

Save almost 50% with this collection of AUDIO books.
"best of AUDIO" ($2.00) 5th AUDIO ANTHOLOGY ($3.50)
McProud High Fidelity Omnibook ($2.50) and
Tape Recorders & Tape Recording ($2.95)

TOTAL VALUE ALL FOUR BOOKS . . . $10.95

Your cost only . . . $5.95 Postpaid

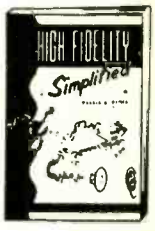
CIRCLE OS400

This offer expires July 30, 1965, and is good only on direct order to the Publisher.

High Fidelity Simplified
Harold D. Weiler

3rd Edition

The complete hi-fi story — answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. Lots of ideas for custom installations. Tells how to achieve concert hall reception in your home. 216 pages.



No. 142 $3.30

AUDIO Bookshelf—RADIO MAGAZINES, INC.
P. O. Box 629, Mineola, New York 11502

*All U.S.A. and Canadian orders shipped postpaid.

Please send me the books I have circled below. I am enclosing the full remittance of $..... (No C.O.D. or billing.)

58	79	112	115	123	124
125	127	130	142	251	OS400

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Getting The Most Out Of Your Tape Recorder
Herman Burstein

Written in "plain talk" for the man who has, ar wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiosts. Its chapters cover every phase af operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.

No. 251 $4.25

ABOUT MUSIC

(*from page 10*)

Scooba-Doo. A beatnik doll that really brings the doll business up to date. Its cool vocabulary includes such phrases as "Hey, doll . . . like you're way out."

But this is only the beginning. Toy manufacturers will soon be producing dolls that can accommodate 'changeable' records. Think of the fun you can have by putting one of Scooba-Doo's discs onto Tatters's turntable.

One of the most successful talking dolls in recent years has been Pete the Parrot. Made in Japan by Marx, this doll was introduced about 9 years ago. Priced at about $40, it differs from most talking dolls in that it uses tape rather than discs. Press a button and its eyes light up. Record your own voice and listen to Pete repeat it. Adults have been known to take it away from thtir children. Æ

AUDIO ETC

(*from page 15*)

plitude—it's a new kind of radio. "Oh, radio. You mean *radio*? By the way, we got our new television yesterday. It's really very interesting, though we don't like the ads very much." And so it went. Sort of hopeless.

Poor little FM, revolutionary, brand new (almost) FM, independent little FM, dismally lost in the TV shuffle. We who had worked in the medium were desolate. FM was dead, as far as we were concerned. We were people, not turntables. We had ideas for FM, but who wanted them—who could afford them?

And so in radio the new and shaky king was AM-FM. AM programming sent out over FM, unchanged. Sometimes without even a bow to FM's quality. Remember those telephone lines? "We now take you to Boston"—and down would come the 3000 cps curtain, the old muffled AM sound via FM. Fine thing! Awful. It really hurt.

But FM wasn't quite dead. The FM independents, a few, managed to stay on the air via shifting ownership, drastic retrenchments and, of course, the turntable. (Also, eventually, the helpful "restaurant music" or background, on the main channel or via multiplex.) FM programming was at a dismal low, *we* thought. But time passed. Around 1948 —was it?—came the first heady sign of an FM resurrection. *High fidelity!*

From that moment on, FM-AM programming was technically indefensible. Is it any less so today? Oddly — yes.

Things have changed. But more on this later.

AUDIO CLINIC

(*from page 4*)

supply 10 watts of power to the speaker, the amplifier must actually put out 20 watts of power because it must not only supply the speaker with 10 watts but it must also supply the resistor with 10 watts of power. Therefore, the amplifier will run hotter and produce slightly more distortion, not cooler as you supposed.

In the speakers I design, I use a fuse in series with the speaker and a resistor in parallel with the speaker, but the value of the resistor is 10 times higher than the impedance of the speaker, as in part three of your question. The resistor will still offer protection to the amplifier if the fuse blows, but will not rob excessive power from the amplifier.

Following this procedure, in your case, you would need a 150-ohm resistor in parallel with the speaker. It would have to handle at least two watts of power. The fuse would have to be approximately a 0.7-ampere or 0.8-ampere delay type. This type of fuse will allow transients to come through without burning out the fuse, but still will blow out on sustained passages of overload which might otherwise damage the speaker.

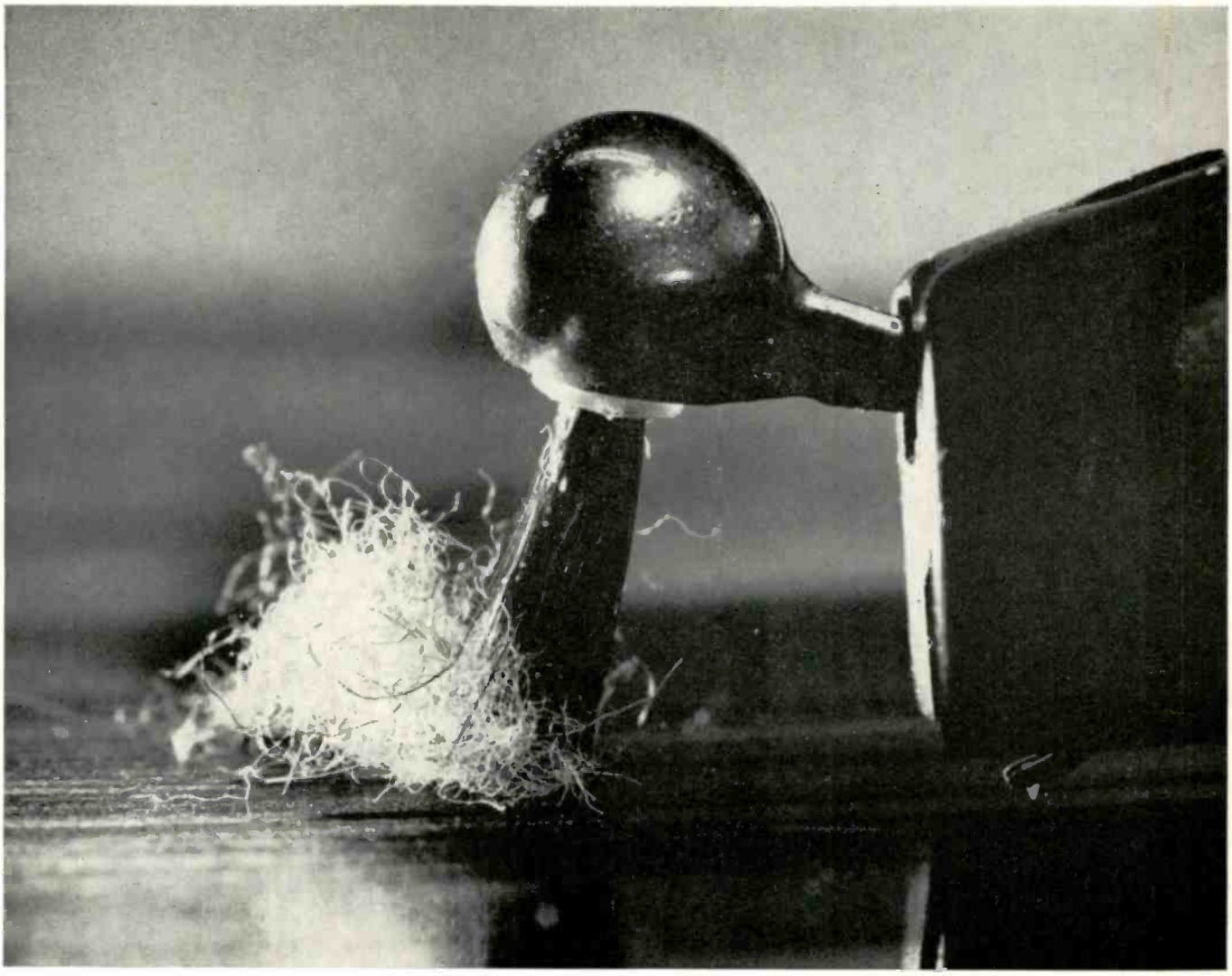
You have quite an idea with regard to the use of Zener diodes, part two of your question. I have not worked with Zeners in the manner under discussion. I would, therefore, like to hear from readers who have done so. If I get some reader response, I'll try to share this information with all of you.

The only question in my mind about Zener diodes is that they do not break down all of a sudden, but gradually as the current and voltage increase across them. If the values are properly chosen, I can see where they would offer protection to the amplifier, but I can also see where this gradual breakdown could cause nonlinearity in the signal fed into the speakers and distortion at a level below that which would damage the speakers.

There is a fourth possibility which is worth considering. A fuse could be placed in series with the speaker as has been previously described. However, a resistor whose value is equal to two or three times the speaker impedance could be placed in parallel with the *fuse*. No resistor is placed in parallel with the amplifier. In the event that the fuse blows, the amplifier will be protected because power will flow through the series combination of the resistor and loudspeaker. Signal will still be heard in the loudspeaker, but its volume will be lower than when the fuse is intact.

It should be obvious that we have an arrangement by which no power is taken from the amplifier except that required by the speaker during normal operation of the equipment. When the fuse blows, the amplifier has good protection and the speaker is still protected from all but the most severe kind of overload produced by a very high-powered amplifier. Æ

Advertising Index



You are looking at the world's only true longhair cartridge.

In this unretouched photograph, the long, black hair of the brush built into the new Stanton 581 is shown in action on a rather dusty record. Note that all the loose lint, fuzz and dust are kept out of the groove and away from the stylus. That's why the Longhair is the ideal stereo cartridge for your Gesualdo madrigals and Frescobaldi toccatas. Its protective action is completely automatic, every time you play the record, without extra gadgets or accessories.

The stem of the brush is ingeniously hinged on an off-center pivot, so that, regardless of the stylus force, the bristles never exert a pressure greater than 1 gram and always stay the right number of grooves ahead of the stylus point. The bristles provide just the right amount of resistance to skating, too.

But even without the brush, the Stanton 581 Longhair is today's most desirable stereo cartridge. Like its predecessors in the Stanton Calibration Standard series, it is built to the uniquely stringent tolerances of Stanton professional audio products. Its amazingly small size and light weight (only 5 grams!) make it possible to take full advantage of the new low-mass tone arms. And its frequency response is factory calibrated within 1 db from 20 to 10,000 cps and within 2 db from 10,000 to 20,000 cps. Available with 0.5-mil diamond (581AA) or elliptical diamond (581EL), price $49.50.

For free literature, write to Stanton Magnetics, Inc., Plainview, L.I., N.Y.

Stanton

Circle 107 on Reader Service Card

New Low Cost!
E-V SONOCASTER I
Indoor/Outdoor High Fidelity Speaker Just $25.00!

Electro-Voice slashes the cost of outdoor fun with the new Sonocaster I. Full-Sized sound, yet so small and light it goes anywhere—plays anything: AM, FM, TV sound, tape or records!

Use the Sonocaster I at your next outdoor party, or year-round in your recreation room. Place it anywhere, or hang it from its wall bracket, as you wish.

The Sonocaster I boasts such true component-quality features as an 8″ Radax dual-cone speaker, high compliance cone suspension, long-throw voice coil and acoustically damped enclosure.

The Sonocaster is completely weatherproof—even the finish. No rusting, peeling, or cracking—and the attractive Steel Gray color is molded into the unbreakable plastic housing forever!

Add the new Sonocaster I to your outdoor living. Or choose the original Sonocaster, now improved with a heavier 8″ speaker for extended range. $36.00. Pick up a Sonocaster (or a pair for stereo) at your E-V hi-fi showroom today!

SPECIFICATIONS Sonocaster: 70-15,000 cps Frequency Response; 8 Ohms Impedance; 30 Watts Peak Power Handling; 120° Dispersion; 16-3/4″ H x 17″ W x 5-7/8″ D; Net Weight 7 lbs; Dune Beige color.
Sonocaster I: Identical except 70-13,000 cps Frequency Response; Net Weight 6-3/4 lbs; Steel Gray color.
Prices include all applicable Federal taxes.

ELECTRO-VOICE, INC.
Dept. 754A, 602 Cecil Street
Buchanan, Michigan 49107

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

Circle 102 on Reader Service Card