AUDIO

JANUARY, 1962
50¢

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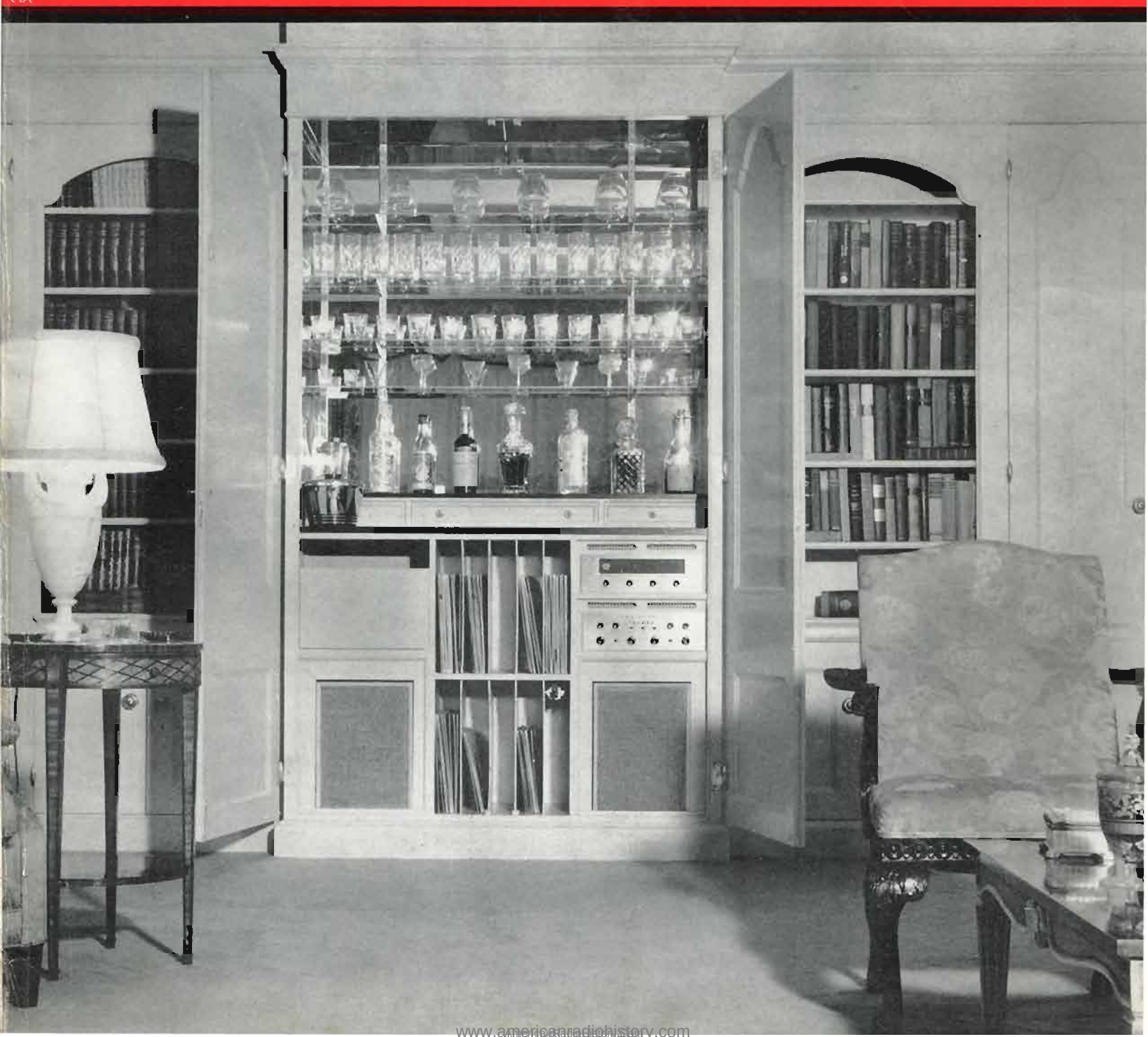

"no acoustic feedback"
"precise in performance"
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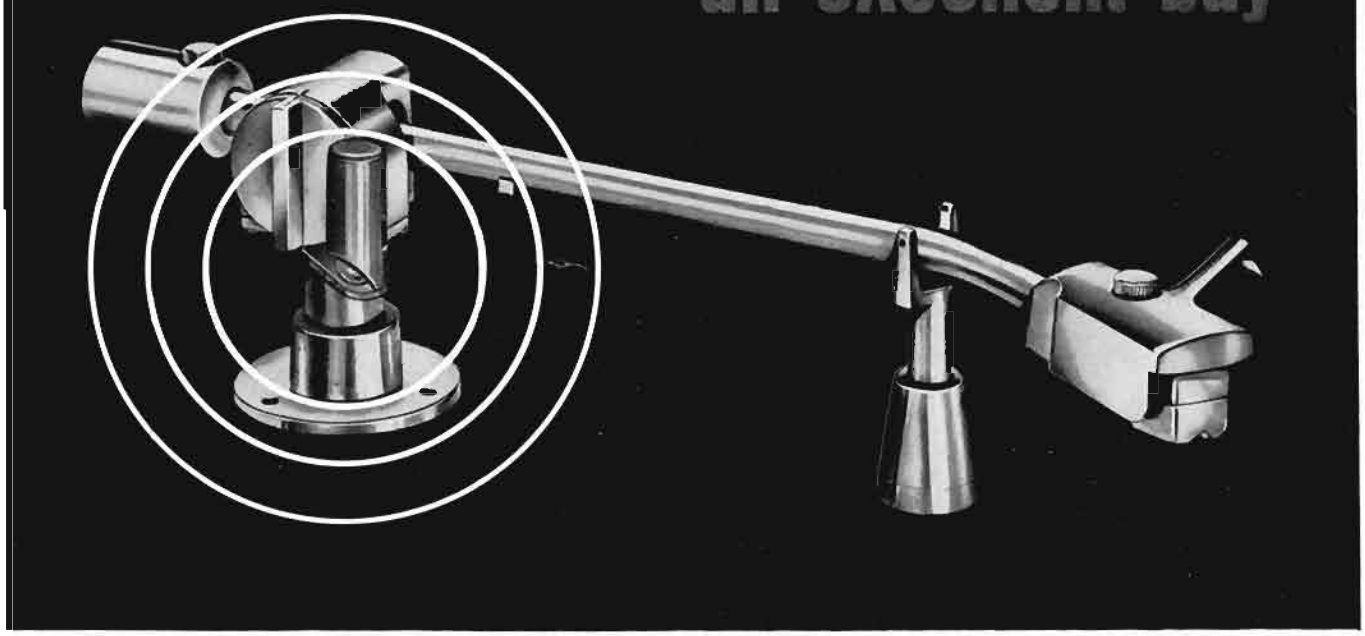
"an excellent buy"



States Audio Magazine about the New Empire 980 . . . world's most perfectly balanced playback arm. *"We tried to induce acoustic feedback by placing the turntable on top of our large speaker system and turning up the gain: we were unsuccessful."* ■ This is the new Empire 980! Featuring: the sensational Dyna-Lift* self lifting device which eliminates stylus abuse and undesirable run out groove sound at the end of the record: fundamental resonant frequency at 8 cps; cartridge overhang adjustment; exact stylus force calibrations; precise lateral and vertical ball bearing suspension; 5 wire plug in shielded cable assembly; tracks as low as ½ gram. Empire 980 Arm with Dyna-Lift, $50

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AUDIO

JANUARY, 1962 Vol. 46, No. 1

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C. G. McPROUD • *Publisher*

DAVID SASLAW • *Editor*

JANET M. DURGIN
Production Manager

Contributing Editors
EDWARD TATNALL CANBY
JOSEPH GIOVANELLI
HAROLD LAWRENCE
CHARLES A. ROBERTSON
CHESTER SANTON
HERMAN BURSTEIN

HENRY A. SCHOBER
Business Manager

SANFORD L. CAHN
Advertising Director

EDGAR E. NEWMAN
Circulation Director

Representatives
Bill Pattis & Associates,
4761 West Touhy Ave., Lincolnwood 46, Ill.
James C. Galloway,
6535 Wilshire Blvd., Los Angeles 48, Calif.

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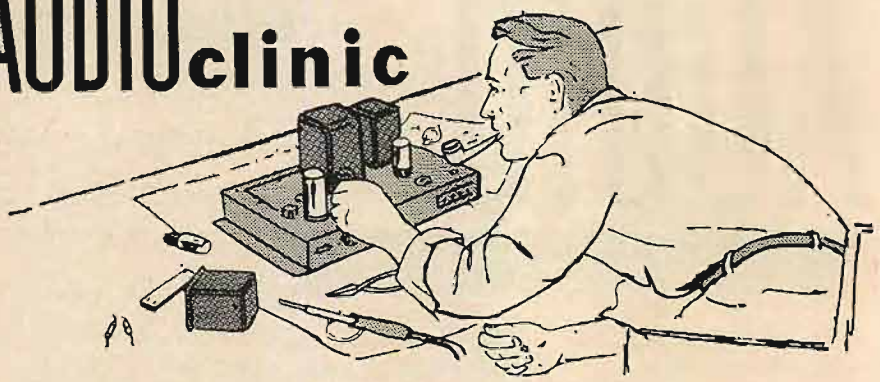


JOSEPH GIOVANELLI*

Note:

Here we are in 1962. Many of you have made resolutions. For my part, I hereby resolve to maintain my present standards of service to all of you who have so kindly expressed confidence in my column and in me. It is sometimes difficult to help some of you; do you know why? It's because you either omitted your address or printed it so badly that it could not be read. Sometimes it is impossible to determine just what you wish to know. Those of you afflicted with this particular problem, please resolve to let me read your letters by writing more clearly hereafter.

While resolving, please resolve to enclose a stamped, self-addressed envelope with your questions; that makes me able to write out more letters during the time I now must spend on envelopes.

One further point and I shall get down to the work at hand. Many of you have stated that you hesitated to write to this column because you needed immediate help and did not want to wait for the publication of the questions in the column. All that can be said is "don't hesitate." I answer all letters by mail, regardless of their suitability for use in *"Audioclinic."* It sometimes takes a long time before a particular question is used, and the writer of the question need not wait around all of that time for his answer. Many questions received and answered by me are not used in the magazine for some reason or other. These questions are given the same treatment as the material which does find its way into print. *I answer them all!*

Now, to work.

HOW DO YOU ANSWER THIS ONE?

Note: The following two questions belong in this category.

COMPONENT SELECTION

Q. I am now in the process of assembling a high fidelity system. I have narrowed my choice of amplifiers to the Marantz Model 7 and the Citation 2.

Which would you choose?

Should I buy the Audio Empire turntable or the Garrard Type A changer? John Smith, Here and everywhere.

A. Since I receive many questions of this sort, I did not want to choose one particular letter. I will, therefore, try to give all of you the only answer possible.

Equipment is available today for use in home music systems which contains a wide variety of features and is available in a wide price range.

Some installations require equipment which features inputs complete with level adjusts for each output. Others require perhaps no more than one single input circuit.

The problem of evaluating the relative merits of a record changer versus a turntable poses other difficulties. Does the user hold many parties? At such gatherings it is bothersome to change records. If the user is one who listens to complete symphonies or other works requiring more than a single record side to perform, however, he will find it necessary to turn the record over in order to hear the final portion of the performance. It is obvious that in the first instance the use of the changer would be indicated. In the second instance, the automatic features are not necessary and a turntable would be suitable.

Along with operating flexibility, operating convenience and price of the equipment, attention must be paid to the space to be occupied by the entire system. Modern homes are compact. The space demanded by the equipment producing stereophonic sound may be as important a determining factor as the previously mentioned points.

Last, but certainly not least, is the question of the sound produced by any single component of the system and the sound of the system as a whole. No two people hear the same sound system in the same way. The quality of reproduction produced by the components of your sound system may sound ideal. To obtain the same degree of pleasure, your neighbor may need to choose entirely different components. Whose judgment is more accurate—yours or your neighbor's? The answer is that you are both right.

If you think that such discussions do not pertain to live music, listen to those sitting near you at a concert as they discuss orchestral balance as heard at that concert. There again all ears do not tell the same story.

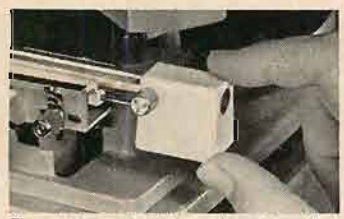
Well, then, how do you—you alone—select your components? In the first place, what do you want your system to do for you? You do not know? Read as much as you can about high fidelity. Note the various forms in which a sound system may be

* *3420 Newkirk Ave., Brooklyn 3, N.Y.*

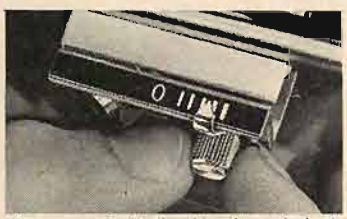
GARRARD's NEWEST...

AT6
AUTOMATIC TURNTABLE

Here, in its brilliant tone arm, you see a striking example of the calibre of Garrard design and engineering. For up to now, you would have had to buy this type of arm as a separate component. A cast aluminum tubular tone arm, dynamically balanced and counter-weighted—it is a professional arm in every respect—yet it comes integrated with the AT6, assuring perfect installation. This is just one of the precision features that enable the AT6 to deliver the quality performance required of a Garrard Automatic Turntable, built for knowledgeable, critical listeners. All the skill, the experience and the established facilities which the Garrard Laboratories have put behind the development of the Type A (most desired of all record players) have also gone into the AT6. Yet this new automatic turntable is so compact in design that it has been possible to price it at only **$54.50**



The AT6 arm is balanced and tracking force adjusted in two easy steps: First... it is set on zero tracking pressure, by moving the counter-weight until the arm is level, in perfect equal balance.



Now...you fix the tracking force desired, on the built-in stylus pressure scale conveniently mounted in upright position at the side of the arm.

The AT6 will now track each side of the stereo grooves accurately at the lowest pressure specified, even for cartridges labeled "professional", and even if the player is intentionally tilted.

The plug-in shell will accommodate any stereo cartridge you favor, and the bayonet fitting with threaded collar, assures rigidity, banishes resonance.

The turntable is oversized, heavy, and balanced. Torque is high, yet there is no noise, no wow, no waver, no interference with the sound of your records.

Garrard's Laboratory Series motor, in a version designed and built especially for the AT6, delivers perfect speed with complete silence—and it's double-shielded against magnetic hum.

The convenient short spindle for single play is interchangeable with the automatic center-drop spindle, which removes for safety in handling records.

While on automatic play, AT6 will accept a mixed set of records—any size, any sequence. For in addition to its other features, AT6 is an intermix changer, affording complete record-playing luxury.

FOR LITERATURE WRITE DEPT. GA-12 GARRARD SALES CORP., PORT WASHINGTON, NEW YORK.

There's a Garrard for every high fidelity system... all engineered and wired for Stereo and Monaural records.

Type A
Automatic Turntable
$79.50

AT6
Automatic Turntable
$54.50

Autoslim
Intermix Changer
$39.50

Model T/II
Manual Player
$32.50

Canadian inquiries to Chas. W. Pointon, Ltd., 66 Racine Road, Rexdale, Ontario Territories other than U.S.A. and Canada to Garrard Engineering & Mfg. Co., Ltd., Swindon, Wilts., England

built. Examine typical home music systems at your dealer. By now, you should have an idea of your own requirements.

From what you have learned, select the various sets of components which you believe will meet your needs. Make your selections of components with the space limitations of your home in mind, as well as the limitations of your budget. Never test systems or components which do not conform either to your space or budget limitations. Go back to your dealer. Have him connect one of your chosen systems for you. Then have him change *one* of the components of the system—i.e., the cartridge. Using the same recording, note which of the two cartridges sounds better to your ears. Compare the one which sounds better to you with a third cartridge. Again select the cartridge which sounds best to you. (I do *not* attempt to compare all three cartridges at once.) After your final choice of cartridge, use this cartridge in testing all other components of your music system. Proceed in like manner when selecting the units for the rest of your system. In other words, if the speaker is the next thing to be selected, compare one speaker to another and select the one which sounds best. Then compare that one with a third one, and so forth until you find one which suits *you*.

After making your selections of components according to what sounds best to you, pay for them, take them home and enjoy them.

TO PLAY MONOPHONIC RECORDS

I have a high-quality monophonic amplifier and high-quality speaker system. This system is used to play monophonic records only. I have about 1000 33⅓-rpm high-fidelity monophonic recordings, all purchased in 1955 or after. The automatic changer I use has a magnetic monophonic cartridge ($20 with diamond variety), about 1958 design. It tracks at about 6 grams. I intend to buy a later model automatic changer with removable spindle for single or automatic playing. With the new changer (which will track at 2 or 2.5 grams) I want to buy a better cartridge ($30 to $35 with diamond variety) and with the stylus replaceable by the user.

In checking I find that available cartridges are mostly stereo. Everybody tells me that the stereo cartridge of 1960 or 1961 design ($30–$35 variety) will give better monophonic reproduction with the two outputs paralleled than my 1958 $20 monophonic unit. When asking about a 0.001 or 0.0007 mil diamond stylus to use in a stereo cartridge for monophonic records only, I get different answers.

My specific questions are:

1. Will a 1960–1961 design ($35) stereo cartridge give better reproduction than my present 1958 $20 monophonic cartridge?

Do you know of a quality magnetic unit?

2. The $30–$35 stereo variety cartridges can be had with either 0.001 or 0.0007 mil radius stylus. Bearing in mind that I will use this cartridge only for monophonic records which radius stylus should I get? Samuel Podell, Newburgh, N. Y.

A. Even in the days of monophonic sound, cartridges suffered from the effects

(*Continued on page 68*)

Langevin

Breakthrough!

ROTARY MIXERS

SINGLE

2-GANG

3-GANG

First basic improvements in mixer design in 20 years • Smooth instrument-type action with feathertouch • Available in single, dual and triple gangs for modern stereo use • Compact design allows replacement of single controls with 2 gang units in FM Stereo conversions • New balanced circuitry for complete cut-off • No maintenance — no cleaning required for decades of noise-free use

SMOOTH ACTION FOR EFFORT-FREE CONTROL
Only four grams of static friction need be overcome to accomplish rotation of Langevin Mixers. Effortless control is the result of long research into the mechanical requirements of friction-free bearings and brushes along with the employment of modern printed circuit techniques for the contact rows.

SUPER ACCURACY THROUGH PRINTED CIRCUITS
Correct contact positioning is guaranteed through printed circuitry derived from master layouts made on dividing heads. This insures satin-smooth, low-drag, bump-free action as the control is rotated.

LONG, TROUBLE-FREE LIFE IN EXCESS OF 100,000 CYCLES
Langevin controls have a noise-free life expectancy in excess of 100,000 cycles. Low, uniform contact pressures decrease wear and give decades of service without cleaning.

SEALED AGAINST DIRT AND CORROSION
Langevin Mixers are pre-lubricated and sealed against moisture, corrosion and dirt for life-time use. Cycling and accelerated aging tests prove quiet operation for the life of the control.

GOLD PLATED CONTACTS FOR LOW NOISE OPERATION
All contacts in Langevin Controls are gold-plated. Gold is a noble metal and does not form noise producing oxides. Alloys such as nickel, nickel silver and brass do form oxides, which are insulators and produce noise as time passes. Contrary to popular belief, the gold does not wear off of the contact, but, rather, galls and works its way into the pores of the base metal through usage. This increases conductivity and smoothness with age.

GENERAL DESCRIPTION
Langevin Rotary Mixers and Attenuators are available in three diameters, as well as in single, double and triple gangs for two and three channel stereo use. Printed circuitry is employed throughout for precision and uniformity. Contact decks are formed of non-hygroscopic phenolic, type FBE. Stainless steel shafts and brass bearings are used for long life, non-seizing properties, and to give friction-free action. Frames are formed of satin-black anodized aluminum. A universal mounting bracket allows replacement of all attenuators and mixers of alternate make because of three different mounting centers provided. These are 1⅜", 1¼" and 1½". All connections are conveniently made to solder terminals at the rear of the control, facilitating wiring and making a neater appearance. An extra "C" center or common terminal is provided on each control to eliminate two wires to the usual "common". This also gives balanced circuitry on the interior of the control, allows maximum cut-off, and eliminates crosstalk. In addition, this makes for easy test and wiring changes. Case grounds on all Langevin controls appear on another terminal, completely separated from signal ground, or "C" common. Controls are sealed against dirt, moisture and corrosion. All units are available with and without detents or Cue Circuit.

POPULAR TYPES OF ROTARY MIXERS—ALL OTHER TYPES AVAILABLE
The "MX" suffix on these units listed below denotes "mixer" function and these attenuators are not supplied with detents unless specified (no added charge for detents). Units are tapered to infinity, come supplied complete with knob, dial plate etched to suit and universal mounting bracket. Standard impedance unless otherwise specified is 600 ohms in and out. Other standard impedances of 150, 200, 250, 500 and 600 ohms in or out supplied in any combination if specified at no additional charge; add 15% for impedances in or out not standard to prices shown. Specify if cue position is desired; charge is $3.00 single, $6.00 dual and $9.00 triple gang. If no knob or dial is desired, please specify; deduct allowance of $0.75 for knob and $0.75 for dial.

						SINGLE			2-GANG			3-GANG		
Model	Circuit	Steps	DB/Step	Curve	Insertion Loss in DB	Diameter "A"	Length "B"	Price, Net	Model	Length "B"	Price, Net	Model	Length "B"	Price, Net
MX-201	Ladder	20	2	A	6	1½"		12.00	MX-201-2		22.50	MX-201-3		31.50
MX-202	Balanced Ladder	20	2	A	6	2¼"		24.50	MX-202-2		45.00	MX-202-3		66.00
MX-203	Ladder	32	1½	B	6	1½"	1⅜	19.50	MX-203-2		36.00	MX-203-3		52.50
MX-204	Balanced Ladder	32	1½	B	6	2¼"		28.00	MX-204-2	2⅞	51.00	MX-204-3	4	74.00
MX-601	"T"	20	2	A	0	2¼"		24.50	MX-601-2		45.00	MX-601-3		66.00
MX-604	Balanced "H"	20	2	A	0	2¼"	2⅞	57.00						
MX-602	"T"	32	1½	B	0	2¼"	1⅝	28.00	MX-602-2		51.00	MX-602-3		74.00
MX-605	Balanced "H"	32	1½	B	0	2¼"		60.00						

*With de luxe K-111 WE type mixer knob or K-108 RCA type knob, add $1.50 (please specify).

BRUSH CONTACT IS GOLD PLATED
Brush contacts are also formed of gold. Thus, no electrolysis takes place between the contacts and brushes, further insuring quiet operation.

QUIET OPERATION IN LOW-LEVEL SERVICE
The combination of accurate printed circuitry for uniform contact, non-oxidizing gold and low brush pressures give noise free operation at —130 dbm. This means satisfactory operation before preamplification for low-level service.

"Over thirty-five years of audio progress"

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LETTERS

Sineward Distortion Again

SIR:

Old "Demagogue John" has certainly made an intriguing point in his article on "Sineward" distortion in the November issue. Even if only a refocussing of emphasis ("Oh, we knew that all the time"), any concept that can lead to the results Mr. Campbell describes is worthy of serious consideration.

I am eagerly awaiting the reactions to this article from you "regulars," the professional audiomen. There ought to be some nice fireworks.

JONATHAN S. ROOT
206 East 25th St.,
New York 10, N. Y.

(There was, too. In fact, too much for this column. Next month a full roundup of the comments. But following is one more. ED.)

SIR:

What are you trying to do, start a fight? John Campbell's "Sineward" article in the November issue could do just that.

For more than thirty-one years the writer has made his living in the field of high quality sound. Mr. Campbell is a fine writer but I find it hard to believe he is serious. If he is—and if he is right—I've been an awful fraud for a long, long time.

WILLIAM N. GREER,
William N. Greer Associates,
Radio Engineering Consultants,
511 El Imparcial Building,
San Juan, Puerto Rico

(You said it, we didn't. ED.)

Electronic Organs

SIR:

Mr. Wolkov's article on the electronic organ certainly does not tell the complete and unvarnished story of the instrument nor of its many drawbacks and limitations, but holds the pipe organ up to ridicule and scorn.

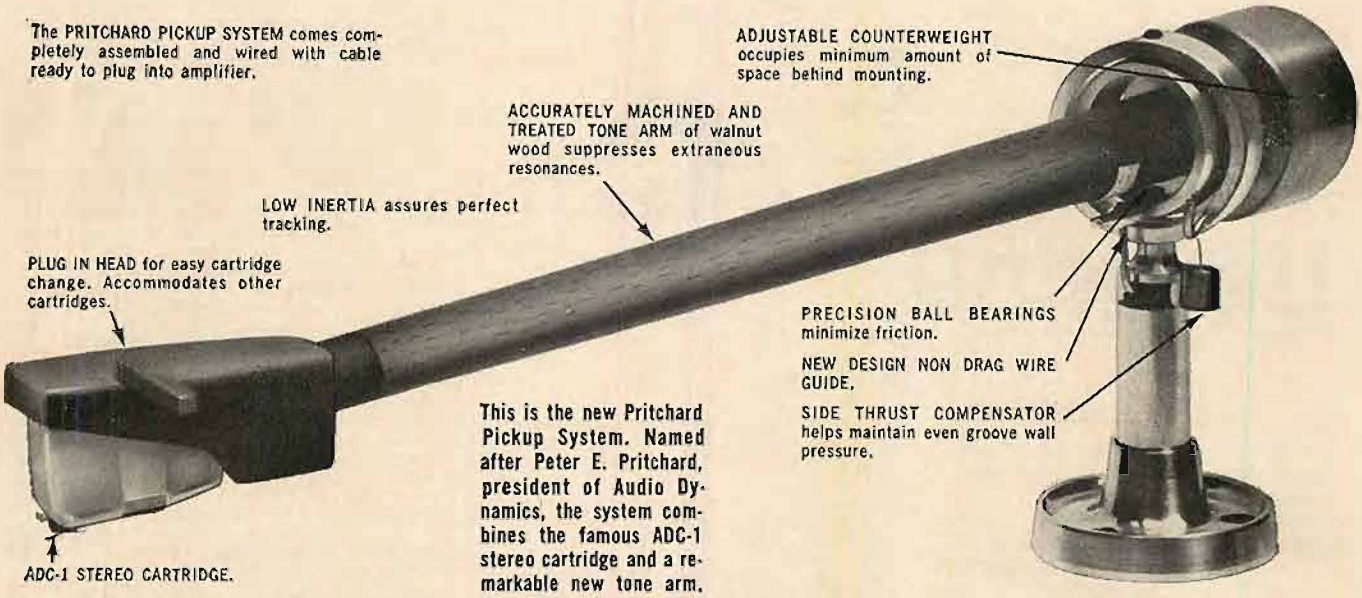
In the first place, which of the various electronic organs is high fidelity? I have examined many of them and have yet to find one which has harmonics higher than 7500 cps, and this is true only with some of the better vacuum-tube oscillator types. The chromatic magnetos, using their own higher frequencies as additives, have an upper frequency limit of slightly over 5000 cps. Certainly the accepted definition of high fidelity implies a frequency spectrum greater than this. Coupling an electronic organ into a really high fidelity amplifier and speaker system is a serious mistake, as it shows up all of the inherent defects of the instrument and reproduces the inharmonic distortion products and keying noises which are most distressing.

Why does an electronic organ have to be a cheap imitation of the real thing? Why do all of the manufacturers strive to produce a facsimile of the pipe organ, when the electronic should emerge as an instrument in its own right?

The article fails to state that the tone color of a particular stop is seldom uniform throughout its compass. The reeds, for example, may sound passable in the middle octaves, but they will go "flutey" in the bass. This is not true in the pipe organ. Those electronics with locked oscillators are totally lacking in ensemble, and are sterile sounding because this is an unnatural condition for complex wave forms to be heard.

True, the electronics designers have made

(Continued on page 10)



This is the new Pritchard Pickup System. Named after Peter E. Pritchard, president of Audio Dynamics, the system combines the famous ADC-1 stereo cartridge and a remarkable new tone arm.

REMARKABLE NEW SYSTEM TRACKS AT 3/4 GRAM!

Audio Dynamics presents an entirely new concept in pickup design that marks a new era in record playing performance by guaranteeing the five essentials of stereo reproduction.

In designing a cartridge for high quality tone arms, Audio Dynamics engineers perfected the highly compliant ADC-1. This cartridge made it possible for the first time to achieve the five essentials of true stereophonic reproduction.

Now Audio Dynamics has gone a step further... they have designed a remarkable tone arm and combined it with the ADC-1 in an entirely new pickup system. Results? The five essentials of true stereo reproduction are guaranteed!

Although the ADC-1 raised stereo reproduction to levels never before possible, this highly compliant cartridge has to be combined with a quality tone arm. The combination must enable the cartridge to track at a force low enough to eliminate distortions and record wear, and also preserve the linearity of the stylus tip suspension. Selecting the proper tone arm was a problem for the buyer. The new Pritchard Pickup System eliminated guesswork. It combines the ADC-1 and a newly designed tone arm that is compatible with this outstanding cartridge.

The Pritchard Pickup System gives you a true, dynamically balanced tone arm. Unlike other systems, the heavy adjustable counterweight occupies a minimal amount of space behind the pivot. To adjust stylus tracking you simply move the counterweight until the arm is in perfect balance. Fine adjustment allows the system to track at the precise force required by the cartridge design.

Because of its low inertia the system will track each side of the groove perfectly even if the record is warped. To stabilize the force created between the disc and the arm, a side-thrust compensator permits the stylus to maintain even pressure on both groove walls. Precision single ball bearings in gimbals minimize vertical and lateral friction.

If you are an owner of an ADC-1 stereo cartridge all you need for a major improvement in your system is a Pritchard tone arm. If you do not possess the ADC-1 and are searching for some way of upgrading your present set of components, visit your dealer and hear how the Pritchard Pickup System makes records sound better than you thought possible. Once you have, you will not settle for less.

For descriptive literature on the Pritchard Pickup System by Audio Dynamics, write to us today.

Pritchard Pickup System Model ADC-85 **$85.00**
Pritchard Tone Arm Model ADC-40 **39.50**

Here are the five essentials of true stereo reproduction. They are yours with an ADC cartridge.

Essential #1—Highs free from peaks and distortion . . . by lowering stylus mass and eliminating heavy damping.

Essential #2—Clean and well rounded bass tones . . . by increasing compliance, lowering tone arm resonance.

Essential #3—Record compatibility . . . through lowered tracking force.

Essential #4—Proper channel separation . . . by removing resonances from the audible range.

Essential #5—Reduced surface noise . . . by eliminating resonances and using super-polished diamond styli selected from perfect crystals.

ADC-1 cartridge for high quality tone arms. $49.50

ADC-2 cartridge for high quality tone arms and record changers $37.50

AUDIO DYNAMICS CORPORATION

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Please send me descriptive literature on the Pritchard Pickup System and ADC cartridges.
Dept. A-1

Name_____

Address_____

City_____

Name of My Dealer _____

CHESTER SANTON*

The symbol ✪ indicates the United Stereo Tapes 4-track 7½ ips tape number.

Don Baker: The Sound of 94 Speakers
Capitol ST 1626

This stereo disc will interest anyone who has been following the fortunes of the electronic organ. The ninety-four speakers heard in this release are part of the three-manual, 600-note Rodgers organ. Last July, Capitol sent Don Baker and a recording crew to Portland, Oregon with instructions to stay there until they had figured out a way to record the speaker arrays of the Rodgers organ located in that city's ultra-modern, 14,000-seat Coliseum.

In order to distribute sound to every seat in the house, the Coliseum technicians had mounted the 94 speakers in 32 enclosures. These, together with 26 amplifiers, were placed in a two-ton "basket" suspended from the center of the arena ceiling. Pointing slightly downward, the enclosures form a huge square whose sides radiate sound throughout the entire arena.

After considerable trial and error, the final microphone placement agreed upon consisted of two mikes suspended from the ceiling at opposite sides of the "basket" and about 35 feet away from it. For best stereo results, the speakers were rewired so that the voice families would be grouped at left and right.

The organ itself is quite a unique affair. It is completely electrified, using neither simple pneumatic nor electrical-pneumatic action. Housed within the console, are 600 separate match-box-sized transistorized etched circuits —one for each tone the organ produces. Don Baker, who has played every type of organ, claims the Rodgers is the only electronic job with authentic pipe organ tone. He may be right although it is not easy to judge the full capability of this organ in the program of movie tunes played by Baker. The dynamic range of the music offers no great challenge to the instrument. Adequate variety is displayed in the voicing considering the limitation imposed by themes used for background in motion pictures. Any low-distortion recording made under these circumstances is an impressive achievement. I'd like to hear the same live acoustics put to more exciting use in some future release devoted to some of the showpieces in the organ repertory.

How To Succeed in Business Without Really Trying (Original Broadway Cast)
RCA Victor LSO 1066

In the latest Frank Loesser-Abe Burrows show, Broadway has its first smash hit in several seasons. You can sense it immediately in the morale of the cast as soon as the overture is over. You realize then what a troublesome item the lack of applause the night before can be when the company assembles for a recording session. From the first words of "How To", this cast is really on the ball and rides it with virtuosity to the last shout of the finale. Stereo itself takes on fresh glitter in the process. "How To Succeed in Business" should do as much in spreading the popularity of stereo recordings as "South Pacific" and "Kiss Me Kate" did in converting to LP the show public of an earlier day.

Tossing of hats in the air at this date may be anticlimactic after the theatre critics have already plastered the ceiling with theirs but this recording rates a place with the very top show albums. The book by Shepherd Mead becomes a sharp-pointed stepping stone to an even more cutting script by Abe Burrows, Jack Weinstock, and Willie Gilbert. The lyrics and sly music of Frank Loesser are in a class with his great score for "Guys and Dolls." Two years in preparation, the show was put together under the working system that director Abe Burrows has found successful in past shows. The mocking humor of this spoof of big business hits its mark so unerringly because Burrows did not start work on the lines until he had selected the key actors who would deliver them. To play the role of the deftly scrambling hero, J. Pierpont Finch, Burrows and Loesser chose Robert Morse whose work in "The Matchmaker," 'Say Darling," and "Take Me Along" had caught their fancy. Rudy Vallee was a natural choice for the part of J. B. Biggley, the president of World Wide Wickets Company, because Burrows became closely familiar with the Vallee comedy talent back in the days when he wrote the hilarious radio shows that starred Rudy and John Barrymore. Vallee appears in only two songs on the record—*Love From a Heart of Gold* and a college-type song *Grand Old Ivy*. He is A-1 in both of them. Morse carries most of the plot with *The Company Way, Been a Long Day,* and *I Believe in You*. The last item is delivered to the reflection of his own face in the mirror of the executive's washroom. Joining the sound of the orchestra at that point is the buzz of a group of electric shavers wielded by the unhappy executives Morse has bypassed in his climb up the corporate ladder.

In producing the recording for RCA Victor, George Avakian and Joe Linhart have taken special pains in capturing each word of the chorus—an important point in this show since most lines have a witty twist that deserves to be heard.

Congratulations are very much in order for all those concerned in one of Broadway's brightest undertakings.

Milk and Honey (Original Broadway Cast)
RCA Victor LSO 1065

In its stereo version, this new Broadway musical based on present-day life in Israel marks a minor landmark in show albums. "Milk and Honey" was selected by RCA as the first recording project to simulate the stage action of the principals in the actual Broadway production of the show. The idea is certainly a laudable one. I go along with those listeners who contend that most stereo original cast recordings have not been venturesome enough in the use of motion on the part of the players. Perhaps it is asking a lot to saddle a busy recording director with an extra chore of this kind when he already has his hands full trying to get reasonably consistent levels on the meters from cast members facing a mike for the first time. Partly as a solution to problems facing a control room crew on such occasions, RCA decided to move this cast by means of electronic gear similar to that used in its Stereo Action series of pop recordings. How does it work out in practice? The "motion" of the actors, as you can imagine, has a mechanical smoothness not immediately associated with human behavior. The movement is plausible enough so long as the singer moves gradually across the stage. The effect becomes artificial when the shift of sound is sudden and hasty. I assume the motion appears less abrupt and rapid if the singer moves only three feet when going from one loudspeaker to another in the course of a phrase. I'll content myself with an assumption because I don't intend to go out and buy a narrow console in order to find out. Where speakers are six feet apart, the shift is too abrupt for my taste. There can be no objection on the part of the listener if more stage action is incorporated into future original Broadway cast recordings . . . provided the movement of the cast is under the strict control of the stage director. It is hard to believe that the man who staged "Milk and Honey" attended the recording session and heard all the numbers of the show on a normally-spaced stereo monitoring system. Just as no Broadway producer would permit a record company to change the lyrics of his show, so too will the producer begin to insist on recording proceedures that are faithful to the actions of his players.

In theatrical terms, "Milk and Honey" is another example of a Broadway show with a refreshing idea that is not quite developed to its full potential. Here was a chance to undertake a really colorful score yet only three of the thirteen numbers on the record draw upon the music and dances of Israel for source material. These include *Shalom* and *The Wedding* as sung by Met stars Robert Weede and Mimi Benzell in the leading roles. The wildly infectious rhythms of the *Independence Day Hora* provide the only other highlight amid a large number of average love songs. Molly Picon, for fifty years the first lady of the Yiddish theater, makes her first Broadway musical comedy appearance in this show and seems to steal a good part of it on the basis of her two songs on the record. Jerry Herman's music has a strong lyric line for a 30-year-old composer invading the Main Stem for the first time but the Manhattan influence is too prominent in an Israeli locale.

There was no suggestion of milk or honey in the pressing RCA sent out for review. I assume future copies of the disc will have less sibilance than mine did.

Ella in Hollywood
Verve ✪ VSTC 259

With the exception of Paul Smith (replaced at the keyboard by Lou Levy) Ella works here with the same group that accompanied her in a recent European tour. Jim Hall, guitar; Wilfred Middlebrooks, bass; and Gus Johnson at the drums take part in this performance before an appreciative audience at the Crescendo in Hollywood. The powerhouse arrangements melt down at least the first layer of audience sophistication as Ella tears into a typical program that includes one of her newer hits—*Mr. Paganini. You're Driving Me Crazy* starts out with a Latin flavor and then dissolves into a realistic demonstration by Ella of a torment generally found only in the mind of a song writer. A soft hued *It Might As Well Be Spring* is followed by a double-deckered *"A" Train* that runs for a full nine-and-one-half minutes with Ella supplying most of the fuel. In this tune and in *Air Mail Special,* the presence of a hep audience encourages an extension of some of the typical Fitzgerald antics. The blistering tempo of *Air Mail* has Ella confessing in an aside to the crowd: "I almost bit my tongue that time." The by-play throughout the album sets up a relaxed mood that many listeners will prefer to the usual formal studio session.

Manny Albam: More Double Exposure
RCA Victor LSA 2432

If this release isn't the last word in stereo motion on records, it will certainly do for a month or two until the next RCA Stereo Action extravaganza comes along. Not only does the sound slide from speaker to speaker on a more frequent schedule than we've been used to in the past; the twenty tunes in the

* *12 Forest Ave., Hastings-on-Hudson, N.Y.*

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album are played two at a time. This isn't the first time that popular tunes have been paired in this fashion. It is, however, my first encounter with dual melodies that are made to crisscross in Manny Albam arrangements. At the start of things, *Stompin' at the Savoy* emerges from the right speaker with *Johnson Rag* cropping up in the left speaker. The trombones in *Stompin'* lead the way to the left speaker—the reeds then take *Johnson Rag* to the right.

Manny Albam, one of the busier arrangers on the New York recording circuit, has written for three groups in this release, each recorded at a different session. A standard dance band is used for classics of the swing era such as Duke Ellington's *C Jam Blues* and Count Basie's famous theme song *One O'Clock Jump*. Another Albam band features five flutes. The third group places much of its trust in thirteen strings and harp.

Interlocking melodies of this kind present a sizeable challenge to a system's ability to maintain the identity of each instrument as it moves through the ranks of the instruments going in the opposite direction. One quirk in the instrumental sound has me puzzled. The trumpets, although stationary, tend to break up in the upper frequencies on a wide-range system.

How To Be Terribly Funny
Riverside RLP 7516
Shelley Berman: A Personal Appearance
Verve 15027

Working on the theory that one comedian may wear thin before a record is over, Riverside has put together a comedy bill that offers six humorists. Peter Ustinov and Henry Morgan carry off the major honors in an album that also features the highly diverse talents of Stanley Holloway, Louis Nye, Ronnie Graham, and George Crater. Ustinov and Morgan have the advantage of distinctive comedy accents. In his two appearances, Peter Ustinov is heard in samples of his sports car material. His sly gibes at the jargon of racing is rated tops by many impartial connoisseurs of higher-grade comedy. The story of Little Red Riding Hood is a perennial Henry Morgan favorite. In earlier recordings he has done it in French style; this time it is a modern Russian fable. Madison Avenue slogans are the backbone of Louis Nye's material and Stanley Holloway digs further into the vein of stories dealing with Albert and the lion. George Crater's wry slant on jazz is already well known to readers of his column in *Down Beat*. Here he develops further his plan to invent Wind-Up Dolls representing leading jazz figures.

Shelley Berman's latest recording includes more than average pantomime for the benefit of the audience heard on the disc. In some of his stories, he still relies on speed of delivery to reap his laughs. The Berman "phone calls" would lose much of their punch if he actually waited for the other half of the conversation allegedly taking place. Unlike many record comics, Berman gears his pace to the sharpest segment of the live audience. In a sense, this is a flattering gesture toward the record audience as well. Berman is really carried away by some of his stories in this release. The home listener will be puzzled on more than one occasion by the fever pitch of his anecdotes.

Sound Effects Library
Offbeat 5702/4

These three records form the nucleus of a new library of sound effects now being offered through channels of distribution that are open to the public. Although material of this type has been available to the trade for decades, few record shops carried in their stocks the specialized sounds once used in quantity by radio and television stations. Offbeat 5702 is limited to carnival sounds. 5703 and 5704 cover a broad field and should prove useful to tape fans looking for musical bridges to accompany the showing of home movies and color slides. These two discs offer a total of eighty backgrounds, bridges, and effects of every conceivable description, played on an electronic organ by Paul Renard. With a choice that great, the possibilities for straight presentation or levity in a background tape are almost limitless. Sound is more than adequate for dubbing to 7.5-ips tapes.

Glen Gray: Shall We Swing?
Capitol ST 1615

It was arranger Billy May who sold the Casa Loma head man on the idea of this album devoted to swing arrangements of the classics. The spark that set off the project was Billy's modern, big-band arrangement of a melody from Cesar Franck's well-known "Symphony in D Minor." Upon hearing what May had done to a somber theme with trombones and saxes, Glen Gray encouraged Billy to take on a cross-section of the classical and near classical repertory. Usually, a gambit of this nature seldom ventures beyond the best-known tidbits of Tchaikowsky and Rachmaninoff. Here the Franck piece served as a springboard to Dvorak's "Humoresque," Brahms' "Hungarian Dance No. 5," and Rubinstein's "Melody in F." Billy May saved his heaviest ammunition for Ponchielli's "Dance of the Hours," and Von Suppe's "Poet and Peasant Overture." These two favorites offer the best example of Billy's proficiency in handling a heavy mass of sound in an effortless manner. Brasses and reeds occupy their own channels without the loss of contact that occasionally occurs when directionality is uppermost in the mind of the recording director.

Whittemore and Lowe: Immortal Music from the Movies
Capitol ST 1599

Normally associated with Capitol's classical releases, the duo-piano team of Arthur Whittemore and Jack Lowe has chosen movie music for the first pop release on that label. The results are several notches above the typical movie album and far more enjoyable than most of the percussion arrangements that have burdened Hollywood's tunes during the past year. In making their selection from the top films of the past twenty years, Whittemore and Lowe are treading on the safest ground within the movie capitol. Just about every important name in the roster of major film composers is represented here. Backing the two concert grands are three different orchestral groups. In the more dramatic selections, harp, timpani and a quartet of French horns fill out the string orchestra. A wordless choir, with string quartet and English horn, emphasizes the folk-like quality of "How Green Was My Valley" and "The High and the Mighty." "Ruby" gets a soft Latin treatment with discreet bongos. An ensemble of woodwinds, accordian and rhythm delivers the lighter touch required for *Hi-Lili, Hi-Lo*. Throughout the album, Whittemore and Lowe justify their position in the spotlight with a standard of taste that doesn't crop up every month in material from Hollywood. AE

LETTERS

(from page 6)

great progress in imitating the pipe organ, and some of the newer designs have eliminated the blurps and key clicks. One company is even injecting white noise to simulate the chiff of the baroque pipe voicing, but why must they devote all of this energy to being imitative when with the wonderful world of electronics before them they could do something original?

All of their stop nomenclature is derived from the pipe organ, and even after 30 years, the work of Louis Theremin remains as the only original work in musical electronics.

It all adds up to the fact that "wheezing air pipes" still sound the best, and after all, the ear is the final judge.

RICHARD C. SIMONTON,
Toluca Lake, California

(*But really, Mr. Simonton, not all of us have* two *pipe organs in our homes!* ED.)

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PHASES OF THE HI FI MOON

I. HEADPHONES

What about headphones?

I am still unable to get over my astonishment at the dramatic rise of the lowly headphone, after all these years of reputational degradation. Suddenly, phones are a sensation, and in these last months dozens of brands of "hi fi" phones have been made available for the purpose of home listening, where a half-dozen years ago phones were still mainly used by telephone operators, tank crews, airplane pilots, radio men, and a handful of hi fi cranks who were obviously out of their minds. *Headphones?* Who could imagine, a half-dozen years ago, that advertisers today would be billing headphones as more desirable than loudspeakers!

It's clear, whatever the billing, that phones are heading toward the top in the scale of desirability, if it is a somewhat zany and decidedly diffuse top right now. Headphones are wonderful but nobody is really quite sure what they are supposed to be for—though they are for "hi fi," naturally. What area of hi fi? Home use mainly? Professional use? Both, via the same model? (Natch. Any sensible manufacturer will try to play both sides of that sort of selling appeal, if his equipment warrants it.) One-channel? Two-channel? For records and tape? For radio broadcasts? For voice? For music?

For home recording, monitoring and playback? For professional recording, the same? For stereo? For binaural? For mono?

And so headphones are billed for everything, so long as it can be called hi fi. Headphones for the living room and headphones for the patio. Headphones, (maybe tomorrow) for the swimming pool and for the skin diver's hi-fi helmet. Headphones for the bedroom (while your husband, or wife, snores beside you). Headphones for the bathroom and the living room and maybe the kitchen. Keeps out that noisy frying sound. Headphones for "stereo" listening, with or without a Bauer Circuit. (We've been through all that.) Headphones for the tape machine as well as the phono player. Above all (I say) headphones for the greatest recording hobby of all and the only area where headphones are *essential* as well as desirable—true-binaural home recording.

All this and more, and along with such omnivorously joyous thinking goes an equally inspirational approach to headphones design; for you must fit your phones to their purpose, match them to the situation in view and, especially, to the equipment with which they will have to operate.

Plug Them in—to What?

Now at this stage of our hi fi development, practically no home equipment provides specifically for two-channel headphone listening. If it does, then the phones are assumed to be high-impedance, as phones mostly have been these dozens and dozens of years back. Even the professional tape recorders have monitor phone jacks intended for high-impedance phones, or at most middle-impedance.

But virtually all the new home-style (and professional) hi fi phones, even so, are low impedance—very low. They range in ratings from 4 to 8 ohms. They will not work out of "conventional" phone jacks, whether mono or twin-channel, even if the plugs happen to fit. (They often don't. There are several sizes of phone plugs and they come in several contact styles, including three-contact and four-contact as well as two.)

Moreover, those phones that do happily find a home at your amplifier's speaker output, with matching jack *and* the right impedance, are likely to go up in smoke the instant you try them. Headphones are more sensitive than loudspeakers and their tolerance of hefty outputs is *extremely* limited. Just plug them into your (low impedance) amplifier output and turn up the volume control if you want to discover what happens. Short of a quick burnout, I've heard my phones squawking right out loud in horrible distress from as far away as twenty or thirty feet—if they had been on my ears, I would have lost a far more valuable pair of transducers than any pair of phones.

No, most won't work off those very useful in-between output circuits, the cathode follower and its relatives, which provide a medium-high impedance match that is low enough to allow for long cables and no shielding, an immensely helpful factor in the front-end area of all sorts of sound equipment. Low enough to obviate shielding, but not low enough, alas, to drive a low-impedance headphone properly. Yes, you can hear the music, with loudness that varies from brand to brand among the hi fi phones but never anywhere near loud enough to please. Worse, if you turn the volume up (when there is a volume control) you will inevitably reach a point where the amplifier is severely overloaded, drained dry, with resulting violent distortion in your phone sound. (On one tape recorder with stereo meters, I found that the visual playback level suddenly fell to zero on the VU scales as the phones' low-ohm circuits were brought all the way in, with the expected accompanying violent distortion.)

So what do you do with your fancy hi fi phones when you've bought them? It all depends. One thing is clear—you'll have to do something drastic. As of now, you simply cannot just "plug them in."

One brand, the expensive Beyer phones from Germany, provides an envelope full of resistors and a big circuit diagram showing how to tear your equipment apart and install a double-pole, double-throw switch (not provided) along with the variously mounted resistors, the net result being that you can flip the switch directly from loudspeakers to phones, at approximately the same apparent volume and with everything correctly matched.

Fine! But who among our hi fi friends is likely to jump with joy at this prospect? The hi fi serviceman—yes. But the heat generated among the living room hi fi users is likely to be considerable.

Professionals? They are relatively well taken care of, at a good price. Transformers are available for the better phones, in order to match them to standard 600-ohm lines. Also resistors, and so forth. Professionals know all about this sort of thing. But I wonder—to turn the tables the other way—how many professionals with 600-ohm lines are going to want their headphones with streamlined styling in decorator colors? Well, that's what they'll get before long, if things go on as is. That is, unless the headphone people make up their minds as to whether they are aiming for the pro or the non-pro market, and act accordingly.

Actually, the phone is on the other ear—I mean the shoe is on the other foot—at the moment; most of the new phones either look vaguely like the old telephone-radio operator type, clumsy, uncomfortable, the earpieces always tangling up in the wires or turning inside out and upside down; or else they are strictly compromised half-way adaptations of the time-honored system, often much bulkier and clumsier in order to get the required near-sealing of the space between phones and ears that hi fi demands for its bass.

Only one set of phones I have tried seem really comfortable to me—light in weight, neatly shaped and non-clammy, without unpleasant side-pressure on the ears and minus those steel knife-edge cutting blades that wear away the top of your head. Also, I add quickly, minus confusion in the donning—they go on right every time and never turn inside out or upside down or backside formost, nor do their springs double up and cross the phones into a knot, nor do the wires entangle themselves in everything in sight. These phones are really nice (though not very small) and they even look nice. They lack only one feature—really top sound. But this is anticipating my detailed account of a preliminary group of hi fi headphones that I have been assembling and trying out, as the occasion for this writing.

It is clear, then, that the present production of hi fi headphones is in a burgeoning but unsettled evolutionary stage. Much enthusiasm, lots of good designing, a noble new area of worthwhile development—but at the same time, an absence of coordination between brands, in the details and, in the over-all, a confusion of the clear purpose that should lead logically toward those details.

This situation won't last. It can't. If phones are to be assimilated into hi fi, there must be a regular place for them, and there will be, just as soon as the proper people get together and work things out. The phone makers between themselves. The phone makers and the amplifier people, plus the tape-recorder makers. Matter of industry standardization.

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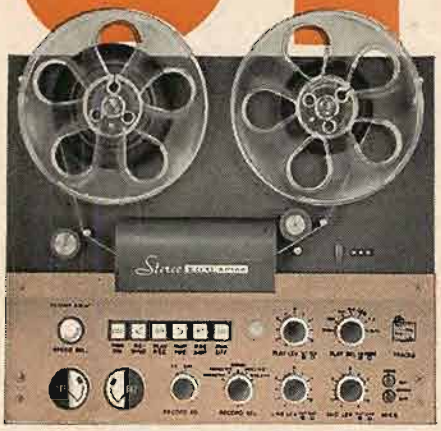

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(Patent Pending)

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ment, we should have standard twin-channel outputs for low-impedance phones—*all* phones. Just switch the knob, or push the button, to PHONES and you're in business. (With or without simultaneous loudspeaker sound, of course.) Just unplug one brand of phones and plug in another—it'll work equally well, just as two brands of loudspeaker, or two brands of magnetic pickup, now operate interchangeably; or two radio tuners, or a brace of different tape recorders.

That happy stage is next in line for headphones. It is very definitely *not* here, as of now. The headphone set in other words, is going through its own version of a generally typical manufacturing evolution which I would like to call Phase 2. In headphones, Phase 2 is surprisingly like the corresponding Phase 2 in many another type of newly introduced product.

Phase 2 is the commercial break-in period, the shakedown. It's a time for agony and confusion and excitement as well. You can't get to Heaven without Phase 2 first—but Heaven (Phase 3, a smooth, stable, bug-free continuing production and sales) is worth it.

Phase 2 is like the out-of-town tryout for a Broadway show or a play; Phase 3—if and when—is the successful long-term run on Broadway itself. But in hi fi we don't have any out-of-town place for our tryouts. We're on Broadway right from the beginning.

Let me digress and elaborate.

II. PHASES OF PRODUCTION

I can think of four phases in a typical hi fi production, from start to finish. Like the moon. New, first quarter, full, last quarter. A good analogy, if slightly loony, and it is the "first-quarter" phase that is most on my mind. Phase 2.

You can guess that Phase 1, like the new moon, is that stage in which the new type of product is virtually invisible to the world at large. The development stage. Everything is behind the scenes. Designers hard at work, mock-ups being worked out, and discarded, bugs and gremlins of all sorts plaguing everybody—and being killed off, before things get rolling. There's much secrecy and many a leak, to the rumor circuits. Something New is Coming Out Soon. The rest of the industry knows all about it before you can say boo, and pretty soon the wise guys outside, who always have the latest inside dope, seem to know all the details too. But J. Q. P., Mr. Public, is still in the dark. And his cash is still safely in his pocket.

Then, at last, Phase 1 draws to an exciting close. Prototypes. More prototypes. *The* prototypes, handmade to look as if they weren't. Demos, small, medium, large, for the bigwigs, then the smaller wigs, and finally for the eagerly awaiting dealers (so you hope) and—bang! the big press show, and the news is out! The ads proclaim! The public demonstrations begin and everything works like a charm! We're off, and into Phase 2.

Phase 1 means no sale—yet. Phase 2 means sales, or else. And it means, at last, a public tryout, for cash. Natch, every known "exhaustive" test has already been made on the new products in every imaginable way with all the ingenuity that experience can summon up. The product is perfect—it has to be. But for all that, it *still isn't born*. It hasn't been tested in the only way that counts—via sales, for money. That test is the Purgatory, bordering on Hell, that determines the real worth of a new type of product—and shapes that product to fit reality.

Phase II Symptoms

This second and most important of the quarters in my hi fi moon-cycle, then, comes after the new product is irrevocably launched in public, but before it reaches a time-tested, stable, confident, bug-free, standardized, reliable, "even keel" production and a solid place in the larger hi fi scene, the much-hoped-for Phase 3. Stereo amplifiers, for example, are now decidedly as a group in Phase 3. So are stereo cartridges, in spite of individual new developments and continuing changes.

Phase 2, alas, is inevitable, in spite of all the pre-testing and pre-de-bugging. Phase 2, according to calculations, should not exist—it wouldn't if men were infallible. Somehow, every major new product lives out its variably hectic Phase 2 period, and most of them move on into the blissful relaxation (relatively speaking) of a long-term Phase 3.

Here are some of the juicier characteristic of Phase 2 hi fi production, as I've observed them with my own somewhat jaundiced eyes these many years. The symptoms are plenty familiar, if you'll stop to apply these thoughts to specific products and product-types.

1. Though the advertisers have been enthusing for weeks and even months over the new models, complete with blow-up pictures and detailed specs model for model, oddly enough there don't seem to be any of the lovely things in the stores. Vast shipments are on the way, due any day now, any moment. But when it comes down to fact, there are only trickles here and there. Supply lines are strangled, though nobody quite knows where. Occasionally there is a small flood, when some smart operator gets his production into high gear, but mostly, Phase 2 is the era of the Unaccountable Trickle. And of the Big Promise.

In Phase 2, the harried promotors go around with sickly grins of outrageous optimism on their faces, making promises they know they aren't going to be able to keep. Can't help it. Even the best of them have to. *Some* day (they think to themselves) the log jams will break—it might be tomorrow, after all. And sooner or later, it *is* tomorrow. But that's Phase 3.

2. Phase 2 products, especially in their earlier production, are notoriously unstandardized, and it isn't anybody's fault. Everybody has been too busy fighting his own problems to bother about his rivals and colleagues.

During the earlier and semi-secret design period of Phase 1, each maker follows up his own best hunches, hoping the other guy won't think of the same thing (he isn't going to *ask* his whether he has or not . . .). Thus, whatever the product may be, it is sure to be highly individual. Competition behind the scenes. Thus the Phase 2 products emerge into the light of the commercial day in a typically dizzy variety of sizes, shapes, and specs. All sorts of specifications are at odds and especially the minor non-essentials that are so important to the home owner—who doesn't know a thing about the insides. Plugs, sockets, electrical levels, impedances, equalizations, groove depths (as in the variable early LP's), wiring requirements, mounting facilities, they all display a typical Phase 2 rash of inspirational individualism.

Now—suddenly—the manufacturers look upon each other's "finalized" production models—and wring their collective hands, for it's too late; the chaos is built-in, production is already booming.

But in no time at all something *has* to

(Continued on page 46)

WHAT—NO EARMUFFS?

She hears the bass without ear cushions. How come?

This unique quality is just one of the bass-ic advances that are putting AKG (Vienna) **K 50** dynamic headphones on the prettiest heads — and keenest ears — this season.

The K 50 is a first-order transmitter*. This means that, like a fine loudspeaker, it delivers a full, true bass without help. It does not need a resonant cavity (formed by bulky ear cushions) to simulate the low notes, but re-creates them faithfully all by itself. With K 50, you need the small ear cushions only to shut out the noise of your environment.

The bass is all there, without earmuffs! So is every other tone and shading from 30 to beyond 20,000 cycles, with inputs as low as 0.156 milliwatts. Even with 90 milliwatts input they won't blast.

Connect K 50 direct into your preamp output for low-impedance matching, or through a **U 50** transformer for high impedance. For use in your power-amplifier output, connect a 20-ohm resistor across the terminals. That's your admission ticket to a new world of musical realism.

K 50s remain cool and comfortable after hours of listening. They weigh less than three ounces — and only you don't know you're wearing them. For mono or stereo, $22.50.

For a unique experience in listening, hear K 50 at your audio dealer's. For information write Electronic Applications, Inc., 80 Danbury Road, Wilton, Connecticut — or phone (203) POrter 2-5537.

AKG

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PUBLISHER'S REVIEW

NEW TITLES

THE NEW TITLE at the top of this page is only one of new titles around AUDIO commencing with this issue. Because of the acquisition of *Communication Engineering,* announced last month in the advertising pages, several changes in duties of the staff have had to be made. David Saslaw, managing editor for the past eighteen months, is now Editor of AUDIO, a post which we have confidently expected him to fill ever since he joined us. The former editor and publisher continues as publisher of AUDIO and *Lectrodex,* and takes on additional duties as editor and publisher of *Communication Engineering.* No part of these "changes" is expected to have any effect upon the scope and character of AUDIO, and it is unlikely that readers would ever know the difference if they did not happen to notice the masthead on page 1.

Magazine publishing differs from the usual business or manufacturing organization in a number of ways. The major difference is that a business organization is usually presided over by one "chief executive officer," who is likely to be the president of the company, and he is in control of all functions of his company's operation. A magazine, however, is actually two separate organizations—one which handles the purely business aspects and one which creates the magazine itself.

The head of the business section is usually known as the Business Manager, and he is principally concerned with the more mundane parts of the operation such as getting money in, directing circulation, and finding out where the magazine can be published most economically. In most small magazines, his corporate position is that of president.

The head of the editorial section is the Publisher, and he and the Business Manager form the broad policy decisions affecting the entire operation, and then each carries out those policies affecting his section. He works closely with the Editor, and co-ordinates editorial and advertising production. When a company has several magazines in its "stable," both the publisher and the business manager may serve on all of them.

The Editor is the person who actually creates the magazine as the reader sees it, and he must be a veritable jack-of-all-trades. In such a magazine as AUDIO, he must be technically capable, able to write clearly and convincingly, and able to recognize other writing and to edit it in accordance with the style of the magazine. He must be able to judge photographs—and sometimes to take them and possibly retouch them—as to suitability and content, check drawings, proofread, and—occasionally—sweep out his office. Mr. Saslaw has already proved his capability in all of these capacities, and we are pleased with the realignment of duties.

In spite of this digression from the usual contents of this page for this one issue, it will be the normal EDITOR'S REVIEW again next month.

NEW FISHER PLANT

Located in the heart of Pennsylvania, the brand new 50,000-sq.-ft. plant of Fisher Electronics was opened on the first of December. Modern as tomorrow, it will provide the much-needed factory space for Fisher products and it is said to be the largest high fidelity plant in the country.

The ceremonies began with a luncheon in Lewistown, attended by many of the local townspeople, some large Fisher dealers, representatives, and the press. Pennsylvania's Governor Lawrence was guest of honor and spoke briefly. The party then moved to the plant site at Milroy where the Governor cut the ribbon which signified the official opening. Fisher employees and their families attended, as did the local high school band, and even the weather co-operated by being fair and pleasant.

We are pleased to see sufficient growth in the industry to warrant the new plant—and we hope that Fisher will have to expand again onto some of its 20-acre site.

HI FI SHOWS

The usual two high fidelity shows on the West Coast appear in March—the combined San Francisco Home and High Fidelity Show in the Cow Palace from March 7 to 11, and the Los Angeles High Fidelity Music Show at the Ambassador Hotel from March 21 to 25. The first show will be sponsored again by the Magnetic Recording Industry Association, and is under the direction of James Logan. The Los Angeles show is presented by the Institute of High Fidelity Manufacturers.

The Fourth International Exhibition of Electronic Components will be held in Parc des Expositions, Porte de Versailles, in Paris from February 16 to 20. This is the oldest show which has specialized in electronic products, having started as the National French Exhibition in 1934. The 1961 show featured some 450 exhibitors, and still more are expected in 1962.

Is everybody ready?

COMPARES...

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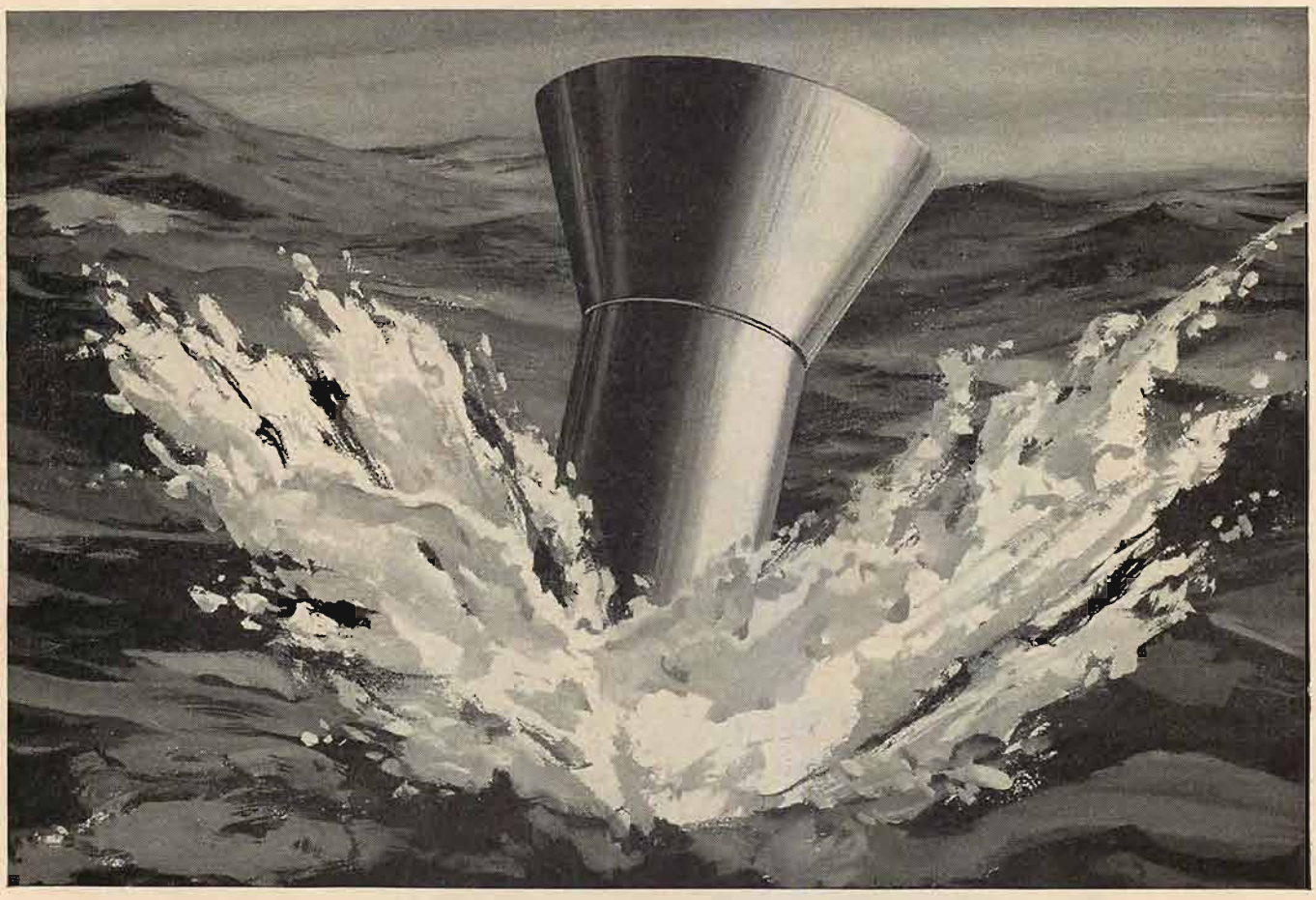
STANTON

stereo fluxvalve pickup

PICKERING & COMPANY INC. offers the stereo fluxvalve pickup in the following models: the Calibration Standard 381, the Collector's Series 380, the Pro-Standard Mark II and the Stereo 90. Priced from $16.50 to $60.00, available at audio specialists everywhere.

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

Pickering and Company—Plainview, Long Island, New York



HOW THE OCEAN GREW "EARS" TO PINPOINT MISSILE SHOTS

A quarter of the world away from its launching pad an experimental missile nose cone enters its ocean target area.

How close has it come to the desired impact point?

Where actually did the nose cone fall?

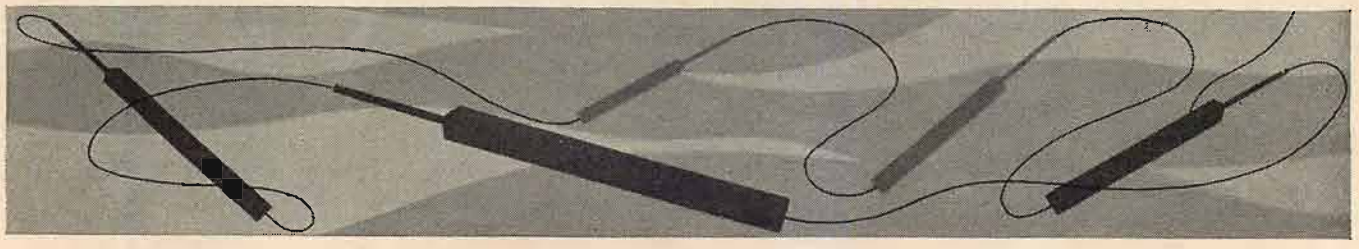
To answer these questions quickly and accurately, Bell Laboratories developed a special system of deep-sea hydrophones—the Missile Impact Locating System (MILS) manufactured by Western Electric and installed by the U. S. Navy with technical assistance from Western Electric in both the Atlantic and Pacific Missile ranges. MILS involves two types of networks.

- One is a long-distance network which utilizes the ocean's deep sound channel. It monitors millions of square miles of ocean. The impacting nose cone releases a small bomb which sinks and explodes at an optimum depth for the transmission of underwater sounds. Vibrations from the explosion are picked up by hydrophones stationed at the optimum depth and carried by cables to shore stations. Time differences in arrivals between these vibrations at different hydrophones are measured and used to compute location of the impact.
- The other is a "bull's-eye" network that monitors a restricted target area with extraordinary precision. This network is so sensitive it does not require the energetic explosion of a bomb but can detect the mere splash of a nose cone striking the ocean's surface—and precisely fix its location.

The universe of sound—above the earth, below the ocean—is one of the worlds of science constantly being explored by Bell Laboratories. The Missile Impact Locating System reflects the same kind of informed ingenuity which constantly reveals new ways to improve the range of Bell System services.

BELL TELEPHONE LABORATORIES

World center of communications research and development



Audio Measuring Equipment

MANNIE HOROWITZ*

Any audiofan interested in maintaining and improving his audio setup will, at one time or another, consider purchasing measuring instruments. In this article Mr. Horowitz discusses the type of instruments needed, plus their essential characteristics. Future articles will discuss how these instruments are used.

HIGH FIDELITY AUDIO AMPLIFIERS have long been involved in the battle of specifications. Hardly an amplifier is sold today that does not have a long list of specifications which define (and sometimes tend to hide) its characteristics. Practically all amplifiers have been checked and reported on by various testing laboratories which have either confirmed or denied the published specifications.

The data presented to the consumer by the manufacturer or independent laboratory requires the use of specialized instruments and careful measuring techniques. Although medium-quality instruments may be used to compare two different units with reasonably reliable results, excellent-quality instruments must be used for absolute measurements.

The type of instruments required, and available, for measuring audio equipment will be discussed in this section. A comparison of different types of instruments used to perform the same group of tests, as well as the characteristics and requirements of a good instrument, will be discussed in some instances. The meaning of the various pieces of data will be discussed in future sections. For example—how peak power differs from rms power and, in turn, how do they both differ from music power? Does the peak power or music power specification have any significance, or is it just a bigger number than rms power which is used primarily for advertising purposes? Do we need as much as 50-watts rms power for true hi-fi reproduction? Is a damping factor of 20 more desirable than a damping factor of 4?

Answers to many of these questions are subjective. However, it is frequently worthwhile reading many opinions before deciding for oneself—especially if these opinions are based on accepted physical concepts.

This and subsequent articles are intended for the audiofan. For maximum benefit, a good working knowledge of electronics is desirable. Mathematics will be used where required but may be bypassed without loss of continuity.

* *1035 Clarkson Ave., Brooklyn 12, N. Y.*

INSTRUMENTS FOR THE LABORATORY

Several specialized pieces of equipment are used in the audio laboratory. These include a low distortion audio signal generator, a square wave generator, a harmonic distortion meter, an intermodulation distortion meter, and sometimes a wow and flutter meter. More general instruments found in practically every laboratory—audio or otherwise—are a VOM, a VTVM, an a.c. VTVM and an oscilloscope.

The various manufacturers supply each of these instruments in different forms. Just as is the case when describing an audio amplifier, claims are presented. The modes of operation and comparisons of the available types of instruments should help determine the reliability and limits of a particular unit.

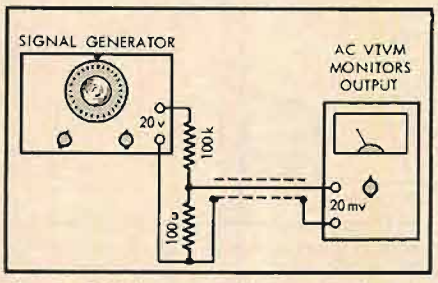


Fig. 1. Divider network arranged to get a 2-mv output with low noise and hum from a 20-volt signal source.

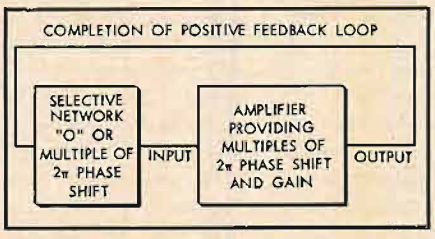


Fig. 2. Conventional audio oscillator scheme.

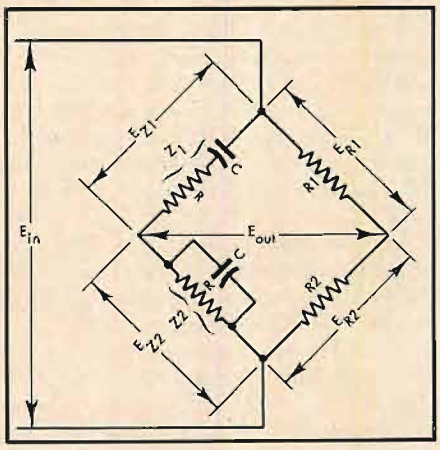


Fig. 3. Wein Bridge used as frequency-selective network.

Signal Generator

A source of audio signal is essential in any laboratory dealing with high fidelity amplifiers. Because the characteristics of a sine wave are easily defined and measured, a generator producing waveshapes of this type has become the universal signal source.

An oscillator must meet several obvious basic specifications to be suitable in high fidelity test and design applications. These can be enumerated briefly as follows:

1. The distortion should be low. A maximum over-all harmonic distortion of 0.1 per cent between 20 and 20,000 cps is usually satisfactory. The percentage of distortion acceptable is only a function of the severity of the test to be performed. Furthermore, the distortion should not be substantially affected by the load presented to the generator.

2. The available frequencies should range from a few cps to several hundred thousand cps. This will provide the flexibility required to check the amplifier's rolloff characteristics at both ends of the audio spectrum.

3. Frequency stability and calibration accuracy can be lumped together although they are in reality two separate characteristics. Exact frequencies are required when checking marginal and critical equipment, such as a tape deck. Large errors can also result in incorrect filter measurements.

4. A reasonably flat output over the complete frequency range is convenient. Absolute flatness is not required since the output can (and should) be carefully monitored with a wide-range a.c. voltmeter or oscilloscope.

5. A low output impedance is a necessity. 600 to 1000 ohms is perfectly acceptable. The frequency selective networks should be independent of the output load.

6. Any hum present in the signal will be measured as distortion on an harmonic distortion meter. Hum and noise must be maintained at a minimum. Hum specifications are usually stated as being

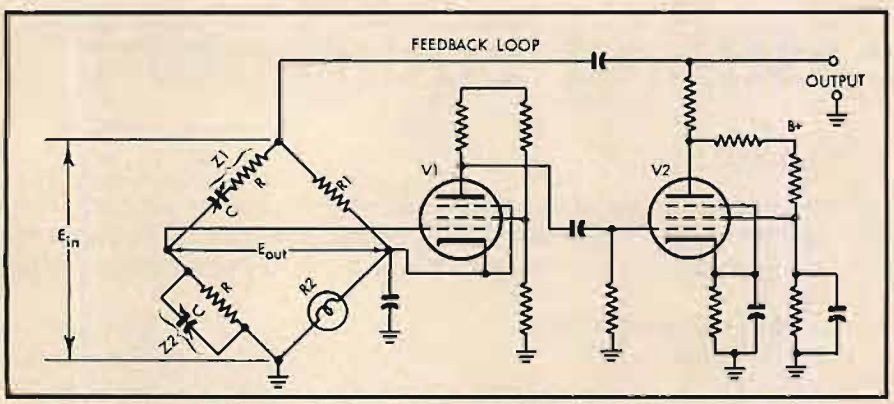


Fig. 4. Wein Bridge used in commercial signal generator.

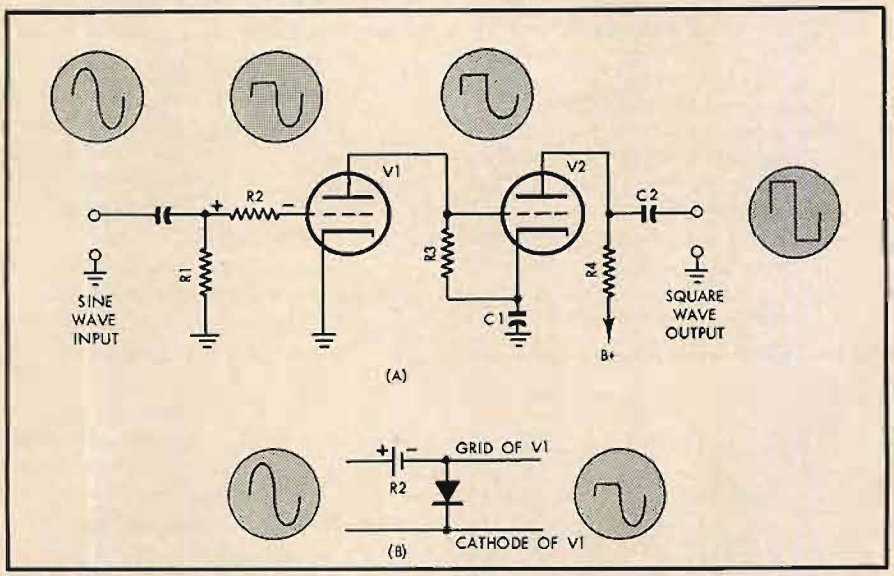


Fig. 5. (A) Circuit used to convert a sine wave into a square wave; and (B) equivalent diode circuit of grid and cathode of V1.

below the full rated output because absolute hum voltages are not substantially affected by the setting of the output control. The best signal-to-noise ratios are achieved at maximum or near maximum setting of the attenuator control.

When extremely low voltage signals are needed, a divider network is usually placed at the output of the generator. The network shown in *Fig.* 1 can be used effectively for the 2 mv, 1000-cps signal usually required at the tape-head input of an amplifier. In this illustration it is assumed that the maximum output at the generator terminals is 20 volts. In order to minimize hum and noise pickup from nearby sources, the leads of both resistors must be kept short and the connecting cables should be well shielded. Low-loss cable as well as a low-value resistor in the bottom half of the divider network should be used to minimize high-frequency attenuation. The output should be monitored at the amplifier with an a.c. meter.

Hum may be due to the way the instruments are hooked up rather than a poor signal-generator.

The a.c. meter used to monitor the output voltages from the signal generator may be partially at fault. Assume the signal generator to be connected to the a.c. meter, as shown in *Fig.* 1. Usually these instruments are designed so that the primary of neither power transformer is grounded to the chassis. It is thus expected that the cabinets of both units will be "floating." This is not the case. The instrument chassis and cabinets are at some actual fixed potential with respect to the line and the secondary because of the capacity between the transformer windings and the chassis. The two chassis and cabinets (signal generator and monitoring a.c. voltmeter) are connected together through these capacitive couplings to the common a.c. line. If the two cabinets should touch, a loop is formed with the a.c. line. The a.c. current in this loop is induced into the signal leads, causing hum to appear on the signal. Separating the two instruments will eliminate this loop and the resulting hum.

Another possible source of hum can be the loop formed on the one hand when the two chassis are connected together, and on the other hand when the commons of the two instruments are joined by leads. This also forms a complete loop susceptible to induce hum. Choose whichever explanation you like best. My guess is that both loops are involved along with some others that are not quite as obvious. Whatever the cause, the cabinets or chassis of both instruments should be separated physically—they must not touch each other.

The basic component of an oscillator is an amplifier, as shown in *Fig.* 2. Positive feedback around the amplifier causes the circuit to oscillate. A frequency selective network inserted in either the amplifier or feedback loop determines the frequency of oscillation. Any properly arranged and proportioned amplifier circuit will oscillate if several criteria are satisfied.

1. At the frequency of oscillation, the amplifier and feedback network must have zero (or multiples of 2π) phase shift.
2. The gain of the over-all circuit (amplifier and feedback factor) must be equal to or greater than 1. This is referred to as the Barkhausen criterion.
3. The output voltage is limited by the nonlinearity of the amplifier.

The conventional audio oscillator uses the Wien Bridge circuit shown in *Fig.* 3 as the frequency selecting network. The output from the amplifier, E_{in}, is fed to the input of the bridge. The output voltage, E_{out}, from the bridge is fed to the input of the amplifier, completing the positive feedback loop.

In order to satisfy Criterion 1, at the oscillating frequency E_{out} must be in phase with E_{in}. That this is true can be surmised as follows:

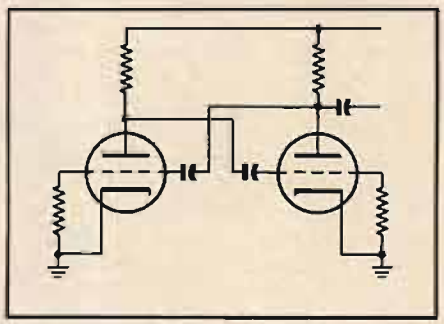


Fig. 6. Multivibrator circuit used to generate a square wave.

The output voltage, $E_{out} = E_{R2} - E_{Z2}$. If both E_{R2} and E_{Z2} are in phase with E_{in}, E_{out} is in phase with E_{in}. E_{R2} is definitely in phase with E_{in}, for $E_{R2} = E_{in} \times R_2/(R_1 + R_2)$, a pure resistance.

That E_{Z2} is in phase with E_{in} can be derived simply as follows:

At the angular frequency $\omega = 1/RC$, $Z_1 = R - j/\omega C = (\omega RC - j)/\omega C = (\omega RC - j)R/\omega RC = (1-j)R/1$, a pure resistance. Also, $1/Z_2 = 1/R - \omega C/j = (j - R\omega C)/jR$. Z_2 is then equal to $jR/(j - R\omega C) =$

$$\frac{jR(j-1)}{j-1(j-1)} = \frac{j^2R - jR}{j^2+1} =$$

$(R - jR)/2 = (1-j)R/2$, a pure resist-

ance. Because $E_{Z2} = E_{in} \times Z_2/Z_1 + Z_2 = \frac{E_{in}(1-j)R/2}{(1-j)R/2 + (1-j)R/1} = \frac{1\,E_{in}}{3}$, there is no phase shift in the E_{Z2} factor. Criterion 1 has been fully met.

From bridge theory, we know that when the bridge is balanced, there will be a zero voltage at E_{out}. For the oscillator to operate, E_{out} must not be equal to zero. Therefore, the bridge is slightly unbalanced when it is used in an oscillator circuit. Instead of $R_2/(R_1+R_2) = Z_2/(Z_1+Z_2) = 1/3$, the ratio of $R_2/(R_1+R_2)$ is made slightly smaller than 1/3.

The circuit has been used fairly consistently in many commercial audio signal generators as illustrated by the circuit shown in *Fig.* 4.

Here the voltage E_{in} is fed from the output of V_2 and the voltage E_{out} is applied between the cathode and the grid. The two capacitors in the Z_1 and Z_2 arms are varied simultaneously to maintain RC relationships with their respective resistors, avoiding phase shift while selecting the required frequency. The R components of Z_1 and Z_2 are changed when different ranges are needed. A variable resistor in the form of a lamp filament is substituted for R_2 to maintain amplitude stability over the various switched ranges as well as guard against variations due to component aging. R_1 is adjusted for best waveform. R_1 serves a dual function. First, it completes the bridge circuit. Second, it is incorporated in a negative feedback loop from the plate of V_2 to the cathode of V_1, reducing distortion and maintaining stability with tube variations.

Another frequency-selective circuit which is used in many commercially available oscillators is the bridged-T network. In one commercial application of this type of circuit, negative feedback is supplied to the amplifier through a "notch" network which is a capacitor-shunted bridged-T. The resultant oscillation occurs at the "notch" frequency where the negative feedback is at a minimum and the phase shift is zero. Although the bridged-T network is characterized by low distortion and good stability, there has been some tendency to use the Wien Bridge configuration because of the somewhat more practical value of the resistors used. In reality there is no basic advantage of one circuit over the other insofar as performance is concerned.

There are frequency limits imposed on the Wien Bridge oscillator by its very nature. At high frequencies, the resistors in the bridge arms are too small. They load down the output tube excessively as well as introduce phase shift. The lower frequencies are limited by the practical size of the capacitor, C, and the resistors, R. Too high a resistor in the Z_2 arm may cause the grid of V_1 to be over-biased due to grid leak action, as well as make the circuit susceptible to stray field pickup.

The sine wave output from the signal generator can easily be converted into a square wave signal, useful for many audio tests. The circuit shown in *Fig.* 5 has been used for this purpose in a commercial generator.

On the positive half cycle of the sine wave, grid current flows through R_1 and R_2. The voltage across R_2 acts as a fixed bias for the diode formed by the grid and cathode of V_1. The equivalent circuit of this is shown in (A) of *Fig.* 5. When the signal is applied to this diode, only the positive peaks of the signal will be

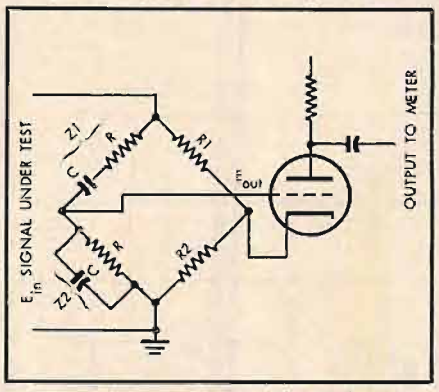


Fig. 7. Wein Bridge used in distortion analyzer.

sufficient to overcome the bias voltage and cause the diode to conduct. The conducting diode will be a short for these peaks, resulting in a clipped positive portion. This clipped form will appear

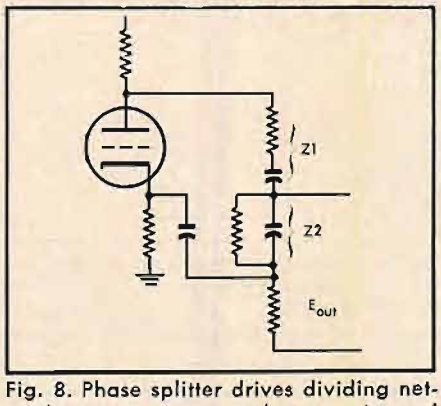


Fig. 8. Phase splitter drives dividing network to get proper voltage ratio and zero output when $\omega = 1/RC$.

at the grid of V_1, where it is amplified. The negative portion is clipped by the tube when it is driven to cutoff by the high bias voltage.

The phase of the signal has been shifted 180 deg. in the plate of V_1. It is fed to V_2, where the tube is cutoff for a portion of the cycle and the negative end of the signal is clipped. The rise time is good because the signal has gone through two stages of amplification and clipping.

Other and more direct means are frequently employed to get a square wave. The popular multivibrator circuit shown in *Fig.* 6 is quite common. Here, one tube conducts while the second tube is driven to cutoff. The frequency is determined by the time it takes the voltages across the capacitors to leak off through the associated grid resistors and the voltage required to cut off the tubes. Symmetrical signals are obtained if both RC pairs are equal.

Excellent rise time and good square waveforms can be obtained using either configuration.

The Harmonic Distortion Meter

The details of the Wien Bridge circuit apply to harmonic distortion meters as well as to audio oscillators.

The operation of a conventional distortion meter is straightforward. The complete signal is fed from the device under test to a meter, and the voltage is measured. The fundamental is eliminated from the signal under test, with the result that only harmonics remain. These are now measured on the same voltmeter. The ratio of the harmonics to the total voltage is the amount of distortion in the signal being tested. The Wien Bridge is often used as the selective network for the elimination of the fundamental component.

The circuit in *Fig.* 7 shows how the Wien Bridge eliminates the fundamental frequency while passing the harmonics. Unlike the circuit used in a signal generator, the bridge here is completely balanced for the fundamental frequency, $\omega = 1/RC$. Then $Z_1/Z_2 = R_1/R_2$. Under this condition, $E_{out} = 0$ for the fundamental (f_o) frequency. It is not zero at all other frequencies due to phase shift

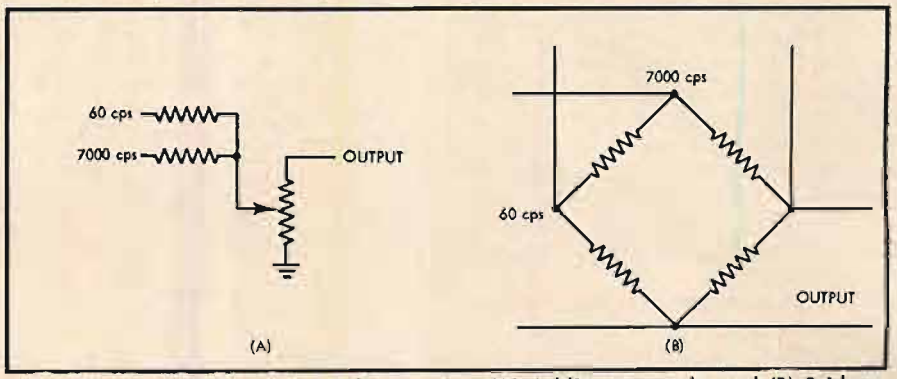


Fig. 9. Networks for mixing 2 frequencies: (A) Adding network, and (B) Bridge network.

in the bridge. Thus, these harmonic voltages are passed on to the next tube. It is interesting to note that E_{in} is frequently obtained from a cathode follower and that there is a considerable amount of feedback around the bridge circuit. This is important in increasing the rejection of the fundamental frequency.

A variation of this is shown in *Fig.* 8, where a phase splitter is used to drive the circuit. As indicated in the discussion of the oscillator, the ratio of Z_1 to Z_2 is 1:3. Thus if voltages of proper bucking phase, but of this 1:3 amplitude ratio are fed to this network, there would be a null between the junction of Z_2 and ground only at the fundamental frequency, f_o, while all other frequencies are passed. This method is inferior to the bridge circuit because the null cannot be quite as pronounced.

Using an instrument employing either circuit can be misleading unless the resulting harmonics are observed on an oscilloscope. The meter measures everything except the fundamental. The reading will include hum along with the harmonics. The significance of the hum, as well as the frequency of the undesirable harmonics, can be observed and evaluated on the scope.

The characteristics of a good harmonic distortion meter are many, but a few are quite significant to the operator.

1. The instrument must be capable of measuring harmonics of fundamental frequencies from 20 to 20,000 cps. The voltmeter must then be capable of linear response to 60,000 cps.

2. The fundamental frequency must be reduced by a considerable amount. For measurements with up to 0.1 per cent distortion, the fundamental must be down about 80 db. However, the closest harmonics, such as the second, should not be reduced by more than 3 db. This is best achieved when the bridge circuit of *Fig.* 7 is used.

3. The instrument must introduce negligible amounts of distortion and hum.

4. It should be sensitive enough to read 0.1 per cent distortion on a 1 volt signal with reasonable accuracy.

A better method of measuring distortion requires the use of a wave analyzer. Here, a voltmeter measures the relative harmonic components in the signal. Thus, the amount of second or third harmonic component is checked, rather than the composite sum of all components. In this type of instrument, only one frequency component at a time is fed to, and read, on the voltage measuring instrument.

Although harmonic distortion characteristics are practically always stated in the list of audio amplifier specifications, intermodulation distortion measurements have gained in significance because of the excellent correlation with actual listening tests.

To test intermodulation distortion, two signals of different amplitude and frequency are passed through the amplifier under test. These two signals will appear at the output of an undistorted amplifier. If nonlinearity does exist in the unit under test, the two input signals will heterodyne and produce sum and difference frequencies along with the original two frequencies.

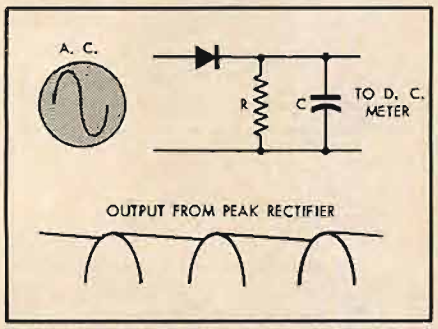


Fig. 10. Peak reading circuit for use with d.c. meter.

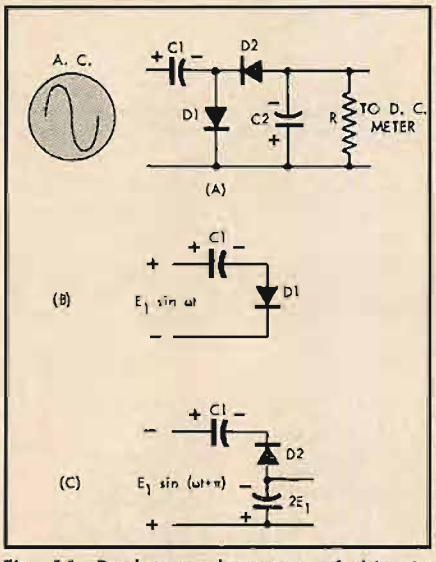


Fig. 11. Peak-to-peak output of this circuit (A), to be read on d.c. meter. (B) Condition during positive half of cycle, and (C) condition during negative half cycle.

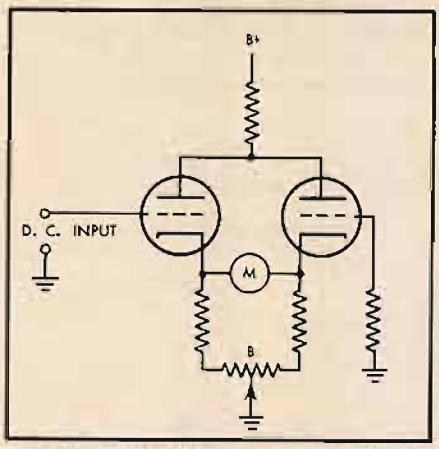


Fig. 12. D.c. reading meter in balanced circuit.

The conventional intermodulation distortion meter supplies these two signals in a 4-to-1 amplitude ratio. The frequencies commonly used are 60 cps and 7000 cps respectively. Two methods are generally used to combine these frequencies in the analyzer before they are fed to the amplifier. The first mixes the two frequencies in the type of adding network shown in (A) of *Fig.* 9. The combined signal appears across the potentiometer. A second method, shown in (B) of *Fig.* 9, uses a bridge for mixing.

The latter configuration is usually preferred because in the first method the signals can interact with each other. On the other hand, the balanced bridge isolates the two signals. Balance is maintained only if the signal is attenuated by means of a T-pad at the output. The bridge will then be balanced at any output level.

The operation of the rest of the instrument is straightforward. The combined signal is connected to the input of an amplifier. The output from the amplifier is sent through a high-pass filter eliminating the 60 cps component. If the amplifier has introduced distortion, the remaining 7000 cps will appear to be modulated by a low frequency. The amplitude of the total modulated 7000-cps signal is measured. The signal is then detected with only the modulating frequency remaining. This is in turn measured and compared with the amplitude of the 7000 cps. The ratio of the two is the percentage of intermodulation distortion.

This section of the analyzer is quite important. The accuracy of the measuring instrument and the quality of the filters determine the accuracy of the measurements. Low hum circuitry is necessary to eliminate any stray signals. The analyzer input impedance must be relatively high (500,000 ohms will do) to avoid putting an excessive load on a preamplifier that may be under test.

The Oscilloscope

The oscilloscope is a visual voltmeter used to observe the output of the equipment under test. Unfortunately, low percentages of distortion are not too obvious on the 'scope screen and the measuring instruments described previously must be used. A 'scope can be used as an effective indication of some amplifier characteristics. It can also be used to supplement the information gained from other instruments.

The heart of the oscilloscope is the cathode ray tube. In this tube, a potential difference between the cathode and one of the other electrodes starts the electrons in motion towards the fluorescent screen. Two groups of deflection plates are arranged so that each pair is perpendicular to the other. A potential applied to these individual pairs of

(*Continued on page 71*)

Test Equipment Roundup

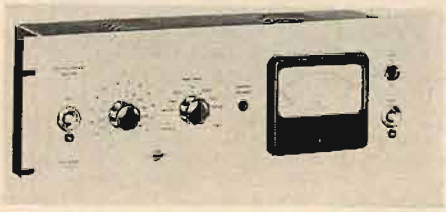
DAVID SASLAW

For the audiofan, fulfilling New Year's Resolutions may well require audio measuring equipment. In order to simplify the task of finding "the" piece of test equipment to satisfy your needs, Audio has rounded up the specifications and description of most of the available equipment although some manufacturers are not represented because we could not get the information in time for this issue. The types of equipment we concentrated on are the mainstays of any audio measuring endeavor: audio signal generators, oscilloscopes, and voltmeters. Also included are more specialized equipment such as harmonic distortion analyzers, IM analyzers, flutter and wow meters, and an electronic switch. The price (and performance) range presented varies from the most inexpensive kit intended for the beginner up to the very expensive laboratory instrument. The specifications listed for each instrument have not been verified by Audio; they are the ratings provided by the manufacturer. Happy hunting.

VACUUM TUBE VOLTMETERS

B & K INSTRUMENTS, INC.

• **True RMS VTVM.** A professional instrument designed for use in the audio laboratory, the Bruel & Kjaer Model 2409 VTVM is especially valuable for the measurement of distorted sinusoidal or non-sinusoidal voltages. A.c. measurements are possible in the frequency range from 2 cps to 200,000 cps with an over-all accuracy of ± 3 per cent over the full scale.



Frequency response is within 0.2 db from 2 cps to 200,000 cps. The 2409 also reads peak and average values from 1 mv to 1000 volts. Simultaneously, it operates as a calibrated amplifier with up to 45 volts peak undistorted output. Other features of the Model 2409 are slow and fast meter damping, built-in calibration standard, and complete overload protection. The Model 2409 costs $315 and is also available in a rack-panel version. B & K Instruments. Inc., Cleveland, Ohio. **A-1**

B & K MFG. CO.

• **Direct-Reading VTVM.** The B & K Mfg. "Dynamatic" 375 is an automatic VTVM that provides direct readings without multiplying or converting in any way. An individual scale is provided for each range, all scales are the same size, and only one scale is visible at a time. The 375 measures rms and peak a.c. volts, and d.c. volts, in seven ranges up to 1500 volts. Over-all accuracy is given as 3 per cent over the full scale for either a.c. or d.c. measurements. The unit also measures direct current up to 500 ma and resistance up to 1000 megohms. A single probe is provided for d.c., a.c., and resistance measurements. Price of the Model 375 is $89.95. B & K Mfg. Co., Chicago, Ill. **A-2**

EICO

• **A.C. VTVM Kit.** The EICO Model 255 a.c. VTVM kit is a high-sensitivity unit at a modest price. It measures a.c. voltage from 100 μv to 300 volts in 12 ranges. The 255 responds to the average value of an applied wave and indicates the rms value of a sine wave. The db range is from −80 to +52 db in 12 scales. Frequency response is ± 0 db from 10 cps to 600,000 cps. Accuracy is ± 3 per cent of full scale. Other features include a two stage RC-coupled amplifier and a full bridge meter circuit, stabilized power supply incorporating a voltage regulator, and d.c.-biased filaments and hum-adjust potentiometer. Hum and noise is 30 μv on any range. Price of the Model 255 kit is $44.95. EICO Electronic Instrument Co., Long Island City, N. Y. **A-3**

GENERAL RADIO

• **Laboratory VTVM.** The General Radio Model 1800-B VTVM combines the accuracy of the laboratory instrument with the durability necessary for production use. It measures alternating voltage at frequencies up to several hundred Mc, as well as d.c. voltages of either polarity. The voltage range is 0.1 to 150 volts a.c. and d.c. in six ranges. Accuracy on both the a.c. and d.c. measurments are ± 2 per cent of full scale. The frequency response is essentially flat, ± 1 db from 5 cps to 500 Mc. On the higher a.c. voltage ranges the instrument operates as a peak voltmeter, calibrated to read rms values of a sine wave, or 0.707 of the peak value of a complex wave. Features of the Model 1800-B include stable calibration which is substantially independent of tube characteristics, and an illuminated mirror-type scale. Price of the 1800-B is $490.00. General Radio Company, West Concord, Massachusetts. **A-4**

HEATH

• **Low-cost VTVM Kit.** Featuring the same basic circuit as the well-known Heathkit V-7A, plus new improvements,

the Model IM-11 measures a.c. volts rms, a.c. volts peak-to-peak, d.c. volts, resistance, and db. The d.c. and a.c. rms scales measure to 1500 volts full scale. The a.c. peak-to-peak scale goes to 4000 volts in seven ranges. The resistance range is from 0.1 ohm to 1000 megohms in seven ranges. Frequency response is ±1 db from 25 cps to 1 Mc with a 600-ohm source. Accuracy is ±3 per cent d.c. for the d.c. measurements and ±5 per cent for the a.c. measurements. The IM-11 is supplied with a slim, all-purpose test probe. A switch on the probe body provides simple selection of a.c. ohms or d.c. functions, and is equipped with a hook which enables clipping the probe to the circuit for "hands free" operation. The price of the IM-11 Kit is $29.95. Heath Company, Benton Harbor, Michigan. **A-5**

HEWLETT-PACKARD

• **Laboratory VTVM.** The Hewlett-Packard Model 400-D VTVM is a relatively low-priced laboratory voltmeter, offering wide voltage range, 2-per-cent accuracy and broad frequency coverage. The voltage range is 1.0 mv to 300 volts full scale in twelve ranges. The frequency range is 10 cps to 4 Mc, and the accuracy is ±2 per cent full scale from 20 cps to 1 Mc. The Model 400-D is calibrated to read rms value of sine waves. Other features include overload protection which guards the instruments against peaks of up to 600 volts, special circuitry to minimize transients during switching, and output circuitry which permits the voltmeter to be used as a broad-band, high-gain amplifier throughout its full frequency range. The price of the Model 400-D is $250.00. Hewlett-Packard Company, Inc. Palo Alto, California. **A-6**

LAFAYETTE

• **Peak-to-Peak VTVM Kit.** designed for ease of construction and versatility, the Lafayette KT-174 VTVM Kit measures a.c. peak-to-peak, a.c. rms, and d.c. voltage, and resistance. In addition it has a direct reading db scale. Two a.c.-range groupings are provided—a low a.c. range for audio applications and a regular a.c. range. The low range provides rms readings up to 500 mv, peak-to-peak voltage readings up to 1400 mv, with an accuracy of ±5 per cent of full scale. Frequency response in this range is ±1 db from 20 cps to 250,000 cps, with a 600-ohm source. The regular a.c. range provides rms readings up to 1500 volts and peak-to-peak readings up to 4200 volts, also with an accuracy of ±5 per cent. Frequency response in this range is ±1 db from 20 cps to 4 Mc. The d.c. voltmeter provides ranges up to 1500 volts with an accuracy of ±2 per cent. The ohmmeter section reads up to 1000 megohms in seven ranges. Other features of the KT-174 are special all-in-one probe, external calibration controls, and terminals which permit monitoring directly with an oscilloscope while making a.c. measurments. The KT-174 sells for $26.95. Lafayette Radio Electronics Corp. Jamaica 33, New York. **A-7**

KNIGHT

• **A.C. VTVM Kit.** Featuring the same circuitry and accuracy of the Knight automatic a.c. VTVM kit, this new manual a.c. VTVM kit, Model 83YU978, provides a sensitive, accurate instrument at a modest price. The unit measures up to 300 volts in eleven scale ranges, and the db range is from −65 to +52, also in eleven ranges. The frequency response is ±1 db from 20 cps to 2 Mc. The over-all accuracy is ±3 per cent of full scale. The stable 3-stage amplifier has a cathode-follower output that may be connected to an oscilloscope for simultaneous waveform observation while making measurements. The price of the Model 83YU978 kit is $89.95. Allied Radio, Chicago, Illinois **A-8**

RCA

• **Senior VoltOhmyst.** The RCA Senior VoltOhmyst Model WV-98B is an all-electronic voltmeter designed to measure d.c. voltages, resistance, rms values of sine waves and peak-to-peak values of complex waves. Rms a.c. and d.c. voltages up to 1500 volts are measured in seven ranges with an accuracy of ±3 per cent of full scale. It also measures resistance values up to 1000 megohms and complex wave forms having peak-to-peak values up to 4200 volts. The instrument is frequency compensated for a.c. voltage ranges up to and including the 500-volt range, and can be used at frequencies up to about 3 Mc. All measurements are made with a single unit probe. Additional features include provisions for zero centering of the meter pointer, and two separate scales for low-voltage a.c. measurments. The Senior VoltOhymst is available as a kit at a price of $62.50 and factory-wired and calibrated at a price of $79.50. Radio Corporation of America, Harrison, New Jersey. **A-9**

AUDIO SIGNAL GENERATORS

B & W

• **Model 200 Audio Oscillator.** The Barker & Williamson Model 200 Audio Oscillator is intended for use where a stable, accurately calibrated source of frequency from 30 cps to 30,000 cps is required. The Model 200 achieves its 30,000-cps range in three steps, each step being continuous. The output is 10 volts into a 500-ohm load, with an attenuator available to reduce the output if necessary. The Model 200 utilizes an RC oscillator circuit whose output achieves harmonic distortion of less than 0.5 per cent from 100 cps to 15,000 cps at 10 volts output. Frequency response better than ±1 db is claimed over the 30 cps to 15,000 cps range (500-ohm load), with stability exceeding 1 per cent. No zero reset or line calibration is required and dial calibration is accurate to ±3 per cent of scale reading. Barker & Williamson, Inc., Bristol, Pa. **A-10**

EICO

• **Sine-Square Wave Audio Generator Kit.** The EICO Model 377 sine-square wave generator features versatility and modest cost. The frequency range in the sine wave setting is 20 cps to 200,000 cps in

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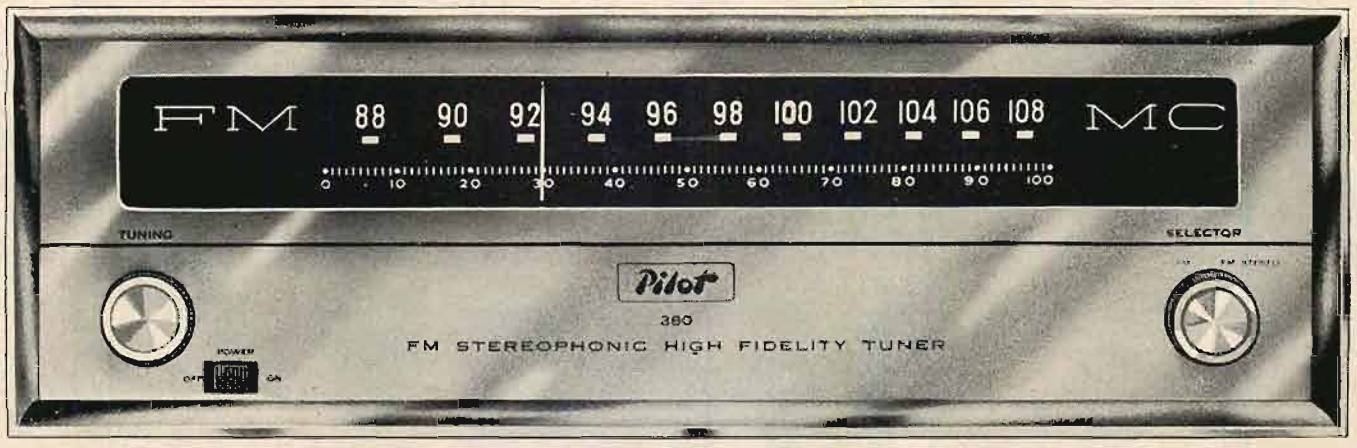

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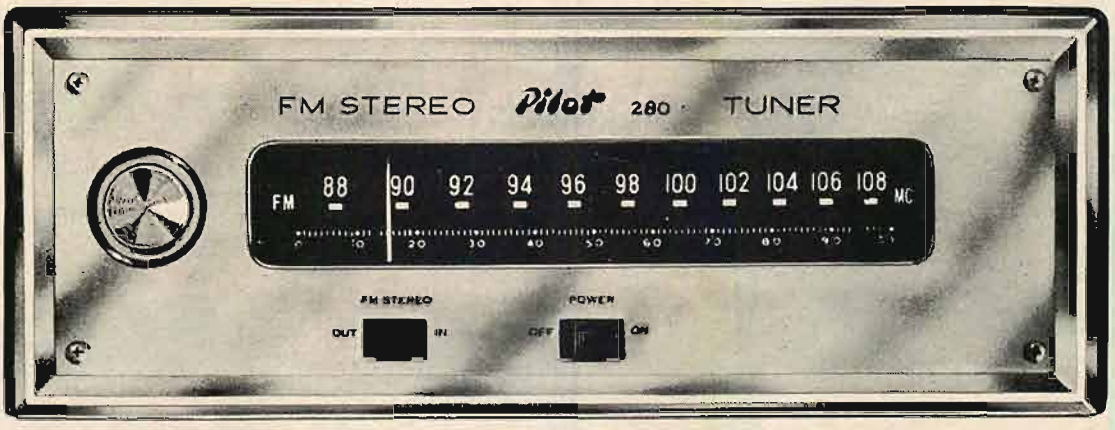

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4 bands and in the square wave setting the range is 60 cps to 50,000 cps (5 per cent tilt at 60 cps and 5 per cent rounding at 50,000 cps). Calibration accuracy is ±3 per cent. Frequency response is ±1.5 db from 60 cps to 150,000 cps. Voltage output is 8 volts into a 500-ohm load, 10 volts into a 1000-ohm load, and 14 volts for loads of 10,000 ohms or higher. Distortion is less than 1 per cent. The circuit utilizes a Wien Bridge in the frequency determining network. Price for the kit is $31.95. EICO Electronic Instrument Co., Inc., Long Island City, N. Y. **A-11**

GENERAL RADIO

• **Model 1302-A Audio Oscillator.** The General Radio Type 1302-A Audio Oscillator features wide-frequency range with excellent stability and low-harmonic distortion. It provides a frequency range from 10 cps to 100,000 cps in four ranges, with an accuracy of ± (1½ per cent + 0.2 cps). The output impedance is a balanced 600 ohms and grounded 5000 ohms and it provides at least 20 volts open circuit with the 5000-ohm output and 10 volts open circuit with the 600-ohm output. The 1302-A is an RC oscillator which employs an inverse-feedback circuit. The frequency-determining network is a Wien Bridge. Harmonic distortion is less than 1 per cent with normal loads. The frequency dial has a semi-logarithmic scale which eliminates crowding at the low-frequency end. Price of the Model 1302-A is $500.00. General Radio Company, West Concord, Mass. **A-12**

HEATH

• **Audio Generator Kit.** The Heath Model AG-9A Audio Generator Kit features switch-selected frequencies, low distortion, and a built-in output meter. Frequency range is from 10 cps to 100,000 cps and can be varied in steps of 1 cps from 10 cps to 100 cps while a 4-position multiplier increases this range in multiples of 10 up to the maximum frequency. Output is indicated on a 4½-inch panel meter, calibrated in volts and db. The output attenuator operates in steps of 10 db and is calibrated in eight full-scale meter ranges. Output voltage is up to 10 volts into a high impedance load and up to 1 volt into a 600-ohm load. Frequency accuracy is ±5 per cent and harmonic distortion is less than the 0.1 per cent from 20 cps to 20,000 cps. A slide switch allows selection of the built-in 600-ohm load or external load of higher impedance. Frequency determining network is a bridged-T. Price of the AG-9A is $39.95. Heath Company Benton Harbor, Michigan. **A-13**

HEWLETT-PACKARD

• **Model 200-AB Audio Oscillator.** The Hewlett-Packard Model 200-AB Audio Oscillator is the basic unit in a series of laboratory instruments. Frequency coverage is 20 cps to 40,000 cps in four overlapping bands. The 63-inch effective scale length and 72 dial divisions aid in providing accurate direct frequency setting. The voltage output of the unit into a 600-ohm load is 24.5 volts, with a maximum distortion of 1 per cent from 20 cps to 20,000 cps and 2 per cent from 20,000 cps to 40,000 cps. The circuit utilizes an RC type oscillator with both positive and negative feedback. Frequency response is flat ±1 db over the entire frequency range of the instrument. Calibration accuracy is ±2 per cent. Price of the Model 200-AB is $165.00. Hewlett-Packard, Inc., Palo Alto, California. **A-14**

KNIGHT

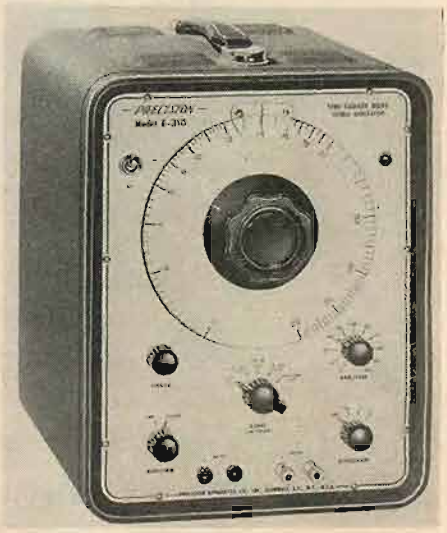
• **Sine-Wave Audio Generator Unit.** Knight Kit Model 83YX137 utilizes a bridged-T RC oscillator circuit and operates into either high-impedance or 600-ohm loads. It provides 10 volts output from 20 cps to 1 megacycle ±1 db in five ranges (into high impedance). Both a step attenuated output voltage control and a continuously variable level control are provided in the output stage. Distortion is less than 0.25 per cent from 100 cps up to 15,000 cps into high impedance load. Price of the 83YX137 is $35.95. Allied Radio, Chicago, Illinois. **A-15**

LAFAYETTE

• **Sine-Square-Wave Generator.** Featuring an unusually modest cost for factory-wired sine-square wave generator, the Lafayette Model TE-22 combines a sine-wave and a square-wave generator on one chassis. The sine-wave range is 20 cps to 200,000 cps ±1.5 db in four bands. The usable square-wave response is 20 cps to 25,000 cps. Frequency accuracy is ±5 per cent, with less than 2 per cent harmonic distortion. The output voltage is 7 volts maximum. The Model TE-22 incorporates a large etched dial. A variable attenuator prevents overloading test circuits. The price of the TE-22 is $32.50. Lafayette Radio Electronics Corp., Jamaica, New York. **A-16**

PRECISION

• **Sine-Square-Wave Generator.** The Precision Model E-310 offers both sine- and square-wave frequencies from 5 cps to 600,000 cps at a moderate price. It achieves its frequency range in five bands with a scale accuracy of ±2 per cent. The sine-wave output level is 10 volts rms into 600-ohm leads and the square-wave output is 10 volts peak-to-peak with a 0.2 μs rise time. Distortion is less than 1 per cent from 5 cps to 600 cps. Special features include metering terminals at the front of the panel for monitoring output level by means of an external VTVM or VU meter. A 6-inch diameter tuning dial provides scale lengths of 85 inches over the five bands. The price of the Model E-310 is $199.95. Precision Apparatus Company, Inc., Glendale 27, New York. **A-17**



RCA

• **Sine-Square-Wave Audio Generator.** The RCA WA-44C Sine-Square-Wave Audio Generator is designed for general radio work and provides a frequency range of 20 cps to 200,000 cps over four ranges. The sine-wave output voltage is 8 volts rms with a maximum total harmonic distortion of 0.25 per cent from 30 cps to 15,000 cps. The square wave output voltage is 10 volts peak-to-peak. The dial calibration accuracy from 20 cps to 20,000 cps is ±5 per cent. The circuit of the sine-wave function consists of a bridged-T RC oscillator with a cathode follower output stage. An attenuator circuit, a clipper circuit, and an output cathode follower are combined to produce the square wave output. Price of WA-44C is $98.50. Radio Corporation of America, Harrison, New Jersey. **A-18**

HOW TO CHOOSE A LOUDSPEAKER

The loudspeaker is potentially the weakest link in a high fidelity system. It is the most difficult of audio components to choose.

The choice should be made primarily on the basis of prolonged, careful listening to different speakers, with varied musical program material used for each. Quick demonstrations with gimmick records do not provide a valid basis for evaluation.

Acoustic Research maintains showrooms on the west balcony of Grand Central Terminal in New York City, and at 52 Brattle Street in Cambridge, Massachusetts. There you can listen at leisure to music reproduced through AR loudspeakers, from harpsichord concertos to Dixieland jazz. No sales are made or initiated at these "Music Rooms." Although attendants are on hand to answer questions, you may stay as long as you like without being approached.

SPEAKER RENTAL PLAN In line with the effort to make careful auditioning of AR speakers possible, Acoustic Research has now instituted a rental plan. Any model of AR speaker, or a stereo pair, can be rented from a participating dealer for a week at a cost of one dollar per unit.

If the speaker is purchased the dollar is applied toward the price. If you decide not to buy the speaker you can feel completely free of pressure to keep it, since the trial has been adequately paid for. (AR gives the dealer an additional sum for his trouble.)

AR Music Room at Grand Central Terminal

AR's Cambridge Music Room

AR speakers are priced from $89 to $225. Literature, including a list of dealers in your area participating in the AR rental plan, is available on request.

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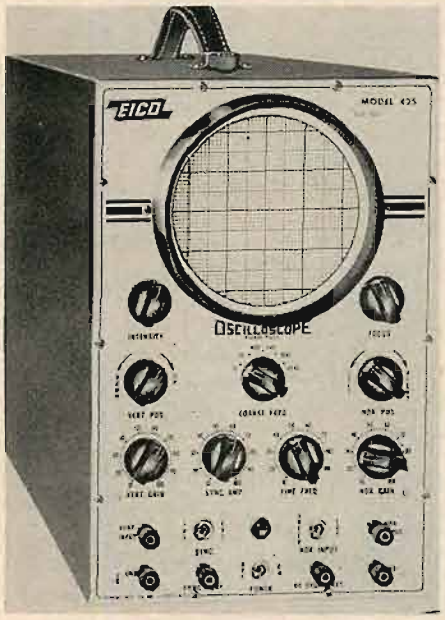
OSCILLOSCOPES

EICO

• **5-inch Push-Pull Oscilloscope Kit.** Intended for service as a general purpose oscilloscope, the EICO Model 425 features push-pull output stages in both vertical and horizontal amplifiers. Vertical and horizontal frequency range is 5 cps to 500,000 cps although the vertical response is usable up to 2.5 Mc. Vertical sensitivity is 0.05 to 0.1 volts rms per inch; horizontal sensitivity is 0.05 to 0.15 volts rms per inch. The sweep generator is a multivibrator with a frequency range of 15 cps to 75,000 cps. Other features include Z-axis input, direct connections to deflection



plates of cathode-ray tube available at rear of cabinet, and provision for external as well as internal synchronization. Price of the Model 425 kit is $44.95. EICO Electronic Instrument Co., Long Island City, N. Y. **A-19**

HEATH

• **5-inch Oscilloscope Kit.** Designed to accomodate those applications where wide bandwidth is necessary, the Heath Model IO-30 5-in. oscilloscope provides a vertical bandwidth from 3 cps to 5 Mc within ± 3 db. Horizontal bandwidth is ± 3 db from 1 cps to 400,000 cps. Vertical sensitivity is 0.025 volts rms per inch at 1000 cps. Horizontal sensitivity is 0.3 volts rms per inch at 1000 cps. The sweep range is 10 cps to 500,000 cps in 5 steps. Synchronization is automatic. Other features include push-pull output amplifiers, positive trace-position controls, peak-to-peak calibration reference, 3-step frequency compensated vertical input, Z-axis input, and two switch-selected preset sweep frequency positions for those who use certain frequencies often. Price of the IO-30 kit is $69.95. Heath Company, Benton Harbor, Mich. **A-20**

HEWLETT-PACKARD

• **Model 120A Oscilloscope.** The H-P Model 120A 5-in. laboratory oscilloscope features direct reading calibration, automatic trigger, and automatic baseline. The frequency ranges of the vertical and horizontal amplifiers are d.c. to 200,000 cps for d.c. measurements and 2 cps to 200,000 cps for a.c. measurements. Vertical sensitivity is 10 mv per cm to 100 volts per cm in 4 calibrated steps accurate within ± 5 per cent. Horizontal sensitivity is 0.1 volt per cm to 100 volts per cm in 3 calibrated steps accurate within ± 5 per cent. The sweep range is from 5 µs per cm to 200 ms per cm in 15 calibrated sweeps. A sweep multiplier expands the sweep rate 5 times on all ranges. Synchronization is automatic from 50 cps to 250,000 cps. The Model 120A is supplied with an illuminated graticule and a filter appropriate for the phospher used. Price of the 120A is $450.00. Hewlett-Packard Co., Palo Alto, Calif. **A-21**

KNIGHT

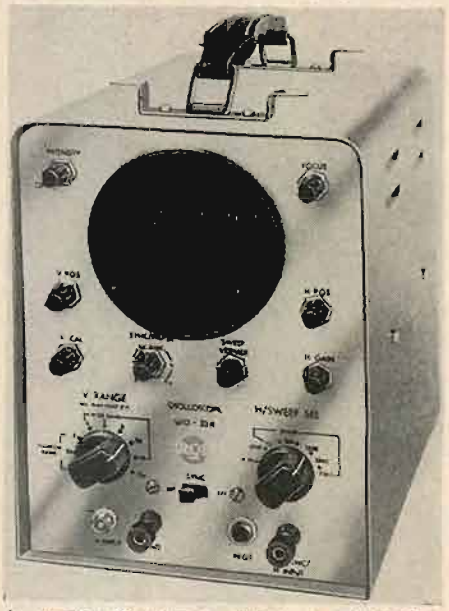
• **5-inch Oscilloscope Kit.** High-frequency vertical range and high-speed sweep rate feature the Knight Model 83YU144 oscilloscope kit. The vertical amplifier response is ± 3 db from 5 cps to 5 Mc. Sensitivity of the vertical amplifier is 25 mv rms per inch; sensitivity of the horizontal amplifier is 600 mv rms per inch. The sweep range is 15 cps to 600,000 cps and synchronization is either internal or external. The vertical and horizontal amplifiers are push-pull with cathode-follower inputs. Other features include frequency compensated input attenuator, 1 volt peak-to-peak calibrator, retrace blanking, and Z-axis input. Price of the Model 83YU144 is $69.95. Allied Radio Corp., Chicago, Ill. **A-22**

PRECISION

• **High-Sensitivity 5-inch Oscilloscope.** Featuring high sensitivity plus unusually modest price, the Precision Model ES-550B oscilloscope is intended for use in industrial and service applications. Vertical frequency response is ± 1 db from 10 cps to 2.5 Mc, and ± 3 db to 5 Mc. Horizontal response is ± 1 db from 10 cps to 1 Mc. Vertical sensitivity is 10 mv per inch and horizontal sensitivity is 100 mv per inch. Sweep range is 10 cps to 100,000 cps with an auto-synch circuit operating on all internal sweep ranges. A high-contrast illuminated graticule is provided. Both amplifiers are push-pull and have cathode-follower inputs. Other features include direct reading peak-to-peak voltage calibrator, vertical pattern-reversing switch, and built-in 60-cps phasing and blanking controls. The price of the Model ES-550B is $274.95. Precision Apparatus Co., Inc., Glendale, L. I., N. Y. **A-23**

RCA

• **3-inch Oscilloscope Kit.** The RCA Model WO-33A is a 3-in. oscilloscope designed for "on location" and service shop use. The vertical amplifier frequency response is within 3 db from 5.5 cps to 5.5 Mc; the horizontal amplifier response is within 6 db from 3.5 cps to 350,000 cps. Sensitivity of the vertical amplifier is 0.10 volts rms per inch in the wide-band position and 0.003 volts rms per inch in the high-sensitivity position. Sensitivity of the horizontal amplifier is 0.9 volts rms per inch. The sweep range is continuously adjustable from 15 cps to 75,000 cps with external and positive or negative internal synchronization. The vertical input attenuator is frequency compensated and voltage calibrated, and the graph screen is scaled directly in volts. A calibrating voltage is automatically applied to the vertical amplifier when the bandwidth control is set to the calibrate position. Price of the WO-33A kit is $79.95. Radio Corporation of America, Harrison, N. J. **A-24**



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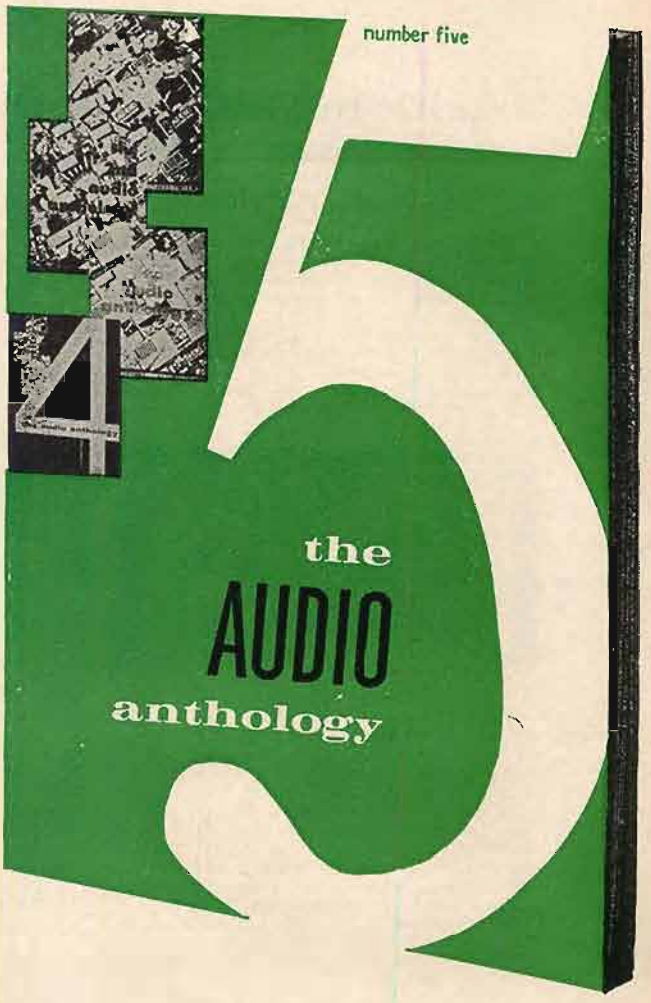

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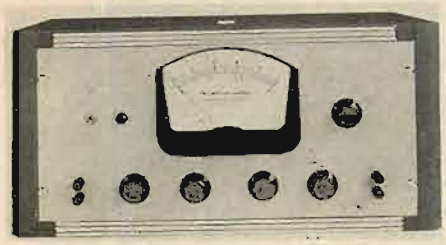
Miscellaneous

AMPLIFIER CORP.

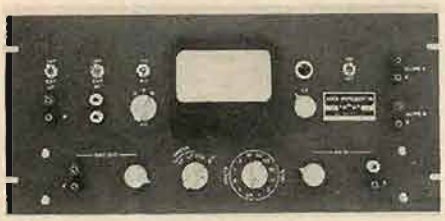
• **Flutter Meter.** Featuring a built-in three-range filter and test oscillator, the Amplifier Corp. of America Model 590-A-1 flutter meter is a sensitive instrument which complies with IRE standards for flutter and wow. A built-in preamplifier and high-impedance input attenuator will accept voltages from 1 mv to 300 volts. The built-in 3000-cps oscillator permits the unit to be used as a complete tape-



recorder test instrument. Hum, noise, switching surges, and other extraneous transients have no effect upon the reading or stability of the instrument. Three scales are calibrated for the measurement of wow and flutter: 0.3 per cent, 1.0 per cent, and 3.0 per cent. Significant readings can be made down to 0.01 per cent. Controls consist of an input voltage selector, a vernier calibration adjustment, a capacitance balancing control to compensate for differences in linear speeds of the mechanism under test, a filter selector, and a scale selector switch. Price of the 590-A-1 is $495.00. Amplifier Corp. of America, New York, N. Y. **A-25**

AUDIO INSTRUMENT CO.

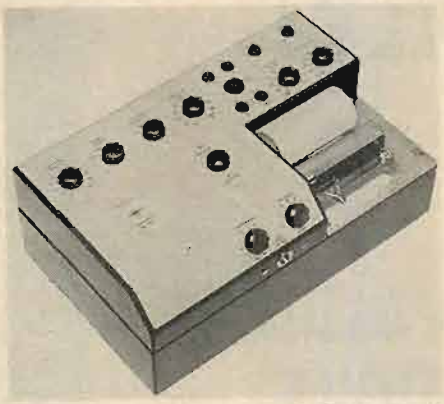
• **Intermodulation Measuring Instrument.** The Audio Instrument Company Model 168 Intermodulation Measuring Instrument features a residual intermodulation of less than 0.05 per cent, thus making possible the measurement of modern high-quality amplifiers which, in many cases, have less than a few tenths of a per cent of distortion at low power outputs. Minimum residual intermodulation results from the use of an accurate bridge-type mixing circuit for the two tones. The low-frequency



test signal is 60 cps from the internal source, or any frequency from 40 cps to 200 cps from an external oscillator. The high-frequency test signal is 2000 cps, 7000 cps, and 12,000 cps from the internal oscillator, or any frequency from 2000 cps to 20,000 cps from an external oscillator. The low-frequency/high-frequency voltage ratio is 4:1 and 1:1. The signal generator output is +8 dbm. The analyser IM ranges are 1, 3, 10, and 30 per cent full scale. The voltmeter measures up to 100 volts. The accuracy of the voltmeter is 3 per cent from 40 cps to 40,000 cps. Audio Instrument Company, New York, N. Y. **A-26**

B & K INSTR. CO.

• **Level Recorder.** The Bruel and Kjaer Model 2305 Level Recorder is a high-speed graphic recorder for the recording of frequency response curves, noise levels, and reverberation decay curves. Adjustable writing speed and paper-drive speed, including two different writing widths are provided. The instrument will record rms, arithmetic average, and peak a.c. signals. A chopper is built in for the recording of d.c. The frequency range on a.c. measurements is 10 cps to 200,000 cps ± 0.5 db.



The minimum voltage required to give 0 deflection of stylus is 5 mv rms for a.c. measurements. For d.c. it is approximately 10 mv. The dynamic range is determined by interchangeable range potentiometers. The resolving power is better than 0.25 mm on scale when adjusted for 50 mm paper, and 0.5 mm on scale when adjusted for 100 mm paper. The maximum input voltage is 100 volts. The writing speeds are selectable by a control knob and for 50 mm paper they range from 2 to 1000 mm per second. On 100 mm paper they range from 4 to 2000 mm per second. A variety of inks and papers are available. B & K Instrument Co., Cleveland, Ohio. **A-27**

B & W, INC.

• **Harmonic Distortion Meter.** The Barker & Williamson Model 410 Distortion Meter is designed for general laboratory use in measuring audio distortion, noise level, and a.c. voltage level (gain or loss). The

Model 410 suppresses the fundamental frequency and measures the amplitude of all unwanted frequencies, including noise, as a percentage of the fundamental. The instrument includes an improved variable frequency Wien Bridge network, a calibrated attenuator, and a sensitive VTVM. The Model 410 measures distortion on fundamental frequencies from 20 cps to 20,000 cps and indicates harmonics up to 100,000 cps. Scale ranges provided are 1, 3, 10, 30, and 100 per cent. Input signal levels may be as low as 0.1 volt or up to 30 volts rms. The frequency range of the VTVM is 20 cps to 200,000 cps, with an accuracy of ± 5 per cent on measurements from 0.0005 volts to 300 volts. For noise and db measurements, the voltmeter is calibrated in 1 db steps from 0 db to −15 db. The attenuator provides additional ranges from −60 db to +50 db in 10 db steps. Voltage meter output terminals are provided for scope monitoring. Barker & Williamson, Inc., Bristol, Pa. **A-28**

EICO

• **Electronic Switch Kit.** The EICO Model 488 Electronic Switch is a useful accessory for audio testing. It permits simul-

taneous observation of two patterns on one scope so that voltage and current amplitudes, wave forms, frequencies, and phase relationships may be observed. It provides continuous variable switching rates from less than 10 cps to over 2000 cps. It also may serve as a square-wave generator over the same range. Price for the kit is $23.95. EICO Electronic Instr. Co., Inc., Long Island City, New York. **A-29**

HEATH COMPANY

• **Audio Analyser Kit.** The Heath Model AA-1 Audio Analyser Kit combines the function of an a.c. VTVM, a wattmeter, and an intermodulation analyser. A high- and low-frequency source is built in for IM tests. Also 8, 16, and 600-ohm load resistors are built in. The frequency response of the a.c. VTVM is ±1 db from 10 cps to 100,000 cps. The range of the VTVM is 0.01 to 300 volts rms full scale.

The db scale reads from −65 to +52 dbm. The wattmeter reads up to 150 watts full scale, with a maximum continuous power of 25 watts and an intermittent power to 50 watts. The IM Analyser has 1, 3, 10, 30, and 100 per cent scales. The internal generator frequencies are 60 cps and 6000 cps. The accuracy of the a.c. VTVM and wattmeter are within 5 per cent of full scale, and the IM analyser is within 10 per cent of full scale. Price for the Model AA-1 Kit is $54.95. Heath Company, Benton Harbor, Michigan. **A-30**

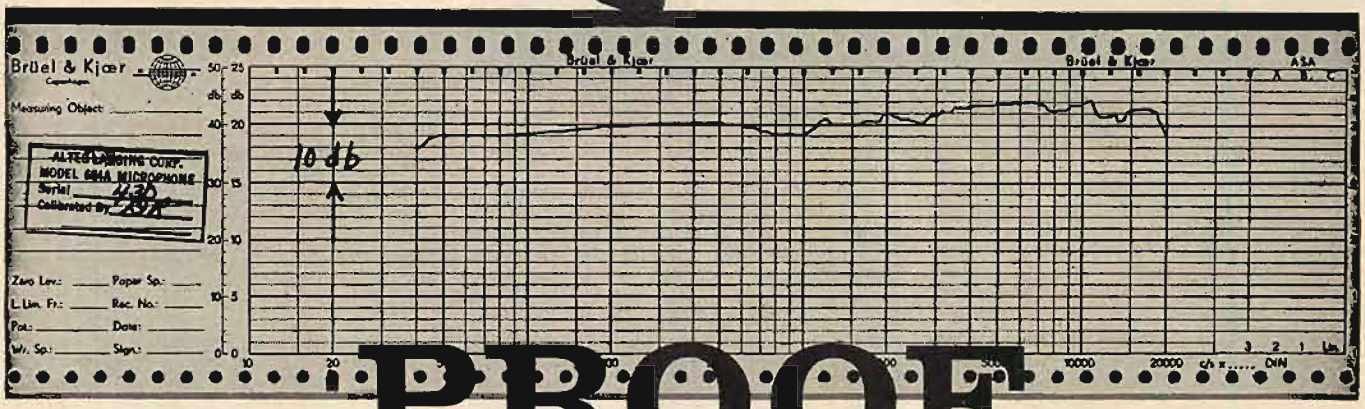
MEASUREMENTS CORP.

• **Intermodulation Meter.** The Measurements Corporation Model 31 Intermodulation Meter is a completely self-contained

test signal generator, distortion analyser, and VTVM. The low frequency is 60 cps and the high frequency is 3000 cps with

(Continued on page 62)

Frequency Response: 35 to 20,000 cycles
Output Impedance: 30/50, 150/250 and 20,000 ohms (selection by connections in microphone cable plug)
Output Level: −55 dbm/10 dynes/cm²
Hum: −120 db (Ref.: 10^{-3} Gauss)
Dimensions: 1⅛" diameter at top (1½" largest diameter) 7½" long not including plug
Weight: 8 oz. (not including cable & plug)
Finish: Two-tone baked enamel, black and dark green
Mounting: Separate "Slip-On" adapter No. 13338 furnished. Adapter has standard ⅝" −27 thread.



PROOF

Concrete visual proof of performance is now supplied by ALTEC with each 684A Omnidirectional Dynamic Studio Microphone. This proof—a soundly scientific and coldly unemotional statement of exact performance capabilities—is an individual certified calibration curve that you receive free with each 684A Omnidirectional Dynamic Microphone.

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The ALTEC 684A Professional Microphone shown is a production model chosen at random. Its calibration curve is actual and unretouched. It offers dramatic proof that the exclusive new ALTEC design, incorporating the highly sensitive ALTEC "Golden Diaphragm" of Mylar®, results in an omnidirectional dynamic microphone of remarkable superiority. This superiority will be maintained, year after year, by the exclusive ALTEC sintered bronze filter that positively bars the entry of iron dust and foreign matter. And, as proof of superior value, consider the price: the ALTEC 684A costs only $81.00 net!

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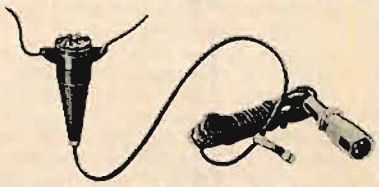
ALTEC 682A—$49.50 net—Featuring uniform frequency response from 45 to 20,000 cycles, the 682A Omnidirectional Microphone incorporates the new ALTEC "Golden Diaphragm" and exclusive sintered bronze filter. Output impedances of 30/50, 150/250, and 20,000 ohms easily selected in microphone plug.

683A DYNAMIC CARDIOID—$66.00 net—Uniform response from 45 to 15,000 cycles with average front-to-back discrimination of 20 db. Design incorporates the new ALTEC "Golden Diaphragm" and exclusive sintered bronze filter. Output impedance of 30/50, 150/250, and 20,000 ohms selectable at cable plug.

ALTEC 685A STUDIO CARDIOID—$96.00 net—This dynamic microphone offers flat frontal response from 40 to 16,000 cycles with average front-to-back discrimination of 20 db. Design incorporates the new ALTEC "Golden Diaphragm" and exclusive sintered bronze filter. Output impedances of 30/50, 150/250, and 20,000 ohms selectable at cable plug. Individual certified calibration curve is supplied with this model.



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HERMAN BURSTEIN*

Low-Noise Resistors

Q. I am trying to make some improvements in my tape recorder and plan to put low-noise resistors in the plate load of the first stage of the tape amplifier. Should I use low-noise resistors anywhere else? Are deposited carbon resistors satisfactory in this connection?

A. Unless the cathode resistor is bypassed by a large capacitor, it is just as important to use a low-noise resistor here as in the plate load. While the final amount of amplifier noise depends largely upon the amount of noise generated in the first stage, it sometimes pays to use low-noise resistors in the second stage as well, which may yield a slight additional improvement. My own experience with deposited carbon resistors has not been very satisfactory. I prefer to use deposited metal film types, which are not much more expensive than the deposited carbon ones, but are substantially cheaper than wirewound resistors and virtually noise-free (that is, tube noise will predominate over resistor noise). On the other hand, on rare occasion one may run into a defective deposited metal film resistor (as once did happen to me), so in the last analysis you might decide to go for wirewound resistors as the safest bet for minimum noise. Should you decide upon the latter, be absolutely sure to get the non-inductively wound type. Some persons claim to have obtained good noise reduction by using conventional molded carbon resistors of oversize wattage rating. For example, they have used a 2-watt conventional resistor where a ½-watt one would ordinarily do. You might try this expedient in the second stage, especially as it is a good deal cheaper than deposited metal film or wirewound resistors.

Strange Low-Frequency Sound

Q. My problem is that my tape recorder records a strange low-frequency sound. If I use bulk erased tape I hear this only in the record function. It does not follow a definite pattern. It may go for several seconds before a bit of it is heard. The moment I cut the tape machine to playback the noise stops. I have tried using another deck with the same oscillator and the noise continues. I even sent the offending machine to the manufacturer for repair. The manufacturer increased the frequency response by changing several capacitors but this was not my trouble.

Some more symptoms might be of help. I have tried degaussing the heads but this does not seem to help much if any. The recorder uses pressure pads, which I have replaced with new felt but this does not help. Could it be that electrostatic charges are being recorded on the tape? These charges could be generated by the friction of the tape on the felt pads. The noise sounds like an irregular low-frequency flutter.

I keep thinking it is the bias oscillator. Are such noises inherent in these oscillators? It is a push-pull type with disc ceramic type capacitors. Might not micas be better? This noise is worse and more frequent at the faster speed. Having a monitoring head, I can easily hear the difference. I have even used this head for recording. I have grounded all the heads, but the noise continues. The noise decreased considerably when I disconnected the erase head, but it is still there.

A. I do not have a specific, sure answer to your baffling problem, which appears to be of the type that requires hours of searching in order to turn up the answer. However, I am very much inclined to agree that the noise probably comes from the oscillator. Let's look at the evidence: (1) You have used your oscillator in conjunction with the deck and record amplifier of another tape machine, and the noise continues. (2) The noise abates when you disconnect the erase head, which is fed by the same oscillator that supplies the record head. (3) You state that the noise gets worse at faster tape speed, but you do not say that its pitch increases; by "worse" I assume you mean "louder." For a given magnitude of signal (noise) *presented* to the tape, the magnitude of the signal *recorded* on the tape goes up as tape speed is increased. If the noise were due to tape friction, the pitch would increase with speed.

Possibly the noise is due to serious distortion in the oscillator waveform. Placing an oscilloscope across the oscillator output would quickly establish this. The distortion may be caused by an excessive load on the oscillator, which could be due to a faulty record or erase head with shorted turns. Or there may be something else in the oscillator and associated circuitry which presents too great a drain on the oscillator output. Inasmuch as the noise decreases when the erase head is disconnected—thereby removing an appreciable part of the load—excessive loading seems to be a likely cause. A defective oscillator transformer or other components could also be responsible for the distorted waveform and consequent noise.

Have you by any change overlooked the simple expedient of replacing the oscillator tube? Have you tried a *second* replacement tube? Once in a great while a new tube turns out to be bad. Have you tried replacing the other tubes in the record amplifier on the chance that microphonics or other noise produced by one of them is somehow getting through?

To answer your question about the use of ceramic versus mica capacitors in the oscillator circuit: Generally, mica capacitors are recommended for a bias oscillator, whereas ceramic ones are not recommended from the viewpoint of frequency stability.

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

Testing Tape

Q. Many "good buys" in tape continually appear in the audio magazines. Is there a simple way or test to compare the quality of different tapes? I have a good deal of test equipment.

A. There are many things for which a tape can be tested, including at least the following: frequency response; harmonic and intermodulation distortion (the latter is much more revealing) at various levels of tape *output;* variation of the record-playback response curve with changes in bias current to ascertain if the tape is unduly sensitive to slight changes in bias; dropouts; constancy of output level from one end of the reel to the other; warping; accuracy and constancy of physical dimensions; squeal under varying conditions of temperature and humidity; print-through; breaking strength; elasticity; recovery from stretching. All told, it would seem that your best course is to rely upon the reputation of the tape manufacturer and the audible results obtained from each tape.

The tests most likely to be within your province are those for frequency response (including the change in response with variation of bias current) and distortion. In checking frequency response, be sure to record all signals at a level at least 20 db below maximum recording level as shown by the record-level indicator, for otherwise you will saturate the tape at high frequencies due to record treble boost, resulting in a seeming treble loss. When checking distortion, check this at various levels of *output* signal; after all, you don't mind pumping in *a little bit more* signal if, for the same amount of distortion, you get out *a substantial increase in* signal.

Three Head Machines

Q. I know that having separate record and playback heads permits one to monitor the tape as it is being recorded. But are there any advantages so far as quality of performance is concerned?

A. When separate heads are used, each one can be designed to do its job as well as the state of the art permits. A playback-only head is built with a greater number of windings than one which must serve for recording as well as playback. The larger number of windings results in more head output, leading to a better signal-to-noise ratio. On the other hand, a large number of windings raises the impedance of the head to the point where it is not suitable for recording, because it makes excessive voltage demands upon the bias oscillator and the record amplifier. For recording purposes a low-impedance head is desirable in order to permit the record head to be driven by reasonable values of audio and bias voltage, with accompanying low distortion. Also, a record head does not require an extremely narrow gap, which is difficult to manufacture and raises cost. Instead, the manufacturer can concentrate on making a gap with very straight and sharp edges, which is the more important thing for recording purposes.

It should be further taken into consideration that it is much easier to make performance checks—frequency response, signal-to-noise ratio, distortion, and so forth—on a machine with separate record and playback heads than on a machine with a single head for both purposes. Accordingly, it is more likely that such a machine will be kept in condition to provide high quality performance.

A Filterless Method for the Detection of FM-Stereo Signals

THEODORE BIALLY*

The use of a demodulator switching waveform of odd symmetry and zero average value may eliminate the need for filters to separate the sum and diference signals as well as the SCA signal.

TWO PRIMARY CONSIDERATIONS in the design of a multiplex receiving system are:

1. The ability of the system to maintain consistent channel separation over the entire audio spectrum (50–15,000 cps); and
2. The elimination of audible products resulting from the detection of signals in the SCA region (60,000 to 74,000 cps).

The scheme which is commonly employed to recover stereo information from the composite multiplexed signals which appear at the ratio detector consists of isolating the $L-R$ (difference) sidebands and the $L+R$ (sum) channel from each other through the use of bandpass and low-pass filters. Then the $L-R$ sidebands are demodulated and matrixed with the $L+R$ signal to obtain the left and right channel audio signals.[1] It has been pointed out that even slight errors in the phase of the $L+R$ channel with respect to that of the detected $L-R$ sidebands will place serious limitations upon channel separation. In order to preserve proper phase relations several excellent linear phase shift filter designs have been offered by the industry.[2]

Although the method described is a solution to the problem, it requires extremely delicate alignment. Stringent tolerances must be rigidly maintained if reasonable channel separation is to be realized. Practical difficulties also arise from the fact that "linear phase shift" filters are not completely linear thus making channel separation dependent upon frequency.

Analysis of the output spectrum which results when the total composite multiplex signal is applied to a synchronous demodulator indicates that if the demodulator switching waveform has zero average value, then, in the region from 50–50,000 cps, only the demodulated $L-R$ sidebands will appear. (See spectrum analysis.) Thus, in the spectral band of interest, a properly designed demodulator will deliver exactly the same signal whether or not it is preceded by a bandpass filter. The demodulator output may then be matrixed with the (unfiltered) composite input signal to yield the desired left and right stereo channels. Omission of the filters introduces high frequency components (above 15,000 cps) in the form of suppressed carrier AM signals into the output waveform, but normal de-emphasis effectively attenuates these undesired products. By eliminating the major cause of relative phase shift between main and sub-chan-

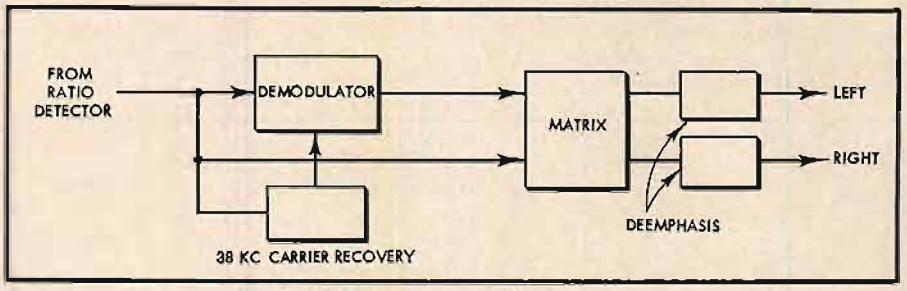

Fig. 1. Block diagram of filterless scheme.

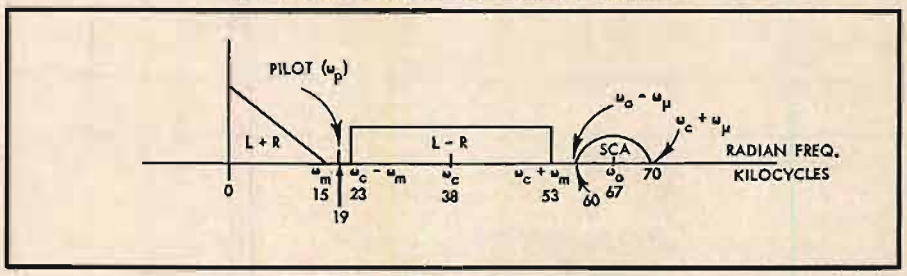

Fig. 2. Spectral distribution of signal.

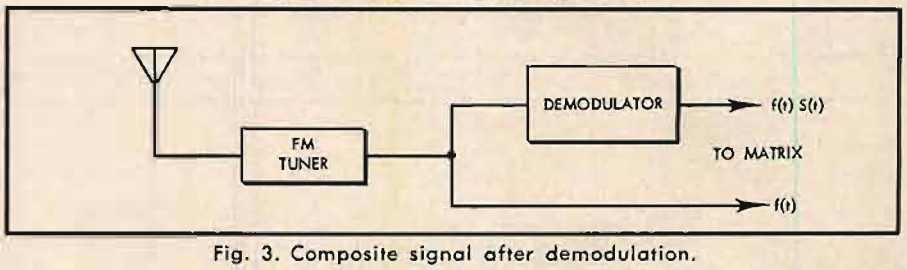

Fig. 3. Composite signal after demodulation.

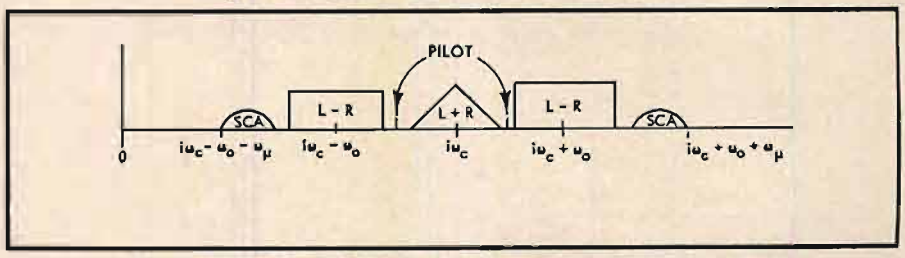

Fig. 4. Spectral distribution of the product $f(t)A_i\cos(i\omega_o t + \phi_i)$.

* *Design Engineer, EICO, 3300 Northern Blvd., L.I.C. 1, N.Y.*

[1] Comments by the General Electric Company on the FCC docket No. 13506, Appendix L, pg. 87.

[2] Comments by the Zenith Radio Corp. on the FCC docket No. 13506, Appendix 5, pg. 72.

nels, the inherent separation capability of the receiving scheme may be substantially increased.

Rejection of SCA Crosstalk

Crosstalk from the SCA channel is a result of the mixing of SCA components in the 60,000–74,000 cps region with a signal between 45,000 and 89,000 cps. The result is an undesired product in the 0–15,000 cps band. This mixing occurs in the $L-R$ sub-channel demodulator which by virtue of its nonlinear nature injects, in addition to the required 38,000 carrier, various harmonics of 38,000 cps. Note that the second harmonic (76,000 cps) lies between the 45,000 and 89,000 limits and is a potential source of SCA crosstalk. The solution to the problem lies either in preventing signals in the 60,000–74,000 cps region from appearing at the demodulator input (i.e., passing the composite signal through a low-pass filter having a cutoff frequency between 53,000 and 60,000) or in eliminating the second harmonic component of the demodulator switching waveform. Once again the filter solution is avoided because of the phase shift which it introduces in its passband. If the demodulator is designed to switch with a waveform of odd symmetry (i.e., no even harmonics) SCA crosstalk ceases to be a problem.

The block form of the receiving scheme is shown in *Fig.* 1.

Spectrum Analysis

Let the following notations apply:

$\omega_p = 2\pi \times 19 \times 10^3$ *rad/sec* = pilot frequency

$\omega_c = 2\pi \times 38 \times 10^3 = 2W_p$ *rad/sec* = subcarrier frequency

$\omega_m = 2\pi \times 15 \times 10^3$ *rad/sec* = upper audio frequency limit

$\omega_o = 2\pi \times 67 \times 10^3$ *rad/sec* = SCA subcarrier frequency

$\omega_\mu = 2\pi \times 7 \times 10^3$ *rad/sec* = upper SCA audio frequency limit

If the left channel audio signal is

$$\sum_{k=1}^{m} A_k \cos(\omega_k t + \phi_k),$$

the right channel signal is

$$\sum_{n=1}^{m} A_n \cos(\omega_n t + \phi_n),$$

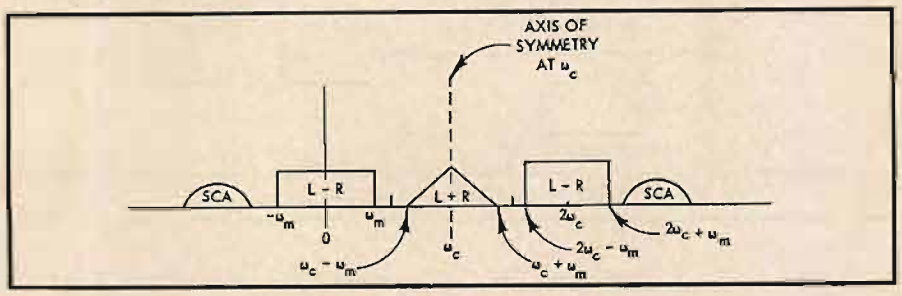

Fig. 5. Spectrum translated by ω_c.

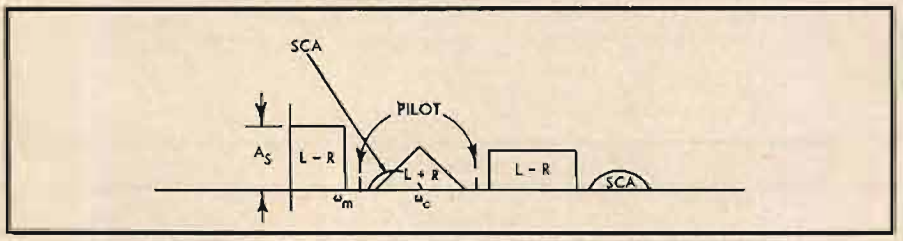

Fig. 6. Negative frequency portion redrawn in positive region.

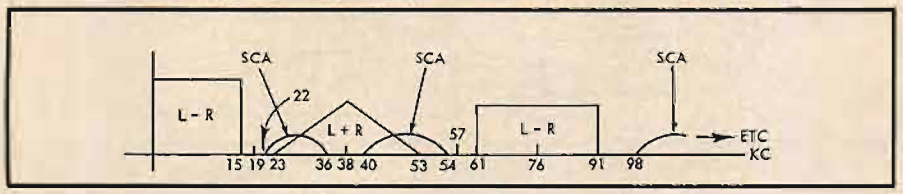

Fig. 7. The spectrum of the output signal.

and the SCA audio signal is

$$\sum_{j=1}^{\mu} A_j \cos(\omega_j t + \phi_j),$$

then the composite signal ($f_{(t)}$) which is available at the ratio detector output is:

$$\sum_{k=1}^{m} A_k \cos(\omega_k t + \phi_k) + \sum_{n=1}^{m} A_n \cos(\omega_n t + \phi_n)$$

$$+ A_p \cos \omega_p t + \tfrac{1}{2} \sum_{k=1}^{m} A_k \{\cos[(\omega_c + \omega_k)\, t + \phi_k] + \cos[(\omega_c - \omega_k)\, t - \phi_k]\} - \tfrac{1}{2} \sum_{n=1}^{m} A_n$$

$$\{\cos[(\omega_c + \omega_n)\, t + \phi_n] + \cos[(\omega_c - \omega_n)\, t - \phi_n]\} - \tfrac{1}{2} \sum_{j=1}^{\mu} A_j \{\cos[(\omega_o + \omega_j)\, t + \phi_j] + \cos[(\omega_o - \omega_j)\, t - \phi_j]\}.$$

The spectral distribution of this signal is as shown in *Fig.* 2.

Upon demodulation, the composite signal is effectively multiplied by the demodulator switching function $S_{(t)}$— i.e., the demodulator output is the product $f_{(t)}S_{(t)}$ as shown in *Fig.* 3.

$S_{(t)}$ in its most generalized form may be expressed as a periodic waveform having fundamental frequency ω_c:

$$S_{(t)} = \sum_{i=o}^{\infty} A_i \cos(i\omega_c t + \phi_i)$$

The spectrum of $f_{(t)}S_{(t)}$ may be determined by algebraically adding the spectra resulting from the individual products of $f_{(t)}$ with each of the spectral components of $S_{(t)}$.

Each such product $f_{(t)}\, A_i \cos(i\omega_c t + \phi_i)$ yields the spectral distribution shown in *Fig.* 4.

Note that the $f_{(t)}$ spectrum has been translated to the frequency $i\omega_c$ and is symmetrically distributed about this point. The amplitude of the translated spectrum relative to the original $f_{(t)}$ spectrum is $A_i/2$.

The fundamental (ω_c) component of $S(t)$ translates the $f(t)$ spectrum to the position shown in *Fig.* 5.

The portion of the spectrum which falls in the "negative" frequency region can be drawn in the "positive" frequency region as in *Fig.* 6.

Since the $L-R$ information on the negative frequency axis is the exact mirror image of that on the positive frequency axis, the amplitude (A_s) of the resultant "positive" $L-R$ spectrum is a function of the relative phasees of the negative and positive frequency contributions. In particular, the translated $L-R$ spectrum will vary in amplitude as the cosine of the phase angle ϕ_i of the fundamental component of $S(t)$. In order to obtain maximum sideband recovery, the phase of the fundamental component of $S(t)$ should be identical with that of the subcarrier at the transmitter.

It is the purpose of the demodulator to deliver only the detected $L-R$ sidebands in the audio region $o \rightarrow \omega_m$. This has been accomplished by the fundamental component of $S(t)$. However, it remains to be seen whether any of the other spectral components of $S(t)$ will deliver outputs in the o to ω_m band.

The $i = o$ (d.c.) component of $S(t)$ effects no translation of the input spectrum but simply alters its amplitude by the factor A_o; the input of the demodulator due to the d.c. component (A_o) of $S(t)$ is $A_o f(t)$. This contains the $L+R$

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information in the region between zero and ω_m. In order to obtain *only* the demodulated $L-R$ sidebands in this region, the A_o term of $S(t)$ should be zero.

As was previously pointed out, each spectral component of $S(t)$ produces an output which is symmetrical about that component in frequency. In fact, it is clear that each component of $S(t)$ yields an output of bandwidth twice that of $f(t)$. The input signal bandwidth is $\omega_o + \omega_\mu$ radians/second, or 74,000 cps, so that for each component $i\omega_c$ there will appear at the demodulator output a signal whose spectrum lies between the limits $i\frac{\omega_c}{2\pi} \pm 74{,}000$ cps where $\frac{\omega_c}{2\pi} = 38{,}000$ cps. Those components of $S(t)$ which are sufficiently high in frequency so that $i\frac{\omega_c}{2\pi} - 74{,}000 \text{ cps} > 15{,}000$ cps will deliver no output in the 0 to ω_m (0 to 15,000 cps) region. In other words, $i\frac{\omega_c}{2\pi}$ *must be* greater than $74{,}000 + 15{,}000 = 89{,}000$ cps in order to produce no audible output signals. Since $\frac{\omega_c}{2\pi} = 38{,}000$ *cps*, $i > \frac{89}{38} = 2.35$. However, i can assume only integral values so that for $i \geq 3$ there will be no audible response. The second harmonic $(i=2)$ of $S(t)$ must be suppressed, since this component delivers an output in the 0 to 15,000 cps region.

The spectrum of the output signal of a demodulator which satisfies the aforementioned requirements appears in *Fig. 7*.

Note that the $L-R$ information is the only audible component of this signal.

Since the matrixing process effects no spectral translation, the audible output of a matrixing circuit will be composed only of the audible components of the input signals. The only audible components of the original $(f(t))$ and demodulated

(Continued on page 69)

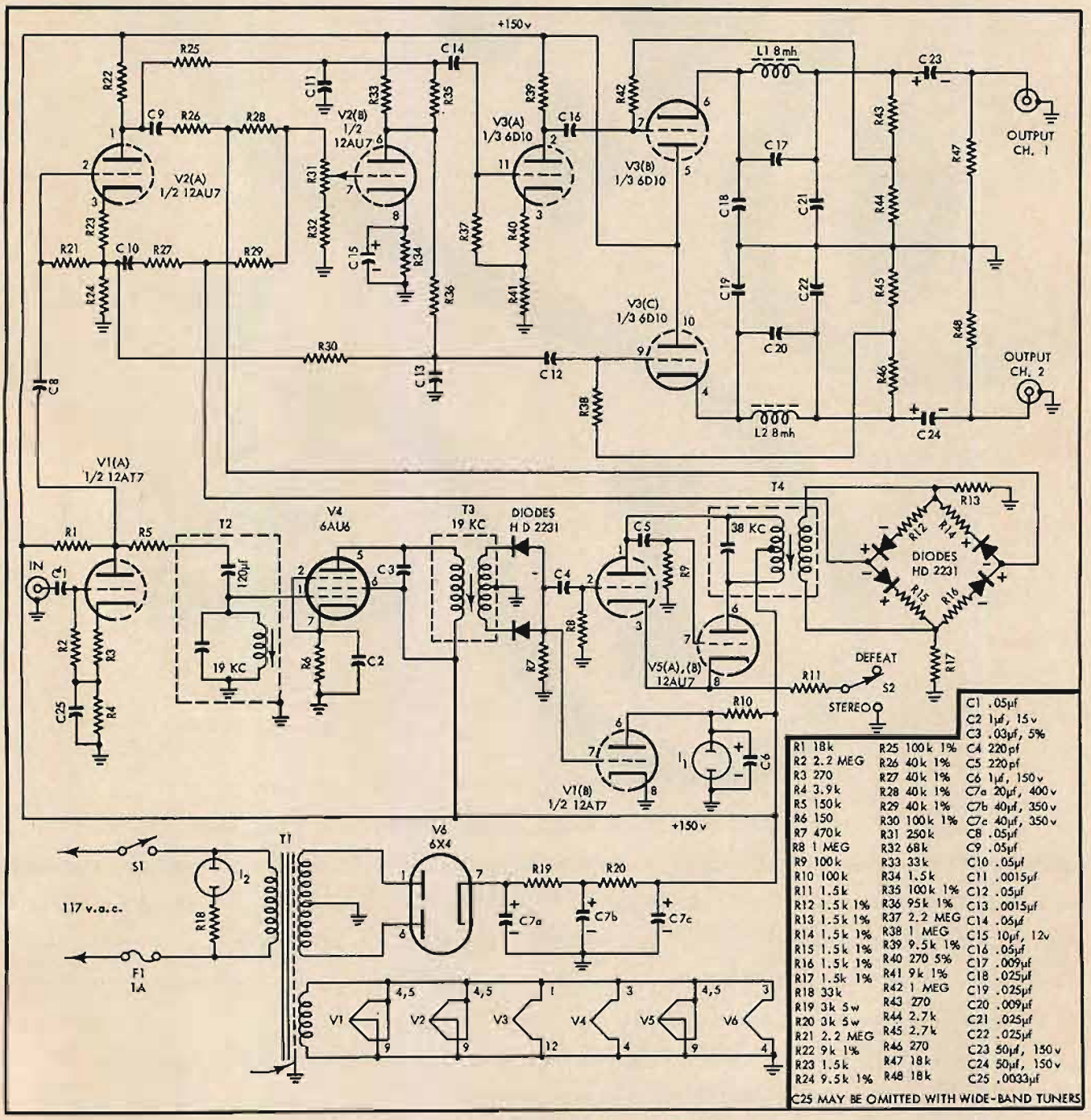

Fig. 8. Schematic of Eico MX-99 multiplex adaptor.

Feedback—Head Cook and Bottle Washer!

NORMAN H. CROWHURST*

Feedback can reduce frequency and phase errors, gain, and distortion as well as improve stability—but rarely can it do all of these things at the same time.

LIKE A MAN in a one-man establishment, feedback can do a lot of things: reduce distortion, adjust frequency response, improve stability from variation due to component deviation or fluctuation, adjust or control input and/or output impedance, and variations of same; but also like the one-man establishment, it is seldom able to do all these things at once.

This fact is often overlooked in various ways. We start with some algebra from which we draw a magic factor $-(1+AB)$—generally identified as the *feedback factor*. More academic people may prefer $\mu\beta$ instead of AB, but it's the same thing with benefit of fraternity letters. Some people prefer to write the factor $(1-AB)$, or $(1-\mu\beta)$. While the difference in sign may confuse, it's really only a matter of where you start, and both ways of writing it lead to the same conclusions.

If B, or β, is taken to represent a *negatively* phased feedback fraction, we land up with the first expression, $(1+AB)$, which is greater than unity. From this starting assumption, if the feedback is positive, then B has a negative sign, the expression becomes $1+A(-B)$, which results in something less than unity.

Our more academic friends prefer to say that, if B represents negative feedback, it should have a negative sign and if it represents positive feedback it should have a positive sign. To conform with this rule, the factor should always be written $(1-AB)$.

But most people visualize something bigger than unity any time they see $1+$ something, so I find it simpler to use $(1+AB)$ for negative feedback and $(1-AB)$ for positive feedback, where B is the feedback fraction in each case, without any implied sign to indicate its phase. We have taken care of that by designating it as negative or positive feedback verbally.

So it's really a matter of algebraic "semantics." I'm not fussy, so long as it's done right. Most important to the whole thing are two facts: first, and best known perhaps, although it's still often overlooked, in any practical application the expression is not a simple scalar quantity. It is complex, or possessed of both magnitude and phase.

Secondly, and this almost always overlooked, it is not constant, but subject to variation *with each of the things feedback is supposed to control.*

The usual presentation tells us that gain is reduced by the factor $(1+AB)$, distortion is reduced in the same proportion, stability of amplification is improved by this same factor, frequency and phase errors are reduced by the same magic number, and impedance is stepped up or down, according to a convenient table, using the same number as operator.

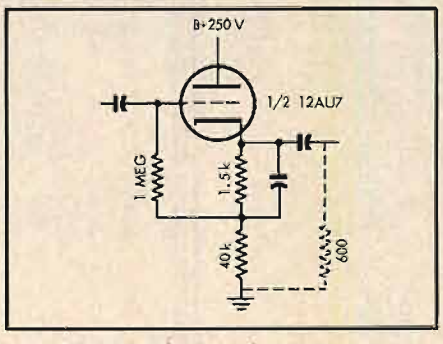

Fig. 1. Cathode follower circuit.

The fact is, it just ain't so. Feedback can do all of these things, but seldom all at once. To illustrate, let's take some typical examples.

Cathode Follower

A common fallacy of this type is the usual understanding of a cathode follower. In this case B is unity, so the gain degenerates to $A/(1+A)$, which is usually a fraction slightly less than unity. Any input impedance connected virtually between grid and cathode is multiplied by $(1+A)$. And the effective output source impedance is the normal source impedance of the plate circuit with the operating condition chosen (plate voltage and current, and load resistor), divided by $(1+A)$. Finally, the normal distortion for the stage is divided by $(1+A)$.

Let's put in some figures, to see what all this means. We'll use a half 12AU7. With a 40,000 ohm coupling resistor, 250 volts plate supply and 5 volts bias, the plate current is 3.5 ma. The bias resistor should be 1400 ohms (1500 ohms is near enough for practical purposes, *Fig.* 1). With these values a ±5 volt grid swing will produce a plate swing from 125 volts to 45 volts and 182 volts, according to the curves (*Fig.* 2). This is a gain, or A, of (182–45)/10 = 13.7, with a second harmonic of 11.5/137 × 100 per cent = 8.4 per cent distortion. The plate resistance of the tube at the operating point is 12,000 ohms.

As a cathode follower, working open circuit, the degeneration will be 13.7/14.7 = .93. The distortion will be 8.4/14.7 = .57 per cent. This is at 137 volts output, peak to peak, or 48.5 volts rms. At lower voltages, the distortion will be proportionately lower. For example, at the 10 volts rms level, it will be .57/4.85 = .118 per cent.

If the grid-to-bias-point resistor is 1 megohm the input impedance will be 14.7 meghms. The normal plate circuit resistance is 12,000 ohms in parallel with 40,000 ohms, or 9200 ohms. As a cathode follower, this is divided by 14.7, to give 625 ohms.

From that, it sounds like a good circuit to match a 600-ohm line. But now suppose you connect it that way. The load line for the tube is now 600 ohms in parallel with 40,000 ohms, or 590 ohms, through the same operating point. For convenience, we'll take it as 600 ohms. The ±5 volt swing now produces a swing from 125 volts to 118 volts and 127 volts.

The gain is now (127–118)/10 = .9. As a cathode follower, the degeneration will be .9/1.9 = .475. The distortion is 2.5/9 × 100 per cent = 28 per cent plate-coupled. For cathode coupling, this is no longer divided by 14.7, but by 1.9, to give 14.8 per cent, with a peak-to-peak output of only 9 volts, or 3.2 volts rms. At this output level, the open cir-

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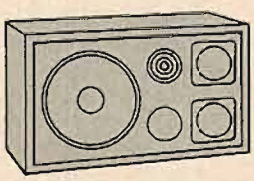

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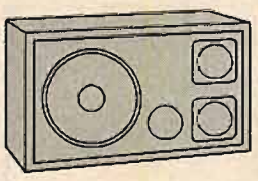

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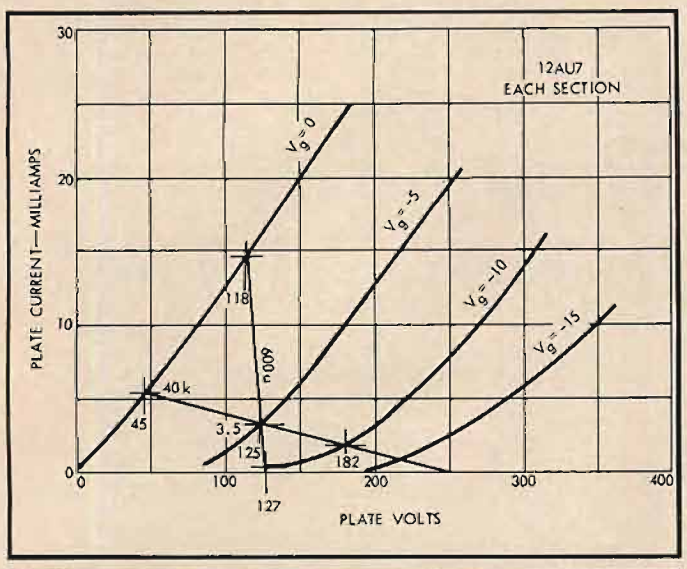


Fig. 2. Load lines on which calculations for cathode follower are based.

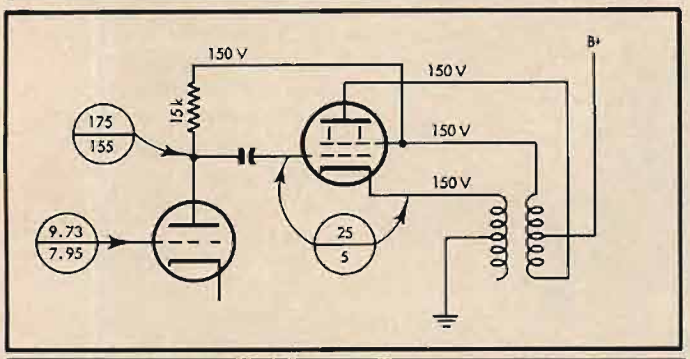


Fig. 3. Essential features of bootstrap arrangement. One side of a push-pull circuit is shown.

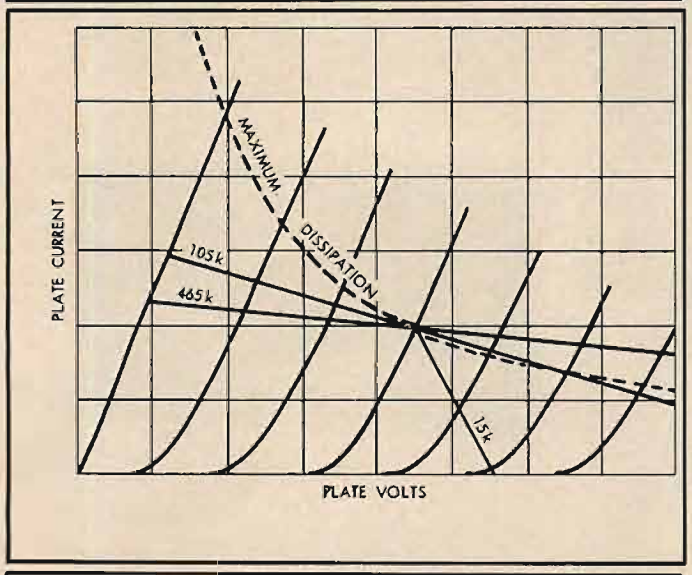


Fig. 4. Principle of the bootstrap illustrated by load lines.

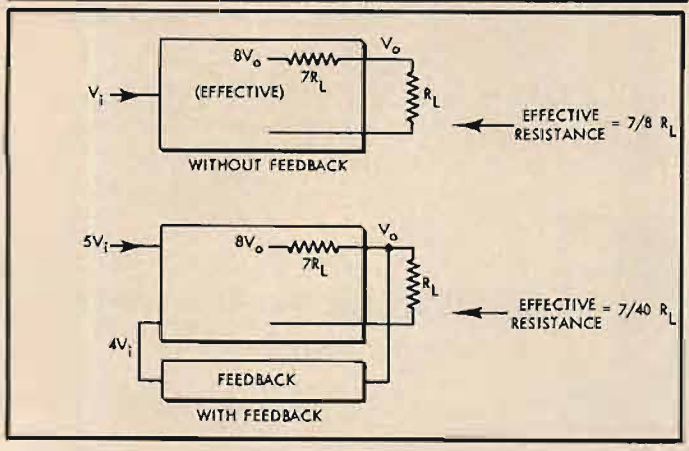


Fig. 5. Some of the quantities discussed in the complete feedback amplifier.

cuit distortion would only be .038 per cent. Also the input impedance is no longer 14.7 ohms, but 1.9 megohms.

Quite a difference! We might say the feedback has been "used up" to change the output impedance, so little or none is left for the other functions.

Bootstrap

Now let's take a case of positive feedback: the bootstrap driver, often used for unity coupled output circuits. We'll assume the output stage develops 150 volts swing in both cathode and plate circuit, for 25 volts swing at the grid. This means we need 175 volts total swing at the grid (*Fig.* 3).

To do this we use a relatively low plate resistor from the screen of the output stage to the driver plate, so the working plate voltage on the drive stage can be kept high at a current approaching maximum dissipation (*Fig.* 4). The positive feedback from the screen connection effectively multiplies this actual value to give a higher dynamic load line. If the actual resistor is 15,000 ohms, its effective value will be 175/25 = 7 times this, or 105,000 ohms.

Positive feedback has multiplied the driver load impedance by 7 times. Does this mean the over-all gain is multiplied 7 times? And what happens to the damping factor?

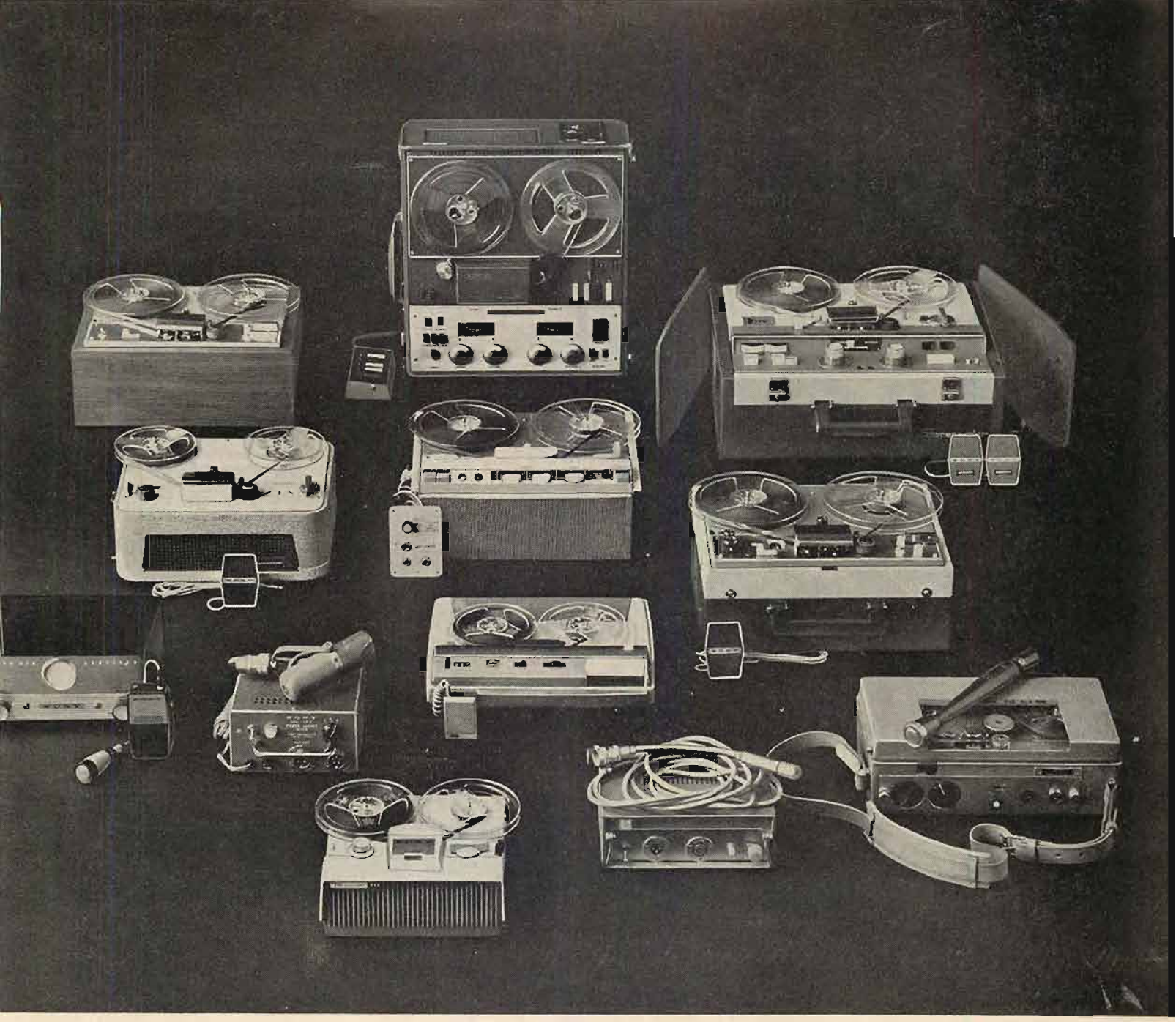
Assume the drive stage has a plate resistance of 12,000 ohms and an amplification factor of 20. Without the bootstrap, its gain would be $20 \times 15/(15+12) = 11.1$. With the bootstrap, the gain becomes $20 \times 105/(105+12) = 18$. The increased gain factor is only $18/11.1 = 1.62$. Use of the bootstrap circuit increases available output *swing* of the drive stage much more than it increases gain, but this only a graphical approach can predict.

Damping factor is a little more involved. Starting with normal pentode operation, if 25 volts grid swing produces 300 volts total swing in a normal load value (the condition on which our earlier figures were based), open circuit operation would require only about 5 volts swing at the grid to produce the same 300 volts output swing. So in unity coupled configuration, to get the same output voltage, the grid swing needed drops from 175 (i. e. 150 + 25) to 155 (i.e. 150 + 5), representing a damping factor of about 7.8.

But that's assuming a constant-voltage drive stage, unaffected by feedback. Now to see what the bootstrap does:

When the load is removed, the positive feedback to the drive stage plate resistor jumps from 7 times to 155/5 = 31 times. So the effective (dynamic) plate resistor is now 465,000 ohms. The gain will be $20 \times 465/(465+12) = 19.5$. (This

(*Continued on page 66*)



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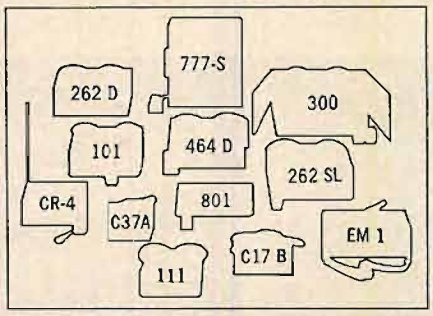

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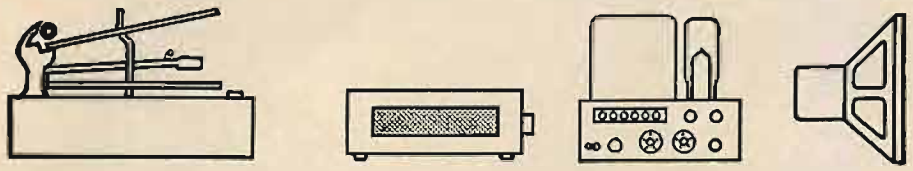

PILOT FM-STEREO RECEIVER, MODEL 602M

The Pilot Model 602M is a complete stereophonic receiver in that it combines on one chassis an FM-stereo tuner, a stereo control center, and a 30-watt stereo amplifier. The 602M incorporates several unusual features, not the least of which is the "Simpli-Matic" test panel which permits the amplifier output tubes to be balanced simply and without the need for special test equipment. Another built-in feature is the power-line antenna which we found sufficient to receive FM-stereo signals over a distance of some 30 miles. Undoubtedly this really reflects the sensitivity and quality of the tuner more than anything else but it is a rather neat way to solve the antenna problem.

The Model 602 is not a new number for Pilot Radio; there have been several antecedents with essentially the same ingredients. For example the original Model 602 contained the same amplifier and FM tuner —and it also contained an AM tuner. The Model 602S added stereo FM with the inclusion of a multiplex adapter (built-in). Now comes the Model 602M which keeps stereo FM but drops the AM section. In other words, you can have it any way you wish.

Circuit Description

FM section. The signal enters the triode r.f. amplifier (½ ECC85) and proceeds to the oscillator-mixer (½ECC85) where it is converted to the intermediate frequency. From there it goes through three i.f. amplifier stages (6AU6) and then to a solid-state ratio detector (1N542). An "eye" type of tuning indicator (EM84) is used. After leaving the ratio detector the signal takes one of two paths: through a de-emphasis network if it is a mono broadcast, or through the multiplex network if it is stereo (assuming the selector switch is in the correct position). We will not describe the multiplex circuit as this was described in detail in the December, 1961, issue of AUDIO in an article by R. Shottenfeld and S. Abilock.

Preamplifier-amplifier section. Three pairs of inputs are provided: two pairs of low-level inputs and one pair of high-level inputs. The low-level signals (phono) enter a preamplifier stage (7025) which incorporates RIAA equalization. After this stage the high-level signals enter and all follow the same path from here on. The path then is through the volume and balance potentiometers; through a tone driver (½ 12AX7); through the treble and bass networks; to the power driver (½ 12AX7); and then to the push-pull power output stage (EL84), half the signal going through a phase inverter (½ 12AX7).

Performance

The Pilot 602M easily met its published performance specifications: FM sensitivity just under 3 μv (IHFM); frequency response ±1 db from 20 cps to 20,000 cps; harmonic distortion les than 1 per cent at full output; and power output at least 15 watts per channel. The power rating is achieved by operating the output tubes with a plate voltage of 325 volts which is just about the maximum rating for an EL84. Of course this is fairly common practice. Although we have not seen any published performance specifications for the multiplex reception of the 602M we observed better than 20 db of separation, which is more than adequate. Actually there are not as yet firm standards for FM-stereo reception, but separation of this order is considered important. In any case, the stereo sound was quite good.

Our total impression is that the Pilot 602M is a fine performer at a surprisingly modest price. Oh yes, we forgot to mention it looks good too. A-40

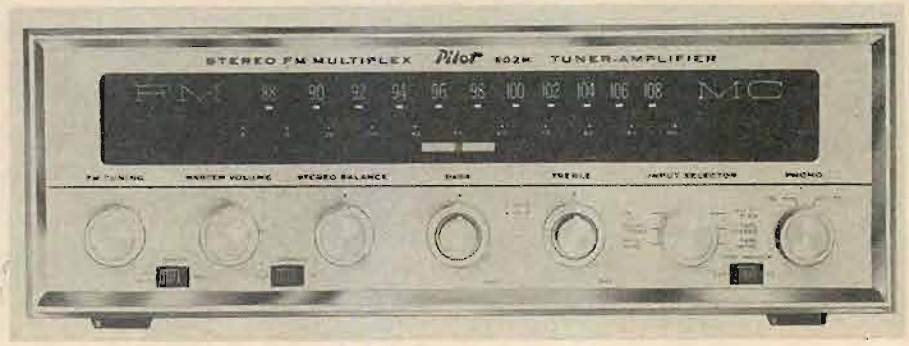

Fig. 1. Pilot FM-stereo receiver Model 602M.

TELEFUNKEN TAPE RECORDER MAGNETOPHON 97

The Telefunken Magnetophon 97 is a 3-speed, 4-track, stereo tape recorder which features pushbutton controls for most functions and an unusually flexible stereophonic microphone. The 97 is a completely integrated unit in that it can record and playback stereo without the need for any further equipment. This includes two built-in microphone preamps, two 2.5 watt amplifiers, and two speakers. One speaker is in the front section of the machine proper and the other speaker is ingeniously mounted in the plastic lid of the machine. (The main body of the machine is made of metal.)

The Magnetophon 97 is a very flexible machine insofar as operating controls are concerned. Because of the individual buttons for the recording channels it is possible to record 4-track mono by pressing one button at a time. To record stereo both record buttons are pressed simultaneously. It is also possible to listen to a previously recorded track while recording a second and, by *not* pressing either of the playback buttons, mix the end result. Thus you can record one part of a duet on one track, harmonize with yourself on the second track, and play them back together as if they were both on one track.

There are four playback combinations possible: track 1 alone; track 2 alone; track 1 and track 2 simultaneously (stereo); and track 1 and 2 mixed. In addition, the playback facilities may be used with an external signal source—in other words as a public address system.

The Model D77 stereo microphone supplied with this machine is rather unique. It comes as a one piece unit which can be mounted on the tripod-like legs supplied with it. There are two microphone elements mounted inside with their axes normally about 90 deg. apart although this relationship is adjustable. The two elements can be separated from each other however by simply unsnapping the snap fastener

(*Continued on page 59*)

Fig. 2. Telefunken Magnetophon 97 tape recorder.

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Integrated within its precisely-matched cabinet are three superlative speaker components: the 12" high compliance woofer that delivers bass frequencies down to the very threshold of feeling; a newly-engineered 8" speaker to assure you of all-important mid-range *impact;* and the Sphericon super tweeter for highs unlimited. Result: virtually uniform response

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—smooth and rich—from *28 to 40,000 cps* (±2db at 22,000 cps). And at your fingertips, network controls to balance the Medallion sound to match the acoustics of your room—*any* room.

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Write for University's "Informal Guide to Component High Fidelity," Desk R-1, University Loudspeakers, Inc., White Plains, New York.

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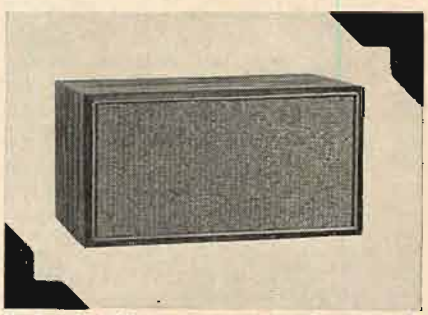

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TIMELESS BEAUTY AND THE SOUND OF TRUTH

AUDIO ETC

(*from page 14*)

be done. The dealers are in blue funks trying to figure out the differences, vainly explaining them to the people who buy. Customers are confused, annoyed, outraged. (They have no compassion for individualistic engineers at all.)

3. And so in Phase 2 there is inevitably that frantic, wholly unforseen period of in-production adjustment that tempers the product to fit, in the hardest possible way. Adjustments, right in the middle of crucial production, that sometimes become so wild and woolly that the end-result is hardly recognizeable for what it had been, weeks before, at the big demos!

Oof! It's astonishing what ingenuity can go into this drastic sort of modification after the fact—while out in public all seems peaceful and happy. (Except for the unaccountably trickling supply of the new equipment, and for the changes, which are always played down as far is humanly possible.)

In other words, Phase 2 doesn't exist in the ads, nor is it officially recognized in public. Everybody in the business makes like Phase 3—and hopes. Sooner or later, if they keep it up long enough, they are rewarded. Phase 2 *does* lead to Phase 3.

3. As Phase 2 progresses, there is a strange, unofficial, mutual sliding towards uniformity and practical standardization. Again, nobody wants to admit anything. But each manufacturer, now that the game is underway, sees acutely saleable things in his rivals' products that he *must* have for himself; and so he hastens to borrow while the borrowing is good. The results are healthy. By a sort of unacknowledged and involuntary cooperation, the individualistic manufacturers are drawn together towards emerging standards for all. Excellent! Democracy in action, in a commercial sort of way. This, needless to say, is the really constructive aspect of Phase 2.

4. And thus the typical end-of-Phase 2 product can be spotted almost at a glance, whatever it may be. Its history reeks from it. Inevitably it is a highly dickered-up and fiendishly ingenious bundle of constructive compromises, a patchwork job but a good one, at last, far more practical that the neatly theoretical products which were displayed as prototypes. It may be ugly, clumsy, over-sized and over-complex, but it works. And it is at least in part adapted to its rivals and neighbors, for joint usefulness and interchangeability, with outward facilities that are reasonably predictable and beginning to approach some sort of uniformity, wherever possible. Thus—instead of five different types of plug, there is one type, on all rival models. One impedance, perhaps; or one output level, within sensible limits. And so on.

5. But adjustments in production can go only so far. Phase 2 products, even the latest and best, are still basically erratic and divergent, but never more so than in the fundamentals, as opposed to the adjustable superficialities. Phase 2 is the era of the short-lived model, which appears and then quietly fades away. Didn't pan out. By the time a general Phase 3 sets in, half the brands are gone, and a good riddance.

Howcome? First, because of high idealism, because of the elevated one-track mind. It is in this Phase 2 that the high-minded one-track products, interesting in theory but in practice not so good, are sadly derailed and sent sprawling into commercial limbo. For as always, the practically useful piece of equipment comes from minds that have whole yardsful of tracks to work upon.

In Phase 2, thus, much fancy equipment cracked up as top-quality (and costing it) turns out instead to be remarkably unsatisfactory. Grossly so, sometimes, and to no one's greater surprise than the maker himself.

Often they are idealists, these developers with too few mental tracks, "pure" scientists who become so involved in a "Principle" that they are blind to its practical faults. They become obstinate; they cannot admit that their principle itself, so lovely in its theory, hasn't worked out very well in practical form; they persist. But Phase 2 usually finishes them off.

There are, too, those opposite men who beat themselves at their own game in Phase 2, by too-quick opportunism. They get themselves derailed and dumped just as neatly. They aren't too pure—they are too "commercial," rushing improvised quickie models on the market without proper designing and development in order to make a killing before the novelty wears away. By the end of Phase 2, they are gone—with or without profit. Funny how the rigors of Phase 2 hits both of these opposite types, eliminating the crass and the idealistic failures alike.

All in all, I'd suggest to everybody that as consumers we should sit out *every* Phase 2, and hold onto our cash. On the other hand, if we all did that, there would be no Phase 3, and an end to our business.

Fortunately for us, Mr. J. Q. Public is usually anxious to get in on something new, with cash, and so are most "pro" engineers too. We all of us buy like crazy in Phase 2, against our better judgement, and thereby contribute to later stability, at our own cost. Good system, I say.

Phase 4, the Last Quarter

We can skip Phase 3; what happens in Phase 4? Well, that's the period when the bloom is off the peach, when the once-new product begins to grow old though it still sells nicely. The last quarter of the waning moon. Why drop a well-proved line of goods that still brings in the cash? And so many a worthy product lives on commercially beyond its time, entering into Phase 4, semi-obsolescence, though still "available."

I will not be so indelicate as to suggest the names of present Phase 4 products, though there are many of them around, as you may well figure for yourself. Pickups, speakers, arms, changers. You'll find Phase 4 items in other fields too—for instance, the old-fashioned but reliable side-valve engines used until very recently in some of the low priced auto models.

* * *

Phase 1: design and development. Phase 2: trial by commercial fire, with running adaptation. Phase 3: smoothly integrated perfection. Phase 4: Onset of obsolescence. Those are the phases of the hi fi mooncycle, the life of a product from birth to old age. You have surely applied by generalities to many hi fi innovations on your own. Here are a few specific phase-reminders, to help your memory.

Stereo disc records? Phase 2 began in June, 1958 and ran well into 1959—but stereo disc settled down to relative stability in a very short time, all things considered. Especially considering the groans and the dire predictions of failure, at its beginning.

The LP record had its Phase 2, a much more difficult one, from its grand inception in June, 1948 all the way through 1952 at least. For a long while the LP remained a touch and go proposition. The LP-45 "battle of the speeds" in 1959 was clearly a macro-symptom, typical of the Phase 2 chaos of non-standardization, as between rival products. You'll note that later on, as Phase 3 came to the microgroove record, the LP and the 45 discs rather suddenly came to terms and established a mutually stable relationship that endured for many years.

FM radio went through a dismal Phase 2 'way back in the late 1940's, at the time of the shift in the FM band from the 40 Mc region up to the present near-100 Mc area, thereby putting all existing tuners out of business and creating what seemed at the time to be momenous problems in tuner design. FM floundered for a number of years, both in broadcasting and in the tuner area, until the burgeoning hi fi movement rescued it and allowed for the inevitable dynamic stability of design that is typical of Phase 3 in any product—and still exists in FM, as it does in the LP record.

Ah—but *FM multiplex stereo* is something else again! There we are right in the middle of a really hectic Stage 2, complete with the usual confusions, erratic standards, incompatibilities, unexpected bugs and unforeseen technical problems—we have everything, including the typical rapid revampings of models already in production, the quiet retirement of some of them, the tell-tale trickle of shipments and the big optimistic promises. Nothing to be worried about at all, I say. It was on the books, though nobody is going to admit such a thing ahead of time.

Indeed, so typically dismal are the professional predictions concerning FM stereo right now, that I have nothing but the greatest faith in its future! Haven't these things been said about every Stage 2 in every major hi fi development? Wasn't the LP solemnly pronounced hopeless by engineer after engineer? (Well, not in quite those words; but the implication was the same.) Wasn't there shaking of heads about the impossible stereo disc system, that should never have been adopted? (Maybe so, but it worked out, nevertheless.)

I guess I should have added a sixth point to my list of Phase 2 symptoms: You can *always* spot Phase 2 in any development by the solemn pronouncements of doom that issue from those who are working the hardest for its success. It takes an engineer in the business really to run down a new product-type, even when he's right in the middle of it himself. Protective pessimism, I guess.

When Phase 3 arrives, these prophets of doom quietly look the other way. They're too busy working on some new Phase 1.

Æ

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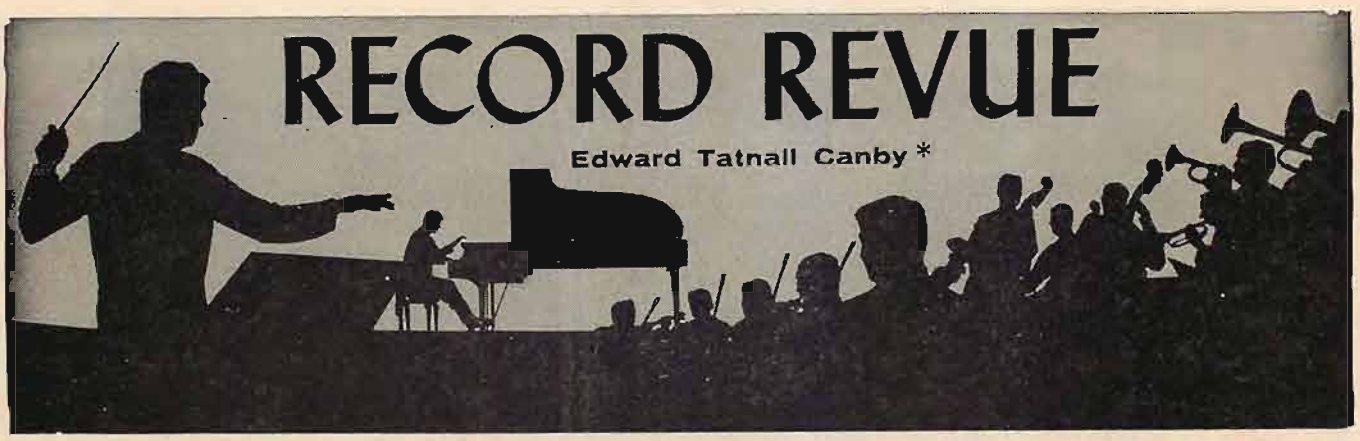
While its performance has thus been improved markedly, its design has also been improved to make it beautiful and attractive. SM-Q300 is positively certain to be completely satisfactory to you in its tone quality, performance and design.

Specifications:

19 Electron tubes and 6 germanium diodes
Tuner left
Tuning range: MW 535 to 1,605kc, SW 3.8 to 12Mc
Practical sensitivity:
MW 100μV (1Mc, output 500mW, at 30% modulation)
SW 100μV (7.5Mc, output 500mW, at 30% modulation)
Tuner right
Tuning range: MW 535 to 1,605kc, FM 80 to 108Mc.
Practical sensitivity: MW identical with Tuner 1
FM 10μV (95Mc, output 500mw, at 30% modulation)
Audio section
Circuit: 6BQ5p.p. 2-channels
Inputs and gain: MAG PU 3.4mV, MIC 4mV, XTAL PU 35mV
TAPE (PLAY) 160mV, AUX 160mV
Equalizer: NF type, RIAA curve
Output: For speaker—4, 8, 16 ohm (each channel), center channel terminal, tape recording terminal
Output power: 17W×2
Undistorted output power: 15W×2(distortion below 1% at 1KC)
Response: 20 c/S to 50 kc, ±1 db (main amplifier section, at 500mV output)
Outer dimension: 18 1/2 (W)×14(D)×5 1/2 (H) inch
Weight: 26.61 lbs

5 Otowacho 6-chome, Bunkyoku, Tokyo, Japan

PIONEER ELECTRONIC CORPORATION



RECORD REVUE

Edward Tatnall Canby *

Leningrad

Tchaikowsky: Symphony No. 4. Leningrad Philharmonic, Mrawinskij.
Deutsche Grammophon 138657 stereo

If only the political and military future of our world could depend on the so-called cultural ambassadors—and upon the economics of a healthy trade! Here we have arch-Russian music played by an arch-Soviet orchestra, recorded and released by a leading German company to everyone's profit, including ours over here in the States.

Listening to this really extraordinary "Fourth," you'll be struck, if you know the piece well, by a number of interesting thoughts. First—a splendidly disciplined orchestra and no doubt about it. Such precision attacks, such accurate roulades of exactly timed string notes, such perfect wind chords. Shall we chalk it up to sheer musical discipline, or is it a party matter? Anyhow, here it is, and we must listen and be amazed.

Then there is an over-all discipline of performance that makes this symphony into a new piece. The outer two movements are far less hysterical than we here expect them to be, and yet they go even faster than our fastest. Whirlwind accuracy, classically precise, coldly fiery rather than hotly so. Strange, and plenty effective too. Gives you a new concept of Tchaikowsky and one that to my ear is decidedly authentic, for he was one of the finest musical architect-builders of his time; his taut, tight structures deserve to be performed with this sort of economy. We stress the schmalz and the hysteria entirely too much.

The two middle movements are simply beyond compare, the sorrowful *Andantino* and the famous *pizzicato scherzo*, which here is played straight out of the preceding movement as though the pair were all one architectural plane. Not only precision, but extraordinarily careful phrasing and shaping, every note placed with incredible exactness, as part of the larger architecture.

Out of curiosity, I suggest it would be well for every owner of a "Western-type" Tchaikowsky "Fourth" to buy this disc as a companion. You will learn a great deal about music in our two worlds, and about Russian temperament, merely by listening here. There's more than words can tell.

Note: Look right now at this department in last month's issue and you will see an example of our penultimately edited version of my writing—minus all the final corrections. In the rush for the printing deadline the proofsheets got switched.

The final correcting job is a tricky one. Strange grammatical aberrations, unfinished sentences, mysterious words in the wrong places, somehow survive a series of preliminary printer's proofreaders. Nicely meaningless statements, positive opinions that were meant to be negative—you have to read for *sense* to catch these! If you want to try for yourself, just read the December installment of "Record Review."

There's even more to it because, with AUDIO's cooperation, I tend to rewrite in proof, improving my deathless prose via substitution of brand new words, exactly replacing the old in the same space. I find it fun, and it makes for better reading, as I trust you'll discover in this month's fully corrected installment. *E.T.C.*

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

NOBLE EFFORTS

Schumann: Cello Concerto.
Tchaikowsky: Rococo Variations. Rostropovich; Leningrad Philharmonic, Rozhdestvensky.
Deutsche Grammophon 138674 stereo

This top Soviet cellist was over here a year or so back and I heard—and watched—him in person. The weirdest performance I've ever looked at, with the mouth wide open, the body wriggling, the face red, the eyes popping out; but the cello sound was smooth as silk and technically just what it was cracked up to be. He is a real "international" cellist, a cellists' cellist too, knowing all the tricks of the trade both East and West, as well as possessing a few of his own in the way of finger dexterity.

The Schumann is a devilish piece to make any sense out of. The somewhat classically cool Leningrad-Soviet approach is surely as successful as any—for most of the attempts to warm the music into lush Romanticism merely end by being maudlin, emphasizing the peculiarly unhinged quality of the musical continuity. A tight, disciplined playing like this seems to help it forward through the two slowish movements until the more lively finale takes over. As for Tchaikowsky's neat set of "Rococo" variations, problems are purely technical and always rewarding when solved; the cello never sounded so easy to take as here. Again, the disciplined, cool accuracy of this ensemble of Soviet musicians does good things.

De Falla: The Three Cornered Hat (complete ballet). L'Orch. de la Suisse Romande, Ansermet. Teresa Berganza, mezzo.
London CS 6224 stereo
(mono: CM 9292)

It is a continuing pleasure to find the complete scores of ballet music on records of this sort, in place of the familiar concert excerpts or suites that merely sample the high spots. Granted that there are parts of virtually every such work that are head and shoulders above the bulk of the music, much of which tends to be routine thanks to necessary stage business. (Only Stravinsky and Tchaikowsky, in very different ways, seem to be able to keep the musical fare on a consistently even keel throughout a ballet.)

Even so, it is better to have the whole of the music. On LP it is both economically feasible and easy in the listening—the dull spots slide by quite effortlessly and the good parts make their impressions within the proper context. Thus a large part of this music will be quite unfamiliar to most listeners, some of it a bit tasteless but a lot clearly good entertainment; the well known sections show up in interesting contrast. Nice singing by Braganza in her brief flamenco-like solo passage.

Beethoven: Missa Solemnis, Op. 123. Farrell, Carol Smith, Lewis, Borg, Westminster Choir, N.Y. Philharmonic, Bernstein.
Columbia M2S 619 stereo
(mono: M2L 270)

The enormous "Missa Solemnis" is usually paired with the "Ninth Symphony," both works originating in Beethoven's exalted and somewhat eccentric last period at a time when he was totally deaf and remarkably well removed from concern over the petty necessities of singers, chorus and orchestra. In the orchestra he seldom miscalculated, deaf or no. But his knowledge of the voice, (especially the choral voice) was always limited and simply went out the window in his later works. The music is singable. It can be sung, that is. And it is of exalted greatness in concept, too. But its vocal requirements are at times almost nonsensical in terms of results achieved. Tenors yell like demons, basses sing tenor-range themes and nearly strangle in the process, sopranos reach for whole lines of high notes fit only for coloratura work. And the soloists—in both this work and the "Ninth Symphony"—do plenty of strangling on their own. To this day, these two works are the most difficult of successful execution in the entire repertory of concert music.

So—what have we here, on records? A recording made at the time of a series of public concerts by these same performers and presumably taped at a special session after the "live" performances were complete. For maximum effectiveness, in these days, there is no better way to achieve a polished, well-practiced recorded performance and this one should be optimum.

Well, it isn't. The fault might be in Bernstein's organizational leadership of the enormously complex forces involved (mostly rehearsed separately before the actual coming-together for performance); or maybe the weather was bad, or the hour late. Say five in the morning. Who knows? More likely the blame is Beethoven's. After all, how many of us can rise to superhuman heights every time a recording director gives the high sign?

The music, as I hear it, comes through with the heights achieved all right—Bernstein has his musical car fixed on the right sort of ineffable greatness. But it is at the expense of detail work along the way. The worst trouble (maybe *it* was recorded at five in the morning) is in the tough *Gloria* section, where Beethoven's violently dramatic and rapid changes of harmony are too much for the singers, notably the quartet of soloists, who come perilously near to atonality in a couple of passages. They simply do not hear

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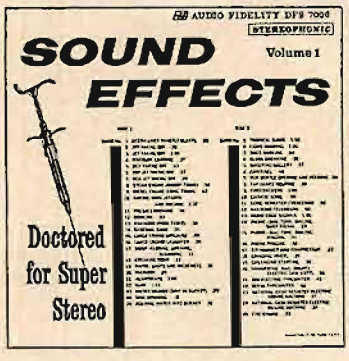

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what they *must* hear, they lose the thread of harmonic continuity and sing (with that typically hysterical sound) via a sort of dead reckoning, until things straighten out!

Don't let me go too far. I must make it clear that this is a splendidly heartfelt performance of a near-impossible work of genius, and in the long run I would much prefer a faulty but inspired performance of this sort to a technically more perfect but less inwardly inspired job, the sort that is normal in these hard-boiled times. Maybe it's just as well there are a few strained passages; the tension is thereby increased.

Oddly enough, one performer who seems unperturbed from beginning to end, in spite of her difficult solo role, is Eileen Farrell. She can sing placidly when others are apoplectic! She has the technique and the temperament. For once, a bit of neutral unconcern is an asset here, where most singers tend audibly to overheat, and plenty simply go up in musical smoke under the strain. I doubt if her concept of the part is quite what the wild Beethoven had in mind but, at least on this solid earth, hers is perhaps the first performance that has ever put over *all* of Beethoven's notes with technical success.

Schoenberg: Verklaerte Nacht. Loeffler: A Pagan Poem. Leopold Stokowski and His Orchestra.

Capitol SP 8433 stereo

Here are two big, fat, thick-textured late-Romantic pieces and Stokowski, the unctuous conductor of so many drippingly sentimental "arrangements," tones them down to size as well as any present conductor can do it. Indeed, those who have enjoyed the semi-hysterical shriekings of the "Transfigured Night" music in its large orchestral form will be somewhat surprised at this version, which is arranged by Stokowski himself as a kind of compromise between the original piece for sextet of stringed instruments and the bloated string orchestra version, Schoenberg's own, that we normally hear. It is much thinner and leaner, less wildly passionate, more pensive and generally a better piece of music in this form, yet more interesting for most listeners than the relatively limited chamber music form of the original conception. Stokowski's version retains many solo and solo ensemble passages, blending them in with string-orchestra elements.

Loeffler was a doughty old Alsacian, French-trained, who lived most of his life in and around Boston. This is his supposed masterpiece, but for our ears it is sadly dated—thick, blatant, long-winded, complex, subtle mainly in its orchestral textures, the once-novel whole-tone-scale harmonies sounding old-fashioned and turgid, an incongruous mixture of Debussy ("Afternoon of a Faun") and Rachmaninoff. The harmonies are of the Debussy sort, but the poetic mystery of Impressionism is wholly lacking in favor of a sort of bouncing assertiveness, nearer to a complicated John Philip Sousa than to Debussy. Beautifully written for the large orchestra plus solo English horn, piano and three trumpets offstage, but I found it very hard to take. Just rubs the wrong way in this nuclear age.

(I have a feeling that a much earlier recording I used to own, done on 78 by Howard Hansen and the Rochester forces, put more poetry into Loeffler and managed the silvery sound of the distant off-stage trumpets—who march triumphantly onto the stage at the end—in a much more successful way than do Stokowski and his Capitol technicians here. But the old set is long since vanished and I must depend on memories of the older sound.)

ROMEO

Tchaikowsky: Romeo and Juliet Duet. Glinka: Songs (Solos, chorus, orchestra). S. Lemeshev, T. Lavrova, I. Kozlovsky; Orchs. Moscow Philharmonic, Bolshoi Theatre . . .

Monitor MC 2055 mono

The gem on this disc, an extraordinary one, is the Tchaikowsky duet for tenor and soprano, composed as a sketch for a hypothetical opera on "Romeo and Juliet" out of the-

matic material taken from the famous "Overture-Fantasy" that everybody knows. The duet was left incomplete and was rounded out by another musician after Tchaikowsky's death (Taneiev), who apparently did the orchestration in the style of Tchaikowsky—not hard, what with the "Overture-Fantasy" available as a model.

Such a work of genius! No one but the master himself—I can't help using the term—could have constructed such a masterful love-duet as this out of these already-familiar ideas of his earlier piece. It is the daybreak scene between Romeo and Juliet, which ends with the hasty appearance of Juliet's nurse who urges Romeo to get away before Mama comes. The scene is lovely in the play, and it is lovely here in music, perhaps rivalling such famous tenor-soprano scenes as the love duets in "Die Walküre" and "Tristan." Typically, Tchaikowsky adds to the familiar "Romeo" material a superb new theme, surely as striking as those already available in the "Overture-Fantasy." It would have been a glorious opera, if he had worked it through on this superb level of musical achievement.

The singing—Romeo, Juliet and, briefly, the Nurse—has a curiously distant Russian flavor, what with the characteristically old-fashioned Russian acoustic deadness, sounding like something from the Nineteen Thirties (though in perfectly good "hi fi"). Excellent performances.

As for Glinka, on any other disc he might charm, but here (for me) he is an anticlimax. These songs, variously arranged for chorus, solos and folksy orchestra, manage to sound more or less like much Russian popular music today. On a high level, relatively speaking, but still far beneath the "Romeo" excerpt in musical impact and, more important, sadly out of style with it. I'd buy the disc any day for "Romeo" alone.

Shakespeare: Romeo and Juliet. Marlowe Society and professional players (anonymous).

London OSA 1407 stereo

I reviewed the "Hamlet" in this London Shakespeare series expecting that it would have to stand for all the rest; but soon afterwards I had guests at home and out came "Romeo." We listened from start to finish and now I have two of these monster productions under my belt, and am the happier for it.

I'll say only that this very different play continues the tradition I found in "Hamlet" by this company, a polished, beautifully proportioned production with a minimum of that awful Shakespeare mouthing and puffing and blowing, a maximum of sensibly spoken, easily intelligible poetry, sounding modern by virtue of its expertly unaffected manner. Juliet makes no attempt to sound her supposed age—fourteen—nor does Romeo gush like a schoolboy. Neither lover, oppositely, is an elderly actor trying to sound coyly youthful. The surrounding characters are similarly natural, well set up and easily distinguished; there are few stereo stunts to distract, but plenty of solid stereo separation where it is most useful, and the whole takes on a clarity and economy of purpose that—given the somewhat torrid text of this play—presents the great love story as convincingly as I've ever heard it.

As in "Hamlet," I find here an unusually penetrating understanding of the subtleties in the Shakespeare lines, a projection of their meaning that is startlingly real and thoughtful. We can credit this, I'd guess, to very careful directing as well as to innate intelligence on the part of the anonymous acting personnel.

Shakespeare: Romeo and Juliet. Claire Bloom, Dame Edith Evans, Albert Finney, and others.

Shakespeare Recording Soc.
SRS 228 stereo

It was happenstance that I picked up London's "Hamlet" and "Romeo" before starting in on this series; I've had both waiting for a good while. At the moment I have not completed this "Romeo" but hasten to report on some interesting differences between it and London's version that have already become apparent, as I listen.

This is a showier, more outwardly dramatic, more self-conscious "Romeo and Juliet" and much of the difference, I'm willing to guess, stems from the anonymous teamwork in the London version versus the solo, famous-name casting for this version. To be sure, this last is the normal procedure. If we are to have Dame Edith Evans, let's not force her into anonymity—for she makes a marvelous nurse to Juliet! Here, we have some big names and many more names that are worthy to be mentioned in the billing, gathered into an assembly of individual actors each playing on his own reputation, present, past, or future. Like competition in the business world, this sort of thing makes Shakespeare go 'round with gusto and energy.

But what a noisy record! The party scenes really sound like parties here. Loud, boisterous talking, laughter, comings and goings, for all the world like that cocktail party next door the other day. When there's a brawl, it's a very real one and no token clashing of stage swords.

As for Juliet, Claire Bloom on the boards, she is billed as a fourteen-year-old and by golly, she's going to act her age. She does, and I find it uncomfortable. Romeo is a dashing hero, too, matching Juliet. Somehow, to my ear, this doesn't jell. Did fourteen-year-old girls act then as they do now? Did Shakespeare really mean to be literal-minded? Or was he merely exaggerating for romantic effect?

I might be wrong and certainly would not go so far as to say this version of the great play errs seriously. But it does give us a more outward, less classic, more literal and modernized reading of the story than we find in the classically restrained performance by London's self-effacingly anonymous team. Interesting.

EXPLORATIONS

Studies in Improvisation. Lukas Foss, Improvisation Chamber Ensemble.

RCA Victor LSC 2558 stereo

I doubt if this music will thrill the marrow of your bones on first hearing, but it could

well stimulate other areas of worthwhile importance; it surely is significant and interesting for its very intent.

Don't think that improvisation is an idea that is going to stick primly within the jazz and folk music fields. Jazz and folk, after all, are already thoroughly mixed up with "classical" and the mixing is two-way, or three-way. Not surprising that somebody, say Lucas Foss, would try improvising purely "classical" modern music, which is to say, music that doesn't sound either jazzy or folksy, but strictly chamber-music-y.

And since chamber music (and plenty of other music) normally requires writing out in advance, being complex and architectural (one doesn't improvise an office building or an apartment house), new areas of compromise are in order, between what is made up and what isn't. Otherwise—musical chaos, like five men singing in five bathtubs, instead of five men on a concert platform, coordinating their music.

It's the coordinating that takes up everyone's time and energy here. As with John Cage and Co. (see AUDIO, ETC. for October), Mr. Foss has branched away from old-fashioned musical notation into codes and graphs, suited to the degree of randomness that he may have in mind. Certain limits, certain free choices, and these players get their cues partly from fancy diagrams (with notes, too), partly from the leader's nodded head, partly via plain individualism. As with all these new-thought pieces, no two versions of the music are supposed to be exactly alike. When you have the stuff nearly memorized, you drop it quick-like and start in on a new graph.

Foss has a big glossary of terms, indicated by symbols, to help you listen. In his tricky diagrams, a square mark means "take the foreground," a triangle indicates "foreground but responding," a sort of oval, a miniature race track sign, indicates "take yourself into the background—or else." A diamond shape means "support" and you'd better support hard, if you want to be cooperative in this music-making.

I might as well suggest the inevitable, that it all seems a bit dry and calculated, as of first hearing-and-seeing. The diagrams are out of this world, and pretty, but they left me somewhat bored. I want to listen, not to follow complicated graphs and charts. The music . . . well, let's not be too quickly committed for or against. The ideas of this group are obviously constructive and useful and, we can easily guess, will eventually coalesce along with other such movements into a profitable break-away from our too-great classical reliance on printed notes. Good idea.

Gassmann: Electronics (taped ballet music). Sala: Five Improvisations on Magnetic Tape.
Westminster WST 14143 stereo

Well, here we go again. Now, with electronics, "we have inherited a 'brave new world' of limitless possibilities and unprecedented artistic freedom" which, the composer's notes here suggest, have released us from the restraints of conventional instruments and performers. Maybe, maybe not.

This music, "composed" on the German equivalent of the RCA Mark II Music Synthesizer, was the basis of the much-discussed ballet "Electronics," about which I wrote at length in an earlier issue, as did Harold Lawrence in the same issue. At the performance, I found the sound exciting, the versatility of the composing machine quite fabulous, the effects remarkably alive and real—but the music itself seemed to me conventional and without very much new to say; it sounded like electronic Respighi, as of maybe 1910.

It still sounds that way, only more so. Not really at all "limitless" in its purely musical imagination, this music, which merely goes to show that unlimited freedom in sound itself is no guarantee whatever of unlimited inspiration in musical terms. Still, for those who think electronic sound "all sounds the same," the noises in this work should be no less than startling. An extraordinary machine, the Studio Trautonium; now let's have somebody develop a real language of originality and force, via its facilities. Give us fifty years and we'll get it, all right.

Game Calling in Hi-Fi. Art Mercier, Russ Gaede.

Mercury GC 100 mono

I sent away specially for this one—I just had to hear it. How specialized can you get on LP? And yet, come to think of it, this isn't so specialized, what with millions of American hunters barging around through fields and swamps and what-not, looking for game. This tells you how to do it—with the aid of a "call," which is an instrument into which you blow, mostly, to imitate the genuine calls of crows, ducks, squirrels, and so on. Related to a clarinet.

What fascinates me, here, is that though millions of us hunt, millions more of us do not, and we who don't are apt to find this sort of instructional record slightly spine chilling. It's not only what the record says, but even more the questions that it blithely ignores—like killing for pleasure and sport, or the paradoxes of our silly modern existence where most of us blanch at the sight of a wounded mouse, yet step on a cockroach and eat lambs, steers, and pigs, but never horses. Illogical, to say the least, and the real enthusiasm for the hunt displayed by the professionals on this record can do a lot to make us seem even more illogical.

The idea, of course, is to deceive, to lure the unwary animals, fox deer, squirrels, and the unfortunately gullible wild birds, ducks, crows, geese, hawks, into your gunshot range—then, WHAM! and you've got your kill.

The record shows you, with examples, how to use each type of game call, describing the haunts and the ways of the animals and birds involved; then each band ends up with a little dramatic sketch, showing how you "talk them in." The WHAM! of the gun, fortunately, is missing in most; it would be too much for the nerves, as well as for the LP stylus. But, frankly, as a non-hunter I found myself fighting lustily for the birds and the beasts, hoping they'd get away, hating the chicanery, the deadly lure of those raucous game calls. Quite an experience, I tell you.

Worst, for me, was the fox call. You don't

call the fox by sounding like a fox; you imitate a small terribly wounded animal, to bring him on with blood in his eye. Then—WHAM! That small wounded animal is perfectly awful to hear, especially if you've heard the real ones, the little rabbits and squirrels and mice. Sure, that's one way to work up a good hate for the bloodthirsty fox, I suppose. He deserves to be shot, for responding to your faked squeals of agony.

Quite a record, this, but not for animal fanciers.

On Location France—A Candid Portrait. Narration by Pierre Crenesse.
Decca DL 9086 mono

This is a semi-promotional documentary, which you'll likely find available at such agencies as Air France, though there are no commercials as such in its material. The assorted sounds, first of Paris (side 1) and then of a few spots elsewhere in the country (side 2) are accompanied by English narration with a *very* French accent, just as any good tourist should expect. Atmosphere.

I like Paris myself, but I fear I'm not an Air France tourist. Of course I'll admit that it is hard to find enough intelligible noise in a big city to make it "live" in pure sound, and the musical night life of said city is an obviously easy way to fill things out with on-the-spot entertainment. After all, the Metro's grinding sounds very much like the New York subway's, only slower, and the traffic is just as unpleasant to hear—the French auto horns are much more unpleasant than ours, and who wants to hear *them*? You've got one on your own Dauphine, anyhow. So night life it is, from one spot, hot, warm or cool, to another. Best episodes, for me, were some quite realistic exceptions to the night-life routine, quick, close-up conversations in a market. *That* sounded like Paris.

Outside of Paris, it's the folk festivals. It always is. The National Geographic, the color film shorts (and longs), the travel supplements, all feature one folk festival after another, with brightly colored dancers and, of course, with music. We get numerous bits here, plus a lot of good natured shouting. What else, after all, can you put on a candid sound-portrait? Church bells. At least. I'd be happy to have a whole LP side of them here, but you'll get only a brief sample. Oh yes, auto races. *BrooOOOooom!* Le Mans. And oh yes, Ascent of the Eiffel Tower, on side 1. Diagonal elevators dating from the 1870's, that make a noise like the sound of gears. Interesting to a gear specialist, anyhow.

Rachmaninoff: Piano Concerto No. 3. Byron Janis; London Symphony Dorati.
Mersury SR 90283 stereo

35 mm Mercury has followed Everest into the extravagantly wide and thick sprocketed magnetic film for master recordings, and this is the first Mercury product via the new system.

You can tell—though it isn't easy to pin down the difference. As I hear it in this excellent disc, there is a clarity, a limpid quality to the sound, a quietness of background (with no trace of pre-echo or post-echo), a remarkable steadiness of pitch in the piano (which is so easily subject to noticeable pitch variation), an over-all fullness and an ease of dynamic range, all of which are factors that could be the results of the wide-track magnetic film, and probably are. If you can afford the process, burning up tons of bulky, heavy, expensive film, then more power to you—it seems bound to work.

It's a good performance, this, aside from stunningly effective recording. This time, I'm all for Dorati, whose disciplined, hard touch is good for the sometimes too-soggy Rachmaninoff. Janis plays warmly, romantically, but also with disciplined tension. I usually quit these concertos halfway through—this one I lasted virtually to the end.

Schubert: Symphony No. 8 ("Unfinished"); "Rosamunde" Overture and Incidental Music. Minneapolis Symphony, Skrowaczewski.
Mercury SR 90218 stereo

This is just ordinary Living Presence recording, no 35 mm film; but it is momentous even so, as the first from Minneapolis with its new young conductor, replacing Antol Dorati, whose records with the orchestra have been rolling off the Mercury presses for years.

What a change! Immediately, one must class this "Mr. S." among those new young performers who have suddenly reverted to a neo-Romanticism, in contrast to the driving classic spareness of most performance in the last twenty years or so. Here is an "Unfinished" that is slow, ponderous, all leisure, such as we have seldom heard since, say, the latter days of Koussevitsky. I could hardly believe my ears. And the "Rosamunde" music, for once, takes all the time it needs, shows up its lovely harmonic contrasts to full advantage—a bit too full, for that matter.

Nice playing, but there's a certain tentativeness, a slightly wooden sound in many string passages that ought to be more alive, for instance, which probably indicates that this radically different new conductor hadn't quite yet (1960–61) got the feel of his new orchestral controls. The men must have had some tall re-learning to do, after the driving Dorati.

Starlight Concert (Debussy, Brahms Elgar, Weber, Tchaikowsky, and others) Hollywood Bowl Symphony Orch., Carmen Dragon.
Capitol Duophonic DP 8276

"NEW! Once-in-a-lifetime performances now available in Capitol Duophonic" says the cover sticker.

Well, you'll pardon me if I doubt that any performance of these standard chestnuts by the Hollywood Bowl with Mr. Dragon is a "once-in-a-lifetime" affair. After all, "Finlandia," on this record, must have many

(*Continued on page 69*)

CHARLES A. ROBERTSON*

STEREO

Horace Silver: Doin' The Thing
Blue Note Stereo ST84076

Any midnight when one of the late movies being shown is "The Bank Dick," television can be forgiven its failings during the rest of the day. One of the film's priceless moments occurs when the great comedian W. C. Fields utters the name of the villainous bank robber. Our hero in two words somehow outlines a figure awesome enough to cause Willie Sutton to surrender the contents of an open vault. The character Fields brings to mind is so formidable and unsavory that the appearance of the actual desperado seems almost an anticlimax. No flesh and blood actor can match all the mental images Fields conjures up, especially when someone sees the role in purely jazz terms as Horace Silver does in a new work also named *Filthy McNasty*.

Silver's heavy dresses fashionably enough to fit in with a hip crowd, yet the cut of his lapels is not so extreme as to offend any local financiers visited after banking hours. He swaggers about boldly enough to attract the admiring glances of passing females, but fast and shifty footwork always keeps him free of entangling alliances. An old reprobate like Fields would certainly approve of the extra con-man touch which Silver adds on several soulful piano choruses. McNasty sounds deceptively close to repenting his sins at times, but the larceny in his heart always wins out in the end.

While jazz composers are being commissioned to score films in increasing numbers these days, Silver's idea of writing about an obscure movie character is something new. A trend may be in the making, as other odd personalities are waiting to be uncovered by jazzmen with the leisure time for late hour viewing. After all, such comic strip notables as Barney Google, Popeye, Harold Teen and Andy Gump were once popular song subjects along Tin Pan Alley, and the task of improving upon the themes created during what was called the Jazz Age should be less than overwhelming.

Silver and the other quintet members let last summer's festival audiences see this slippery article in action, then listed his crimes for the record before the customers at New York's Village Gate. Rudy Van Gelder officiated at the ceremonies, and a month elapsed between the release of the two versions. Stereo repays the short wait, as the extra space permits a full review of each nefarious activity.

Silver's crew is in top shape for its first location recording, and the leader paves the way with brief introductory remarks. The title piece hits a furious pace, with Billy Mitchell delivering slashing trumpet statements before dropping down in tempo for lyrical exchanges with Junior Cook's tenor sax on *Kiss Me Right*. Gene Taylor, bass, and drummer Roy Brooks help out with the rhythmic Spanish touches on *The Gringo*, which is another of Silver's amusing studies in a Latin vein. Two or three years spent together has welded a cohesive unit, and Mitchell continues to develop into a trumpeter able to handle any solo assignment that comes his way.

Booker Little: Out Front
Candid Stereo 9027

Now that the furor over Third Stream music has died down, the phrase-coiners are searching for a new tag to pin on the latest jazz developments. Some are talking about "the new thing," while Nat Hentoff puts forth a tentative "new wave," in his liner notes, to describe the fraternity of younger jazzmen to which the late Booker Little belonged. A trick label like "the new twist" might do double duty, first resolving the differences and then further confusing the frenetic followers of Chubby Checker. But just as the Twist piled up quite a history before the public discovered it, so do Little's seven new compositions in this album deal with things that have concerned the youth of more than one generation.

Progress to the 23-year-old Little was not pursuit of the latest jazz fad, and each work summarizes the whole of his experience as well as attempting to surmount the next step. The subject matter is varied enough to create a total effect similar to the autobiographical novel all young writers are supposed to have in their system. Little's trumpet speaks of the need in jazz for *Strength And Sanity*, explores the literary life on *Man Of Words*, and suggests a painter at work on *Hazy Hues*. Unique rhythmic approaches are tested on *Quiet Please*, and *Moods In Free Time*. Finally, Little advances his own term for the onrushing forces in jazz on *A New Day*.

Max Roach, who employed Little during the last two years, assists on the date and reveals his most recent theories on adapting tympani to jazz. Roach has mastered tonal colorations never displayed before, and the percussion passages are engineered by Bob d'Orleans to present a true stereo picture of a remarkable drummer at work. Julian Priester, another Roach colleague, is on trombone, and Eric Dolphy plays alto, bass clarinet and flute. Ron Carter and Art Davis alternate on bass, and pianist Don Friedman completes the sextet. In all a fitting testament from Little, who before his death expressed his feeling about the way jazz should go by stating, "There should be much less stress on technical exhibitionism and much more on emotional content, on what might be termed humanity in music and the freedom to say all that you want to."

Billy Taylor: Kwamina
Mercury Stereo SR60654

Recordings of unsuccessful Broadway musicals usually come about only because some company is unable to get out of advance commitments or hopes to partially recoup an investment in the show. They rarely meet with much success, but a different and happier fate seems to be in store for the short-lived "Kwamina," as all the drama critics liked Richard Adler's score and expressed regret at the failure of the book to hold their interest. Capitol decided to produce an original-cast album, even though it was known the run would end the day before the recording session was scheduled. Mercury was more adventurous, putting Billy Taylor and arranger Jimmy Jones to work last August on a jazz treatment to be released in time for the October opening. The two albums should have the combined effect of helping each other, as well as the score, get off the ground. Hollywood may use the music in a movie yet, after borrowing the plot of "South Pacific."

Preparing a jazz version prior to a Broadway opening is twice as risky as buying the album rights before rehearsals begin. Not only is the show untested, but both the musicians and any purchasers are unfamiliar with the tunes. Anything in the way of thematic variation must be handled gingerly, while the jazz content should be high enough to withstand competition from latter versions. The team of Taylor and Jones performs this feat with consummate ease, first selling the melody and then picking out various aspects to illuminate more closely. As the only member of the eleven-piece studio group acquainted with the score before the three sessions were held, Taylor solos on each number and buoys up everyone with sparkling piano passages. Some measure of the effort expended is indicated by the eleven takes required for *Ordinary People*, while sixteen tries went into *What's Wrong With Me*. Both are rescued through the eloquence of alto-saxist Phil Woods, who shares solo honors with Clark Terry, Jimmy Cleveland and Les Spann.

The score tells a story of modern Africa without overworking jungle drums or resorting to phony primitiveness. However, the composer does indulge in perky rhythms on *Cocoa Bean Song*, and praises the simple life on *Happy Is The Cricket*. The urge to hear the lyrics sung becomes irresistible, and prospective purchasers should be prepared to invest in the original-cast album as well. Phil Macy, who engineered the date at Bell Sound Studios, turns the center of the stereo stage over to Taylor's piano.

Les McCann: Les McCann Sings
Pacific Jazz Stereo 31

Like many another pianist, Les McCann is unable to completely control the urge to sing while playing and frequently hums with approval over the course of a solo. The vocal chords are unfettered here, and McCann both sings and assumes the featured piano role with Gerald Wilson's big studio band, a sextet boasting Ben Webster, and his own trio. The program neglects McCann originals in favor of such ballads and swingers as *I Cried For You, Deed I Do*, and *Sweet Georgia Brown*. Evidently a scheme is afoot to build up the McCann personality enough to support a band on tour. Another album or two of his own brand of gospelizing may turn the trick, as this seems to be what the customers want. At least, the change from Ray Charles will be somewhat of a relief. In the event the plan fails, a vocal trio consisting of Erroll Garner, Oscar Peterson and McCann should work out just fine if billed as The Singing Pianists. The audio aspects of the production received the careful attention of Dick Bock, and trio regulars Herbie Lewis, bass, and drummer Ron Jefferson give their leader exceptional support throughout.

Peggy Lee: If You Go
Capitol Stereo ST1630

Ruth Price with Shelly Manne: At The Manne-Hole
Contemporary Stereo S7590

Singers are known by the company they keep, and these two young ladies are heard in the best surroundings. Peggy Lee's engagements at Manhattan's Basin Street East brought about an association with Quincy Jones, whose big band is pretty much a club fixture. When news circulated that Jones was flying to California with a sheaf of arrangements for this date, it looked as though the singer might be reunited with the sound of a big charging band at last. Such is not the case, as Jones conducts the usual Hollywood ensemble of lush strings, flutes and french horns on a dozen torch songs. The backgrounds are far from routine, however, and

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

Miss Lee's emotional flame never glowed more seductively than during *Say It Isn't So, I Love You Gypsy Heart,* and *As Time Goes By.* Actually, all any arranger needs to do is keep out of this artist's way, and Jones anticipates every turn of phrase or change of mood. Sensuous Latin rhythms add a touch of variety on the title tune, *I Get Along Without You Very Well,* and *Maybe It's Because I Love You Too Much.* Still, it would be nice to hear Miss Lee sing with the Quincy Jones band, and a little lend-lease maneuvering may bring it about yet.

Ruth Price made her recording debut about five years ago with two albums for Kapp, and the fact that they are still in print is some token of durability. She was working with Charlie Ventura at the time, but West Coast pastures looked deceptively greener for the pursuit of a career as singer and dancer. Closer inspection proved jobs to be scarce and the inside of a recording studio much harder to reach. Not until Shelly Manne took her under his wing did another recording date come along, and the singer is still on the outside of studio walls. Instead, the informal proceedings take place in the friendlier setting of the drummer's own Manne-Hole, and Richie Kamuca, tenor sax, and Conte Candoli, trumpet, drop casually by to augment the house trio. Miss Price is at home with ballads and swingers, but also visits such out-of-the-way tunes as *They Say It's Spring,* and *Listen Little Girl.* Assisting the proprietor in the trio are the able pianist Russ Freeman and bassist Chuck Berghofer. Howard Holzinger's engineering conveys the informal atmosphere of the Hollywood club, and Miss Price's career is now in the best of hands.

Sauter-Finegan: Inside Sauter-Finegan Revisited

RCA Victor Stereo LSP2473

Following on the heels of Capitol's Duophonic method of revitalizing worthy monophonic items for stereo, RCA Victor is beginning to apply its own system of electronic reprocessing to a select list of LPs. Among the first to be refitted with two channels is this pioneering trip into the world of percussive sounds. Eddie Sauter and Bill Finegan were before their time, and their early experiments in fracturing originals and pop tunes still serve as models for today's creators of stereo spectaculars. If the partnership was still in force, this pair would be leading the pack again to the tune of *Doodletown Fifers.* Some of their ideas of nearly ten years ago sound fresher than what is coming off the stereo production line at present, and there should be a whole new audience for the venturesome treatments of *Where Or When, Rain,* and *Moonlight On The Ganges.* Stereo adds perceptibly to the depth of sound, and the wild bunch of drummers put to good use the extra stomping room on *Eddie And The Witch Doctors.* The engineers might follow suit and stomp on undue echo a little harder during the vocals.

The Dukes Of Dixieland featuring Pete Fountain

RCA Victor Stereo LSP2097

This particular Dukes of Dixieland set is piling up mileage, and a third trip to the pressing plant should keep it rolling right along. This time the old carcass comes back completely retreaded for stereo via RCA Victor's new system of electronic reprocessing. The first monophonic release appeared when the Dukes were virtually unknown outside their native New Orleans. After Audio Fidelity spread the group's fame far and wide, a reissue was placed on the market and is still in the catalogue. The recording reunites clarinetist Pete Fountain with the Assunto brothers, Frank on trumpet and Fred on trombone. All three started out as members of the Junior Dixieland Band which won a Horace Heidt amateur contest in 1947, but nearly a decade went by before this session brought them together again on such dixieland favorites as *At The Jazz Band Ball, Tiger Rag,* and *Tin Roof Blues.*

The stereo refurbishing is highly successful, mainly because no attempt was made to

do the impossible and match the extreme dynamics and frequency response of the Audio Fidelity series. The soloists receive more elbow room and are heard with greater presence, a factor especially beneficial to Fountain's liquid tone. The engineers also use the extra space to give the sextet a better balance than before.

Joan Baez, Volume 2
Vanguard Stereo VSD2097

Enough critical praise descended upon Joan Baez's first collection of folk songs to turn the head of any girl of twenty. Wisdom beyond such tender years steadied her debut, and as yet she shows no inclination to rest on her laurels or branch out into the field of television commercials. Either prospect might seem appealing to a young performer hailed as near perfect, but the second volume indicates continued development on the part of Miss Baez, who apparently believes she can learn a lot more about the art of folk singing. One example of an expanding repertoires involves a pleasant journey to the French court of a century and a half ago for Martini il Tedesco's *Plaisir d'Amour*. Miss Baez refuses to become a minion of the king through and a wandering troubadour of even longer lineage might be singing.

The knack of making British broadside ballads sound as fresh and alive as when they first reached this country is one of Miss Baez's strong points, and she demonstrates her skill again on *Lily Of The West, Barbara Allen,* and *The Cherry Tree Carol.* Her grasp of native country styles attains a new depth of perception, and she succeeds in piercing the thick layer of commercialism which encrusts so much of this music. A brief exploration of the bluegrass tradition enlists the Greenbriar Boys as guides on *Banks Of The Ohio,* and *Pal Of Mine.* John Herald, Ralph Rinzler and Bob Yellin combine to achieve a fine group sound, in stereo, while avoiding the slick, mechanical twang of the professionals. The singer's own guitar accompaniments are also increasingly varied in scope, and she beats the Nashville crowd of amplified wonders at their own game on *Engine 143,* and *Old Blue.* In fact, the sales of these two numbers might cause some excitement in the bastion of country music, if Vanguard decided upon the release of a single and reached the right audience. This is the sort of country singing and playing Nashville has forgotten about. Chet Atkins, audiophiles, and all "good doggies" will prick up their ears at the dynamics unleashed to call *Old Blue.*

The Journeymen: Introducing The Journeymen

Capitol Stereo ST1929

Frank Werber, the man who promoted the Kingston Trio before anyone thought three college boys singing folk material could sell records, has taken another trio under his managerial wing and predicts it will have a marvelous future. Distinctions between the two coasts have largely disappeared in jazz, but the Journeymen's debut indicates that any slight differences between the two groups exist because the Kingstons hail from Stanford, while the new bunch got underway at New York's Folk City only a few months ago. Scott McKenzie, who started singing with pop groups, is lead tenor and soloist, as well as being the trio's pin-up personality. John Phillips, leader and banjoist, collaborates with guitarist Dick Weissman on the special arrangements needed to catch the ears of the college crowd. *Make Me A Pallet,* originally a sinful lament, now sounds like a cheerful plea from one fraternity brother to another for overnight

lodging after the big game. The boys also make up their own folk legends, with Phillips supplying the lyrics on *500 Miles, Chase The Rising Sun,* and *Ride, Ride, Ride.* Now embarked on a college tour, the trio is bound to find a ready welcome and a pallet on the floor at any campus in the land. The next time Capitol engineer's use a hound's bay on *Cumberland Mountain Deer Chase,* they might test the result on a deer, or at least a real live hound.

Gene Krupa: Percussion King
Verve VSTC260 (4-track stereo tape)

A percussion extravaganza from the man who insisted on using a bass drum in 1927 at his studio debut is long overdue, and Gene Krupa reigns at last over concert bass drum, seven assorted tympani, African rope drum, or any other whamable objects his heart desires. Bass drums were barred from recording sessions before Krupa broke the sound barrier on Okeh with the McKenzie-Condon Chicagoans, but the drummer can scarcely be blamed for all the thumps that have resulted since. Of course, his booking agency once outfitted the entire band with lighted sticks and small Tom Toms for stage shows. This time Krupa heads a legitimate percussion section composed of Mousey Alexander and Joe Venuto, two successors to his post with Benny Goodman, as well as Doug Allen, a Juilliard graduate. They all came under Krupa's influence during the swing era, and the ability to tell them apart requires more than stereo separation.

George Williams, who wrote arrangements for Krupa when the lights played in darkened movie palaces, is back with revised copies of *Valse Triste,* and *The Galloping Comedians.* Williams also shines the bright spotlight of swinging stereo on such old warhorses as *American Bolero, Meadowland,* and *Sabre Dance.* The prancing drummers set a merry pace for Doc Severinson, Ernie Royal, Urbie Green, Billy Byers and Toots Mondello, but the full company of twenty depends upon bassist Milt Hinton to remember the beat. The most exciting passages occur when the drummers work ad-lib, and Krupa is, in his own words, "feeling and playing as one mind controlling eight arms. Not a centipede, but a *percussion section.* Each drummer depends on the others to blend rhythms and sounds, creating a new pulse and excitement."

Everyone remains fairly serious until the concluding *Poet and Peasant Overture,* which turns into a rout as the whole percussion craze is unmercifully kidded. Krupa should look up Malcolm Arnold's score of the first film about Ronald Searle's girls of St. Trinians. When the four drummers are all going at once, only four-track stereo tape can contain their enthusiasm.

Larry Elgart: The Shape Of Sounds To Come
MGM STC3896 (4-track stereo tape)

At a time when even Ted Heath is making stereo spectaculars, Larry Elgart clings to the belief that the sounds to come will assume a saner and more natural shape. "Our goal is to achieve realism," he says. "The major part of the recording industry has been going the other way. You can strive to make something larger than life and not be interested in the original material, or you can use science and electronic skills to recreate the original material with authenticity."

As far as Elgart is concerned, the most natural sound in the world is a big band playing for dancers or at concerts. Every effort is expended to achieve the same effect in a studio, and the dozen tunes recorded here show that Elgart's view of the future excludes interplanetary echo and rocketing stereo. The band's staff arrangers are imaginative enough at present to activate the senses aurally while keeping both feet on the ground. In fact, Elgart thinks standing to record helps the band's breathing and improves the sound. John Murtaugh, Marty Holmes, Bill Finegan and Lew Gluckin supply the blueprints for building a firm foundation, while Bobby Scott sets it shaking with his lively original *Arkansas Holler.* The rhythm section is one of the best in the busi-

ness, and four-track stereo tape does it full justice. Ray Hall and Don Miller engineered the date under the supervision of Mrs. Elgart, whose feminine ear is golden enough to detect any deviation from her husband's idea of how the band should sound.

MONO

Joe Newman: Good 'N' Groovy
Prestige/Swingville 2019

If jazz writers often devote more attention to new discoveries than to established players like Joe Newman, it is because releases such as this should need no recommendation. After holding a trumpet chair in the Basie band since 1952, Newman is now leading his own quintet in clubs, with one eye open for the offer of a European tour. The group was still in the formative stage when this session was held, and the only regular member to appear is Billy English, who deserted the drum post in the house band at the Apollo Theatre to join up. Frank Foster, tenor sax, and bassist Eddie Jones were borrowed from Basie, and the always adaptable Tommy Flanagan fills in on piano. Newman takes full advantages of the chance he never had with Basie to spend some time with Neal Hefti's *Li'l Darlin'*, the number which draws the most requests from club patrons. The other standard is *Just Squeeze Me*, and four choice originals complete the set. Foster also enjoys the outing, and no admirer of Basie splinter groups can afford to pass this one by. **AE**

EQUIPMENT PROFILE

(*from page 44*)

which holds them together. The result is that we can record stereo by the European method (mikes together—axes 90 deg. apart) or the separate mike method frequently used in this country. An intelligent arrangement which allows a great deal of flexibility on the part of the user.

The drive method for the Magnetophon 97 was obviously designed to minimize extraneous vibration. First of all the husky drive motor is shock-mounted to the main plate. Secondly the motor spindle drives the speed-change idler by means of a flat belt. The speed-change idler in turn drives a rubber-faced idler which then drives the capstan flywheel. The rubber-faced idler contacts the drive idler and flywheel only during record or playback. We noted that the capstan bearing is quite good; after the power was shut off the flywheel continued to rotate for almost a minute. The takeup reel is driven by a flat belt from the capstan, the belt being tensioned by a spring-loaded roller only when the tape is driven.

Tape handling is excellent because of an unusually good braking system and the use of tape guides and tape tensioning devices. Over-all, the mechanism is well designed and constructed. On the other hand we could not say that the amplifier circuitry was equal in calibre to the mechanism although it certainly is good as the amplifiers found in most home tape recorders.

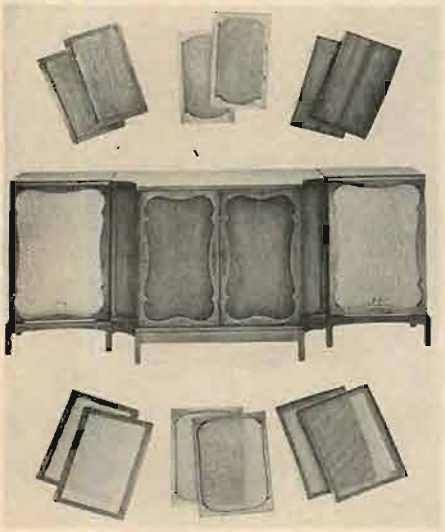
Performance

Using a standard flutter tape, the Telefunken Magnetophon 97 exhibited 0.05 per cent wow, 0.13 per cent flutter, and 0.15 per cent over-all. The frequency response at 7½ ips is ±1.5 db from 30 cps to 15,000 cps. The signal-to-noise ratio at 7½ ips is 52 db.

Clearly this machine performs extremely well in important areas. In addition it is well built and designed. It is certainly worth consideration by the audiofan in need of a home tape machine. **A-41**

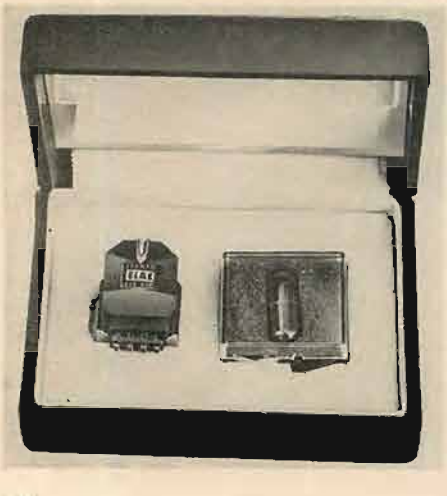
NEW PRODUCTS

• **Credenza Component Cabinets With 'Select-A-Style' Doors.** Dedicated to the belief that a high fidelity system should look as beautiful as it sounds, and offer maximum convenience for its owner, University has introduced a complete collection of Credenza component cabinets suitable for any decor . . . easily integrated with other fine furniture of any period . . . featuring furniture-styled doors that can be removed and replaced with differently styled doors in seconds. This means—should one ever wish to redecorate . . . there is no need to buy a new component cabinet or to move it to another room—one simply replaces the inexpensive doors! Originally developed to complement the University Medallion XII Speaker System, the wide variety of Credenza styles enable them to match virtually any compact speaker system. Utilizing fine hardwoods and veneers, Credenza cabinets and doors are available in

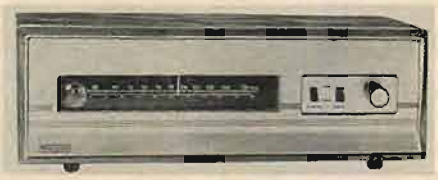


the following furniture styles and finishes: Italian Provincial, French Provincial, Swedish Modern, and Colonial—in Walnut, Oiled Walnut and Fruitwood. Over-all dimension: 36-in. wide x 29¼-in. high x 19-in. deep. Tuner and amplifier interior dimensions: 18⅛-in. wide x 12½-in. high x 15½-in. deep. The Medallion Credenza Cabinet is priced at $179.95 with your choice of decor doors. Additional doors $42.00. University Loudspeakers, Inc., 80 So. Kensico Ave., White Plains, N. Y. **A-33**

• **Stereo Cartridge.** The Stereotwin STS-220 is a new stereo cartridge for the reproduction of both stereo and monophonic records. This cartridge, the latest of the Stereotwin line of moving magnet cartridges, features a channel separation of better than 25 db from 1000 to 10,000 cps, and excellent characteristics to 15,000 cps and beyond. The Mumetal shielding and high output (10 mv at 5 cm/sec) completely eliminates hum. The STS-220 is merchandised in a presentation case which includes the cartridge with diamond 0.7 mil stylus mounted, plus an extra diamond stylus, for the audiophile price of $34.50. The extra diamond stylus not only guarantees a factory built replacement available to the user when his original needle is worn, but also provides continuous listening pleasure, should it be desirable to check the original needle. The Stereotwin line of cartridges are distributed by the Benjamin Electronic Sound Corporation, 97–03 43rd Avenue, Corona 68, New York, exclusive importers of ELAC products. **A-34**



• **FM Tuner-Amplifier Kit.** The PACO Model ST-26 tuner-amplifier kit features a self-contained and prealigned front end which simplifies construction and ensures good performance. The circuit features a



wide-band ratio detector and automatic gain control as well as switchable automatic frequency control. IHFM sensitivity is stated to be 4 μv. A "magic eye" type of tuning indicator is provided, and the tuning is aided by flywheel action. The audio amplifier section of the ST-26 contains a switched phono input (for ceramic cartridge) which permits the unit to be the center of an inexpensive music system. The ST-26 is available with either a metal or wooden enclosure. PACO Electronics Co., Glendale 27, N. Y. **A-35**

• **4-Track Tape Recorder Series.** The new Ampex 1200 Series 4-track stereo and mono tape recorder/player features three newly designed heads. A new tape tracking and guidance system has also been incorporated in the 1200 Series. The combination of narrow-channel heads, fitted shielding between channels, and other new techniques have been incorporated to help eliminate reverse-channel cross-talk and improve the signal-to-noise ratio. The

1200 Series records 4-track stereo and mono, and plays back 2- and 4-track stereo and 4-track mono. Speeds are 3¾ and 7½ ips. A master selector switch permits centralized control of stereo or mono modes, choice of an individual track, sound-on-sound recording, and automatic shutoff of both the motor and the electronics, or either individually. The new erase head permits separate erasure of each of the 4 tracks. The 1200 Series consists of the Model 1250 which is an unmounted deck; the Model 1260 (shown) which is portable; and the Model 1270 which is a portable model with built-in pairs of amplifier-speakers. Prices range from $499.50–645.00. Ampex Audio Co., Sunnyvale, Calif. **A-36**

• **Pickup System.** A new pickup system that is said to track at ¾ gram has been introduced by Audio Dynamics Corp. Named the Pritchard, the new system combines the ADC-1 stereo cartridge with a balanced tone arm thus eliminating the

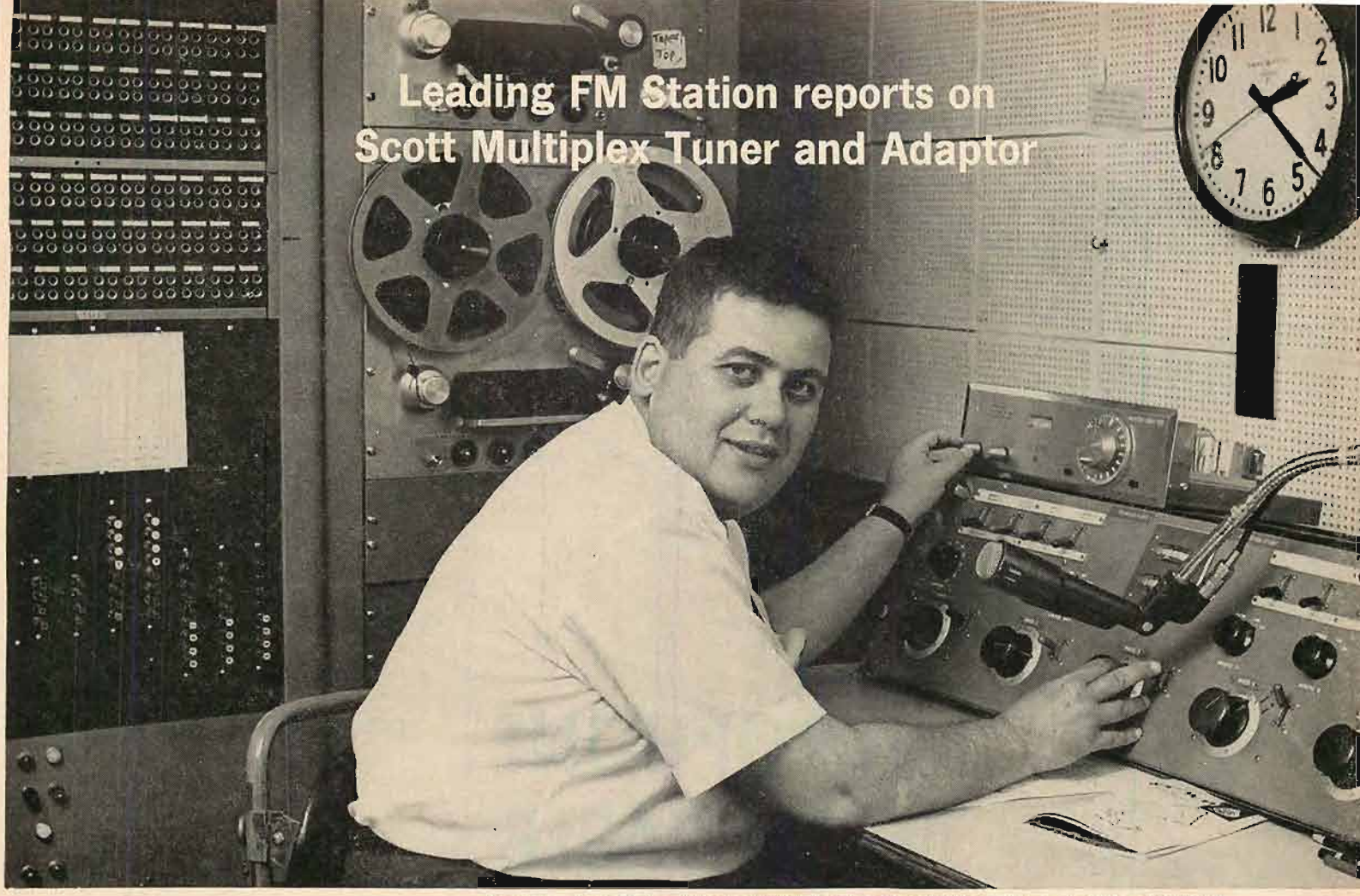
problem of matching a highly compliant cartridge with the correct tone arm. Features of the system include a side-thrust compensator (anti-skating), a heavy counterweight that occupies very little space behind the pivot, and a plug-in head which accommodates other cartridges. The tone arm is fabricated from walnut wood and is available separately for those who already own the ADC-1 or other highly compliant cartridge. Price of the Pritchard Pickup System, Model ADC-85, is $85; price of the tone arm, Model ADC-40, is $39.50. Audio Dynamics Corp., Ridgewood 27, N. Y. **A-37**

• **Audio Equalizer.** A unique professional audio equalizer, designed for use in the recording, broadcast, acoustical measurement, and electronic music fields, has been made available by Gotham Audio Corp. The Gotham EQ-1000 Universal Equalizer combines almost every conceivable function of frequency discrimination without

the use of a single inductively tuned circuit. Instead it utilizes a building-block assembly of RC circuits which provides band-pass and band-reject functions with slopes as high as 24 db per octave while confining distortion levels to below 0.7 per cent total rms at an output level of +18 dbm. 50 pushbuttons and 11 selector switches make it possible to recreate any setting. Complete engineering specifications are available. Gotham Audio Corp., New York 36, N. Y. **A-38**

• **Bookshelf Speaker System.** Featuring low price and modest size, the new Wilder Engineering Products "Playmate" speaker system costs $39.75 and measures 10 x 18 x 8. The enclosure is finished on four sides in walnut-finish veneer. It is

equipped with a 6-in. woofer, a 5-in. midrange, and a 4-in. tweeter. A suitable crossover is included. Impedance is 8–16 ohms. Frequency range is claimed to be 40 cps to 18,000 cps. Wilder Engineering Products, Chicago 14, Ill. **A-39**



Richard L. Kaye, Station Manager of WCRB, using Scott Multiplex Tuner for station monitoring.

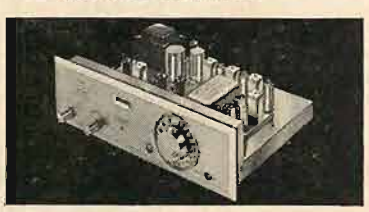
"...Outstanding stereo reception...Scott surpassed our greatest expectations..."

FM Station WCRB, Boston's leading good music station, has been broadcasting in multiplex for several months. During this period they have had the opportunity to evaluate many multiplex tuners and adaptors. Here's what they say:

"This letter is to let you know how pleased all of us at WCRB are with the H. H. Scott Multiplex Adaptor Model 335 and the H. H. Scott Multiplex Tuner Model 350. The Scott multiplex tuner and adaptor have surpassed our greatest expectations. They give outstanding stereo reception. The stereo separation, frequency response and low distortion have proven outstanding."

Richard L. Kaye
Station Manager

Many leading FM stations have chosen Scott for use in their monitoring and testing facilities. If you, too, want the finest multiplex equipment . . . choose H. H. Scott.



350 FM Stereo (Multiplex) Tuner Scott's widely acclaimed 350 FM Stereo Tuner has the multiplex circuitry built right in. You can use it to receive either FM stereo or regular monophonic FM broadcasts. Scott's Wide-Band design and unique silver-plated front end assure fine reception without distortion, drift, noise or loss of stereo separation. IHFM sensitivity is 2.5 μv and stereo separation can match exacting FCC transmission specifications. Exclusive filtering circuits on the 350 and all Scott multiplex units permit flawless results when used with any tape recorder. **$199.95***

335 FM Stereo (Multiplex) Adaptor You can instantly convert any Scott tuner, regardless of age or model, to multiplex with the 335 FM Stereo Adaptor. The combination of the 335 and your Scott tuner offers the same flexibility and tape recording features as the 350 FM Stereo Tuner. Optimum performance can be guaranteed only when a Scott tuner and the 335 are used together. **$99.95**

Here's What Happy Owners Say:

"Multiplex comes in beautifully with 350 Tuner. I've heard stereo before, but never like this."
Kazunori Yonekura, Castro Valley, California

"I am 50 miles from transmitter and get perfect reception with just my TV antenna. I had (competing brand) multiplex but it didn't work."
John Flower, Concord, California

"... Here in Newburgh I am 100 miles from WGFM. I receive them every evening from 8 to 9 PM. . . . My hi-fi equipment is all H. H. Scott. My 310C tuner is 21 months old and has had no maintenance . . . not even tube replacement. My 272 Amplifier and 335 Multiplex Adaptor have been trouble-free. Your quality control must be nearly perfect. In my opinion you offer the finest hi-fi components than can be purchased."
Walter L. Bachman, Newburgh, New York

"Finest separation I ever heard."
Daniel M. Wolfe, Jr., San Francisco, California

"All other equipment is H. H. Scott. Reception 40 miles from station is very good."
W. A. Moss, Mountain View, California

"KPEN stereo terrific on Command Records — perfect channel separation."
L. V. Steele, Belmont, California

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THIS MONTH'S COVER

Proving that home music systems can have more uses than one, this lovely decorator-styled cabinet houses most of the necessities for a pleasant, relaxing, and convivial evening. Beginning with the built-in bar, the owner has made extremely clever use of the space below it which could conceivably house more bottle storage space, a refrigerator, or possibly a sink. He chose, however, to build his hi-fi installation into this area.

The equipment consists of a Fisher Model 100-R stereo AM-FM tuner, a Fisher X-202 stereo control amplifier, and two Fisher Model XP-2 speaker systems, all of which are visible, and a Garrard Type A Automatic Turntable equipped with an Empire Model 108 stereo cartridge, which are not.

With all of this equipment, space is still available for the storage of some 150 records.

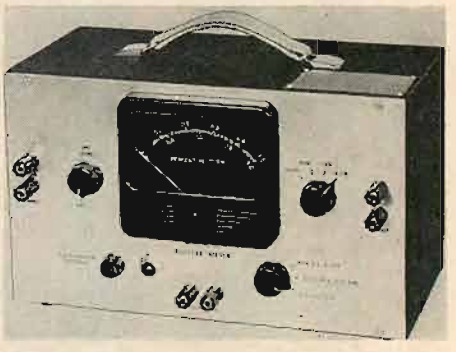
TEST EQUIPMENT ROUNDUP

(from page 30)

the voltage ratio between them being 4:1. The output voltage is 10 volts maximum into a high impedance, or +5 dbm into a 600-ohm load. The residual intermodulation is 0.2 per cent maximum. The voltage scale on the analyser provides four full-scale ranges up to 30 volts rms. The intermodulation scale provides 3, 10, and 30 per cent full scale ranges. Accuracy of the analyser section is ±10 per cent of full scale. Price of the Model 31 is $220.00. Measurements Corp., Boonton, New Jersey. **A-31**

VARO

● **Flutter Meter.** The Varo Model FL-3D Flutter and Wow Meter is designed for use in the maintenance, repair, and calibration of record and tape-playing systems. It conforms to the standards for measuring flutter and wow, as determined by the Standards Committee of the I.R.E.



An internal oscillator provides a 3000 cps signal for measurement of tape recorders. The scale ranges are 2 per cent and 0.5 per cent full scale. Rms calibration is provided on sine-wave flutter. Accuracy is 10 per cent within bandwidth restrictions. The bandwidth of the discriminator is sufficient to allow side bands up to 250 cps to be demodulated with no more than 3 db attenuation with reference to 75 cps. Front panel terminals are provided for observing flutter and wow components on an oscilloscope. A rear apron terminal provides d.c. to 150 cps output for graphic recording. VARO, Inc., Santa Barbara, California. **A-32**

AUDIO Teasers

NORMAN H. CROWHURST

Starting in this issue, AUDIO is providing a new service which many readers have demanded we provide—a department devoted exclusively to technical puzzlers wherein the reader himself can participate. To satisfy this demand we have asked Norman Crowhurst to start the ball rolling by selecting questions from amongst the many which audiofans have addressed to him. After a sufficient number of questions have been submitted by readers, Mr. Crowhurst will select those which seem to him to be most appropriate. To use his own words here: "So everyone can 'have fun,' we'll mix them up a bit, using some that advanced readers will find obvious, and some that have puzzled the best of us." So that readers can participate, we will pose the questions one month and give the answers the following month. Naturally we want all readers to take a crack at answering. To spice things up a bit, AUDIO will pay $5.00 for each question and answer we use. Of course, since many readers may arrive at the "correct" answer, the one we use will be the most complete and intelligent in our opinion.

Now what types of questions should they be? Simply stated, these questions should be of the type which puzzle and engage our intellectual curiosity—and *not* the type which ask about how to trouble shoot or select a piece of high fidelity equipment.

Send your questions and answers to AUDIO *Teasers*, P.O. Box 629, Mineola, L. I., N. Y.

This Month's Questions:

Question 1—A volume control is required on a musical instrument that uses a ceramic pickup. If a load of 250,000 ohms is used, there is serious loss of bass. To avoid this, a value of 5 megohms is tried, which gives satisfactory bass response, but there is a buzzy type of hum except when the control is either full on, or off. How can such a control be installed to avoid either of these troubles?

Question 2—A push-pull output stage in which the screens are connected to tappings on the transformer primary is alternatively called "ultra-linear" or "distributed load" connection. (a) Why is a 40 per cent tap point sometimes referred to as 16 per cent loading (for example)? (b) What proportion of the total output power would come from the screens if the fluctuation in screen current over the audio cycle is one tenth that of the plate current in this connection?

Question 3—An amplifier is originally built with a triode input stage, and feedback connected from the output to its cathode resistor. Because more feedback is desired, without sacrifice of over-all gain, a pentode is substituted for the first stage. Although the amplifier is still quite stable, it is now found that the distortion, with about twice the feedback, is greater than with the triode input stage. Why? How could this be remedied without sacrificing over-all gain or amount of feedback? AE

ABOUT MUSIC

HAROLD LAWRENCE*

A New Look at Gypsy Music and Musicians

AT A HUNGARIAN RESTAURANT in Vienna, a Gypsy violinist wearing a brocaded vest and a florid mustache leans over your plate of stuffed cabbage and gazes mournfully into your eyes, while his quivering fingers produce wide vibratos and his bow digs into the fingerboard, grinding out a cloud of white rosin dust. In the background, the rest of the ensemble (cimbalom, clarinet, and double bass) support the soloist with an alternately langourous and frisky accompaniment. In the eyes of the *gajo* (or non-Gypsy), this is the real picture of the Gypsy and his music. But the melodies he hears are no more "pure" Gypsy than the jazz improvisations of the great Gypsy guitarist, Django Reinhardt.

Ever since they came to Europe from Asia in the fifteenth century, Gypsies depended for their livelihood on being tolerated by the Europeans. They therefore studied the *gajo* carefully, noted his social characteristics, and learned his music. In the process of absorbing the local folk song into their repertoire, Gypsy musicians imbued them with strangely attractive qualities: the melodic base remained European, but the rich embroidery had a distinctively Eastern flavor; the emotional content was broadened often to the point of exaggeration; and the peppery element of virtuosity transformed the essentially simple tunes they worked with. So successful were they at dressing up *gajo* melodies that the Gypsies became what might be called musical scribes for the people. During the heyday of the Gypsy musician (17th–18th centuries) such violinists as Janos Bihari were raised to the level of court musicians, and Gypsy bands performed at royal functions, banquets, and even in military parades. Franz Liszt was so taken with Gypsy musicians that he credited them with having invented Hungarian music.

In the *Gypsy in Music*, Liszt depicted the Hungarian peasant as a musical illiterate "who seized upon the melodies which he heard the Gypsies perform, as a sort of windfall." In his own backward

* *26 W. 9th St., New York City 11, N. Y.*

Gypsy in Transylvania playing flute. Photo: Jan Yoors.

fashion, he stripped them of their "elaboration" and reduced them to crude little ditties. Gypsy instrumental music, on the other hand, Liszt praised "on the score of a bold originality full of the most noble sentiment . . . [and] of exquisite completion of a form as beautifully inspired as it is happily carried out."

Liszt's theory was demolished some 70 years later by Bartók, who toured the Hungarian country-side in 1905, collecting and classifying folk songs. It was not the Hungarians who incorporated Gypsy melodies into their national music; the *Gypsies* were the appropriaters. Worse than this, Bartók lamented, the Gypsies were responsible for corrupting the authentic Hungarian folk songs: "They worked their own subtle transformations on everything they played." To complete their musical conquest, the Gypsies put native village musicians out of work, and virtually took over the popular music field.

In 1933, Bartók finally reached the opposite pole from Liszt when he suggested that there is no authentic Gypsy music after all.

The truth about Gypsy music, however, lies neither with Liszt nor with Bartók. For what both composers heard was Gypsy music meant for *gajo* ears. Even if Bartók, who ferreted out hundreds of remote Balkan folk tunes, had suspected the Gypsies of withholding their own songs from him, it would have required much more than patience and pleading to uncover them.

For authentic Gypsy music is generally performed only by Gypsies and for Gypsies. What are the traits of this exclusive music? Is it a special musical language or simply a variation of sounds familiar to the *gajo?* According to Jan Yoors, a Belgian-American tapestry artist, true Gypsy music departs completely from stereotyped conceptions. Mr. Yoors is uniquely qualified to speak with authority on the subject. Paradoxically, he is both a *gajo* and a Gypsy. At the age of twelve, he ran away from home to live with a band of nomadic Gypsies who were passing by his native Antwerp. For the next half dozen years, he spent about six to eight months out of each year with the Gypsies, who adopted him as a fullfledged member of their tribe (the Lowara) when he was thirteen. He traveled with them throughout Europe and learned many things, including how to speak Romany, a complicated language of Sanskrit derivation containing 53 characters and an eight-case declension. In constant touch with his Gypsy 'relations' Yoors recently returned from a three-month trip to Europe and the Middle East, visiting Gypsy camps and communities.

Yoors points out that there are five main tribes of nomadic Gypsies: the Lowara, the Churara, The Kaldarach, the Matchvia, and the Sinti.

The Sinti conform closest to the popular image of the musical Gypsy. They are, for the most part, professional musicians (Django Reinhardt was a Sinti). Because they play for outsiders, they are looked down upon by the other tribes and have earned the name, "outcasts." The other nomads believe that the Sinti have been corrupted by their contact with the *gajos.* The degeneration of their own musical life seems to bear out this charge; the Sinti have no private music—their songs and pieces today have a faded picture-post-card quality.

Unlike the Sinti, the other tribes do not manufacture counterfeit Gypsy music, not even for the *gajos.* Surprising to report, they play no musical instruments at all.

Their music is strictly vocal, with hand-clapping being the only 'instrumental' accompaniment. And here's a twist—the Gypsies hire *gajo* bands to play for them at weddings. Gypsy songs are usually sung on special occasions such as feasts, weddings, or other social celebrations.

Gypsies rarely perform their own songs for *gajos*. Yoors once visited a Gypsy camp accompanied by a *gajo* and asked one of the tribe to sing for him and his friend. Because of the *gajo's* presence, the chief whispered to the others, "No Romany songs!" On another occasion, Yoors assembled a score of nomadic Gypsies in a recording studio to tape an LP of Gypsy songs. The Gypsies sang loud and lustily to the delight of the recording producer and to the chagrin of Mr. Yoors; not one of the tunes was authentic Gypsy—they were instead Hungarian, Roumanian, Serbian, Bosnian, and Bulgarian. As soon as the *gajo* record producer left the studio, however, they burst forth into Romany song.

To hoodwink a recording executive is one thing, but to mislead a trained musicologist is something else again. Nevertheless this is precisely what has been taking place at the University of Budapest for the past several years. Teams of Hungarian folk-song investigators have been roaming the countryside recording what they believe to be authentic Gypsy melodies performed by authentic Gypsies. A sampling of the hundreds of tunes taped indicates that the University has succeeded in accumulating a formidable collection of *non-Gypsy* songs performed by Gypsies—which somehow takes us back to Liszt.

Obviously, this is no job for a *gajo* song-collector. Jan Yoors, who is writing a book on the Gypsies, knows hundreds of Gypsy songs, and plans to record many of them in the field later this year. Now at last the elusive music of the nomadic Gypsies will be brought to light. *Æ*

FEEDBACK

(*from page 42*)

is neglecting the effect of any output stage grid resistors, which admittedly would modify the result, and must be reckoned into complete design calculations). With normal load, the input to the drive stage, to get full output voltage (150 volts swing at cathode and plate), is $175/18 = 9.73$ volts swing. With the output stage open circuit, the input to the drive stage needs to be $155/19.5 = 7.95$ volts swing. So the overall damping factor is now about 4.5.

This illustrates the principle that feedback can do different things in different places, and that different factors are involved, according to what you are calculating, and how the over-all effects combine. But so far we've assumed the simple case where, although $(1+AB)$ may have different values according to purpose involved, AB is always either positive or negative: no phase angles.

Reactance Loading

Now let's take the case of a typical feedback amplifier. We'll assume it has a midband feedback of 14 db, with normal resistance load, and uses pentode

output stage with plate resistance (without feedback) 7 times load value.

The output shunt resistance, without feedback, is 7/8 times the load value (*Fig.* 5). Feedback will reduce this by 5:1 (equivalent of 14 db) to 7/40 times load value. As part of this is still the actual load, the effective source resistance is 7/33 times load value, or the damping factor is 33/7 = 4.71. The feedback component, AB, is 4/5 of the external input. Assume distortion is 5 per cent without feedback. So with feedback it will come down to 1 per cent.

For now we'll assume that stability criteria have been taken care of, and the amplifier performs satisfactorily (at least remaining stable) when a loudspeaker is connected. We'll stay strictly in the range where amplifier phase shifts and gain changes are negligible. The phase shifts we'll talk about are not those that occur at frequency extremities. These have been discussed before. But at about 2000 cps (for one place) the loudspeaker's reactance will about equal its resistance.

With the resistance load, AB was 4. With the resistance load removed AB would be (1+7) times 4, or 32. With a loudspeaker load whose impedance is $(1+j1)$ times nominal value (or 1.414 at 45°), AB will be $\frac{32(1+j1)}{8+j1} = \frac{32}{65}(9+j7) = 4.43+j3.45$. The factor $(1+AB)$ thus becomes $5.43+j3.45$.

Without feedback, the transfer phase shift into this reactive load will be $\tan^{-1}\frac{7}{9} = 38$ *deg.* With feedback, this reduces to $\tan^{-1}\frac{7}{73} = 5.5$ *deg.*, which is a considerable improvement.

Without feedback, the output voltage would rise, from the value into a resistance load, in the ratio $\frac{4.43+j3.45}{4}$, or by a factor of 1.4. With feedback this rise is held down to $\frac{4.43+j3.45}{5.43+j3.45}\cdot\frac{5}{4}$, which evaluates to 1.09, also a considerable improvement. In short, this means the improved damping factor effect is realized. But what about distortion?

When the feedback was combined precisely antiphase, the distortion was reduced by the gain reduction factor, 5. But now the feedback meets the input at a phase angle of 38 deg. to antiphase. Actually, the feedback is now more than 14 db; it's just over 16 db. Exactly what happens to the distortion depends on the exact distortion components and on the feedback loop gain and phase shift at those component frequencies. Remember the loudspeaker impedance contributes to the phase shift.

First, assume it's practically all second harmonic, which is one extreme possibility. The loop gain phase angle is likely to have risen from 38 deg. to $\tan^{-1}\frac{7}{6}$ or 49 deg. by then. This means the in-phase cancellation will be cos 49 deg. or 0.65 times what it was with resistance load. But there will be a sin 49 deg. component in quadrature, about 0.75 times the no-feedback value. So the 1 per cent will jump to almost 4 per cent.

That's the most optimistic case. If some of the distortion is due to clipping, that occurs during a relatively short part of the fundamental, the phase shift will mean the feedback "correction signal" will completely miss the original distortion kink, and will set up another one in opposition. This will go round the loop again, repeating the miss, until the irregularity dies out—or develops into a parasitic, depending on the stability margin of the amplifier at the frequency represented by this repeated transition time.

If you don't believe this happens, set up an amplifier with a load impedance consisting of a variable phase load. As you vary the phase of the output load, the amplifier will probably go through a distortion minimum at the point where output and input voltage are precisely in phase. For other phase loadings on the output, the feedback holds the overall transfer characteristic to reduced phase deviation limits. But the loop gain phasing is upset, so it cannot *at the*

same time hold down distortion according to formula.

We have simplified the discussion considerably. We assumed the distortion would not change according to output loading, which is seldom true, of course. Reactive loading itself often causes more severe distortion. This will further aggravate the over-all effect.

We have shown in this case that there's no guarantee that the same distortion-reducing factor works for all purposes.

What's the remedy? That's another story. In short it is to calculate quite specifically what the feedback effects are for each purpose in hand. In each calculation there will be a factor $1 + AB$. But it is unlikely to involve the same circuit elements or parameters for each purpose considered. So the relevant factors are *not* the same for each purpose, except in the very basic algebra. Æ

AUDIOCLINIC

(from page 4)

of mass *versus* stylus radius. These effects are still apparent in stereo reproduction. I would say that most stereo cartridges will play back monophonic recordings better than the cheaper variety of monophonic cartridge. However, the sound from these monophonic cartridges was pleasing to many people, which fact accounts for their popularity. Therefore, if you are accustomed to a crisp sound, you may be disappointed in the sound of some stereophonic cartridges because their reduced mass makes the brightness seem less.

When the mass of a cartridge is sufficiently great, the resonance resulting from the mass and compliance of the stylus assembly, together with the plastic resonance of the record, will fall well within the audio spectrum. The effect of this resonance is to create the crisp sound characteristic of the older, cheaper monophonic cartridge under discussion. This condition does not permit a smooth, flat, treble response. The lower the mass of the moving elements in the cartridge, the higher will be the resonant frequency of the moving system. A good cartridge will be designed so that this resonance falls well outside the audio spectrum.

What constitutes good sound is a matter of personal opinion. (Remember that hearing is a subjective experience.) Thus, a comparison of one cartridge to another is needed before you can reach a definite decision as to the unit you should obtain. For a method of comparing cartridges, read the answer to the previous question.

As to the matter of stylus radius, the mass and compliance of a given cartridge play a large part in the ability of a stylus with a given radius to perform properly. In other words, stylus radius cannot be divorced from the other parameters which shape cartridge performance. Therefore we must revert to the same theme—namely, consider and compare these units as a whole because they will function in this manner in your living room. Æ

FILTERLESS METHOD

(*from page 38*)

(f(t)S(t)) composite signals are (L+R) and *(L−R)* respectively, so that the *L* and *R* channels may be obtained from these by the matrixing process:

$$(L+R)+(L-R)=2L$$
$$(L+R)-(L-R)=2R.$$

An Example

The Eico MX-99 adaptor operates on the principles set forth in the preceding discussion.[3] (See *Fig.* 8.) There are no filters in the signal path before the point at which the actual channel separation is effected. Circuit operation is as follows:

The composite stereo signal as received from the ratio detector is amplified by V_{1A}. In order not to alter the performance of the ratio detector, the input impedance of this stage is made exceptionally high.

The 19,000-cps pilot signal is isolated and amplified by V_4. Frequency doubling is accomplished by a full-wave rectifier at the plate of V_4, and the 38,000-cps signal thus obtained is used to synchronize a 38,000-cps push-pull oscillator (V_5) which drives a ring modulator. In addition to a strong 38,000-cps component, the full-wave rectifier delivers a negative d.c. voltage when the 19,000-cps pilot carrier is received. This d.c. voltage is used to cut off switching tube V_{1B}, and thus ignite the neon pilot light, indicating that a stereo broadcast is in progress. V_{1A} also delivers the amplified composite stereo signal to the grid of a split load phase inverter (V_{2A}). V_{2A} provides two outputs which differ in phase by 180 deg. and which are alternately sampled by the ring modulator at a 38,000-cps rate. The two sampled outputs are added and amplified by V_{2B}. Adding the alternately sampled out-of-phase signals effectively produces an output which is the input signal multiplied by a 38,000-cps switching function of zero average value and odd symmetry. The audible portion of this signal is *(L−R)*, as explained in the spectrum analysis. *(L+R)* and *−(+R)* are available at the plate and cathode of V_{2A}, respectively, and these components are added to the output of V_{2B} in a resistive matrix. De-emphasis is accomplished at the matrixing points. Matrixing *(L+R)* and *−(L+R)* with *(L−R)* produces the outputs *L* and *−R*. A phase inverter (V_{3A}) in one channel restores proper phase relations in the output signals, thus making the unit compatible with other stereo equipment (tape decks, etc.) with respect to speaker phasing.

Channel separation is controlled by varying the amount of *(L−R)* signal which is injected into the matrix. This is effected by a gain control in the grid of V_{2B}. The output signal level under the condition of optimum separation is thus determined by the direct *(L+R)* component and is virtually independent of the phase of the reinjected carrier. An error in the phase of the injected carrier will simply require a higher setting of the separation control to achieve the same output amplitude and channel separation that would be obtained under the optimum carrier phase condition.

Note that the demodulator is of the balanced type so that the potentially troublesome 38,000-cps carrier does not appear in the adaptor output. The presence of this signal might conceivably introduce beat notes with tape recorder bias oscillators.

Cathode follower outputs ($V_{3B,C}$) are provided in each channel and filtering of the output wave forms are effected in these stages. Filtering attenuates the high frequency components which are introduced in the demodulation process, and which, while substantially attenuated by the de-emphasis networks, may become objectionable in tape recording. In addition, the filters are designed to remove the 19,000-cps pilot signal which is usually present to a noticeable degree in the output signals.

The adaptor is capable of handling peak signals of 2.5 volts rms, and of providing an essentially flat separation of at least 30db over the entire audio spectrum. Æ

[3] Eico has applied for a patent to cover this circuit. Information contained in this article is supplied without prejudice to Eico's patent rights.

RECORD REVUE

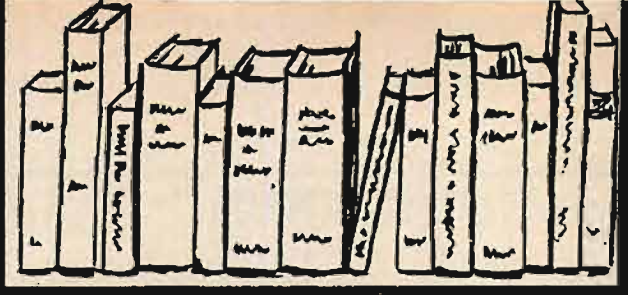
(*from page 53*)

dozens of playings available, and so too with "The Flight of a Bumble Bee." Nothing very exclusive about *this* music-making. That's just the standard Capitol plug for Duophonic; but it does leave the question open as to why these mono recordings should be done over into pseudo-stereo.

I don't think it's hard to answer. Duophonic really works, as already suggested in this column. It does, indeed, add the necessary spread to a mono recording so that it sounds clearly bigger, wider, more naturally placed, as heard on a stereo system. And this without too-noticeable artificiality.

So—why not bring out *any* old mono material that sells consistently? Classical mood music, background music, has a way of selling and selling. Might as well refurbish an item like this, and surely no point going to the enormous expense of doing the whole thing over again in "genyooine" stereo.

I don't suppose the Hollywood Bowl players are very happy—they would prefer the true stereo product, with its attendant union-scale pay for a nice, juicy new recording session. But the majority of mood-background listeners would never notice the difference, since these are perfectly good hi-fi recordings, technically up to date except for stereo. So, you see, Capitol is being very practical. Æ



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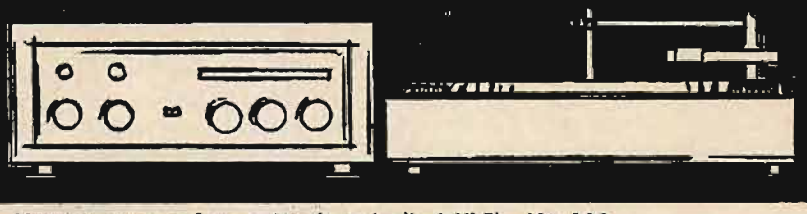

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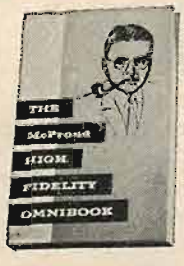

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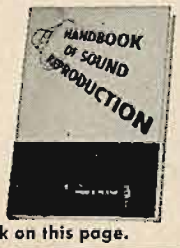

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MEASURING EQUIPMENT

(*from page 22*)

plates deflect the electron stream. The pair of plates that are placed horizontally deflect the electron stream vertically toward the more positive of the two plates. The pair of plates placed vertically provide the equivalent horizontal deflection. The electron stream hits the screen, causing the fluorescent material to glow. Under proper conditions, the waveshapes applied to the deflection plates will appear on the screen.

The amount of deflection on the screen is determined by the sensitivity of the cathode ray tube. This is usually stated in inches or centimeters of deflection per volt. The sensitivity of the 'scope can be increased by providing voltage amplification. Amplifiers employed in a 'scope useful in audio testing procedures must provide linear response from d.c. to about 500,000 cps, respond faithfully to square waveforms, and present no phase shift over much of the range. The sensitivity should be great enough to show the hum components present in a piece of audio equipment—10 millivolts per inch should be satisfactory sensitivity after amplification.

The vertical amplifier is the more critical of the two although the horizontal amplifier must also be undistorted and of wide frequency range. The horizontal amplifier need not have flat response at the extremes.

To display a two-dimensional signal on the screen, a varying voltage must be applied to the horizontal as well as to the vertical plates. A sawtooth signal is applied to the horizontal amplifier so that the vertically applied signal may be swept across the screen. This sawtooth must be linear and variable to about 100,000 cps to be capable of displaying any signal significant in audio tests.

In general, a good 'scope has a thin bright trace, the sweep oscillator is easy to synchronize with the incoming signal, and will usually provide a signal of known amplitude to enable easy calibration of the screen in volts per inch of deflection.

Variations have appeared by the dozens. One of the most useful is the dual trace 'scope for displaying two signals at one time. This is particularly applicable in stereo tests.

This dual trace 'scope usually has a self-contained multivibrator in the form of an electronic switch. It alternately sweeps two signals applied at the input and displays them in sequence on the screen. The persistence of the fluorescent material makes it appear as if both traces are being viewed simultaneously at different vertical positions on the face of the cathode ray tube.

A.C. Voltmeters

The a.c. voltmeter was mentioned throughout this discussion in several different applications. It is the basic instrument in any test setup. All available a.c. voltmeters fall roughly into two groups.

The most common type consists of a wide band a.c. amplifier. The output from the amplifier is rectified and fed to a d.c. meter movement. Although these meters are calibrated in sinusoidal rms voltage, they are actually sensitive to the average values.

A second, and less expensive, type peak rectifies the signal. The resulting d.c. voltage is then fed to a d.c. amplifier or bridge. Once again, the scale is calibrated in rms, but this time the unit is sensitive to peaks. A variation of this is the peak-to-peak reading voltmeter.

Both units are useful in the laboratory. The latter types are relatively insensitive and are frequently incorporated as a portion of a general VTVM used for checking d.c. voltages and resistance along with the a.c. ranges.

The former type usually consists of several amplifier stages. Feedback is provided through the meter circuit, around all of these stages. This contributes considerably to stability, linearity, and wide frequency range. The power supplies must be well regulated to avoid reading variations due to line voltage fluctuations.

The second type of meter can also have many variations. One form of peak reading meter circuit is shown in *Fig.* 10. Here, the applied voltage is rectified and the 60-cps ripple passes through the resistor, R, during positive portions of the cycle. The capacitor, C, smoothes out this ripple, so that only the peaks remain. This may be used as the rectifying circuit for the a.c. ranges and can be included as part of any d.c. VTVM.

The peak-to-peak reading meter is most useful in audio work. A circuit of this type appears in *Fig.* 11. The operation is fairly obvious. During the positive half cycle, diode D_1 conducts, and a d.c. voltage is built up on C_1, as shown. During the negative half cycle, the negative portion of the cycle is added to the voltage across C_1, through D_2. The sum of these appear across C_2 and R. These are in turn fed to the d.c. meter.

The meter movement can be designed into a d.c. amplifier bridge circuit as shown in *Fig.* 12. When the current through both tubes is equal, the meter reads zero. The currents are adjusted by varying resistor R in the cathodes. This resistor adjusts the relative bias on the two tubes and consequently the relative plate (or cathode) currents. Once adjusted, an unknown d.c. input signal upsets the bias on the first triode only, resulting in a deflection of the meter.

Both types of meters are useful. The

average reading type is usually more accurate and more stable, and should be used for monitoring the input and output. The peak-to-peak reading type is useful to measure peak amplifier outputs (to be discussed in the future).

One note of caution. Ordinary VOM's are frequently provided with a.c. scales. The rectifiers used on these units commonly prevent the use of linear scales, with a resultant loss of accuracy. They are frequency-sensitive and should not be used where accuracy is essential.

The Flutter Meter

This is not an audio instrument in the conventional sense of the term. However, tape recorders and phono turntables are important parts of an audio system so that this type of instrument has become most common in the audio laboratory.

Flutter and wow are variations in the speed. For testing tape recorders, a steady single frequency, usually 3000 cps, is recorded on tape. A speed variation appears as a frequency variation of the 3000 cps—not unlike the frequency modulated signal. When the test tape is played on a tape machine the output signal of the machine is passed through a filter where all frequencies *except* the 3000 cps pass through. The remaining signal is then FM-detected and read on an ordinary a.c. voltmeter.

Once again, there are several important characteristics of a good instrument. First of all the filters must be sharp. The circuit must eliminate all extraneous amplitude variations to prevent them from affecting the final reading. Filters should be provided to separate the wow (slow speed variations) components from the flutter (rapid speed variations) components. As always, the power supply must be extremely well regulated to avoid reading variations with line fluctuations.

Other instruments, which are useful and are basic components in most laboratories, are the tube tester, the capacitance bridge, the inductance bridge, and the VOM. Discussion of these might be of interest, but their application to actual audio measurements on audio equipment are strictly limited. *Æ*

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19TH CENTURY TUNES, hymns, waltzes, marches, gayety numbers and others as played by the outstanding "Regina" music box available on tape. Free information. Merle Enterprises, Box 145, Lombard, Illinois.

FOR SALE: General Radio 1551-A sound lever meter. New condition. $225.00. Electro-Voice 15WK woofer. New in original carton. $30.00. W. C. Resides, Sherwood Road, Ridgefield, Conn.

SPEAKERS: Altec 515, 604 Duplex, pair James B. Lansing 150-4, new, 18" Western Electric woofers, crossovers. Sell reasonable or trade. Otto Fichtman, 600 Timpson Place, Bronx 55, N. Y.

SHURE M-232 arm, $21.00, Shure M7D/N21D pickup, $25.50, or both for $46.00, p. p. insured with original warranty inside. (Scout's Honor—these are new and unopened!) Gordon E. Cain, Audioprocess Laboratories, 15 Manet Circle, Chestnut Hill 67, Mass.

SELL: Thorens TD-124 turntable, base, Grado Laboratories arm, ADC-1 cartridge, National Criterion stereo tuner. All perfect condition. A. Gray, 57-11 255 Street, Little Neck, N. Y. BA-9-4664.

FOR SALE: Ampex 401 in portable case, manual control, excellent condition, $395.00. Pentron Dynacord 7½–15 ips, full track, professional machine, 3 motors, good condition, ready to go, $185.00. Magnecord Mechanism PT6 new record/play head, new idlers, both motors excellent, some spare parts also, $65.00. Don Warnock, 117 W. 67th Street, Kansas City, Mo.

TANDBERG MODEL SIX tape recorder, luggage case, two mikes, $275.00. Major R. B. Furlong, 1 King Avenue, Fort Leavenworth, Kansas.

WANTED TO BUY: Ferrograph (Ercona) 808 four track or 424 four track recorder; Tapesonic 70C four track recorder; Concertone 505 four track recorder; 960 or 970 Ampex four track recorder; Ampex 620 speaker amplifier; Altec 355A amplifier. Tom McIntire, 501 Wright, Wilmington, North Carolina.

Industry Notes...

• **Westrex Promotes Wight.** Promotion of Ralph W. Wight to Vice President of the **Westrex Recording Equipment** division of **Litton Systems, Inc.** was announced by Executive Vice President **George T. Scharffenberger.** Mr. Wight will continue to serve as General Manager of the division, which he has been with since 1936. He was named Manager in 1954 after serving as contract relations manager. Westrex, since becoming a Litton division in 1958, has carried its recording technology into the fields of instrumentation data recording and commercial sound equipment.

• **British Industries Corp. Leonard Carduner,** President of British Industries Corp., announced the election of two of its veteran executives to vice-president. **Franklin S. Hoffman,** formerly Sales Manager for Garrard and other BIC high-fidelity products becomes Vice President for Sales. **Arthur M. Gasman,** formerly Marketing Director, becomes Vice President for Promotion. Both men have been associated with BIC for more than 15 years.

• **3M Opens New Plant.** Minnesota Mining and Manufacturing has just opened a second U.S. magnetic tape manufacturing plant. Located at Freehold, N. J., the new plant will boost 3M's magnetic tape capacity by 150 per cent when it is in full production sometime in 1964.

• **James Carroll Joins Fisher. Avery Fisher,** President of Fisher Radio Corporation, has announced the appointment of James Carroll as component Sales Manager at Fisher Radio. Mr. Carroll was audio Sales Manager at **Harvey Radio** for twelve years. In his new responsibilities at Fisher Radio Mr. Carroll will be associated with **Jim Parks,** Vice-President in charge of sales.

• **Eric Appoints Skolnik.** Named to the post of national sales manager for Eric Electronics Corp., **Norman Skolnik** brings to the post experience gained as field salesman for the Electronics Division of Ponder and Best.

• **Tandberg Awards Prizes.** Winners of the Tandberg "Sumfer Sales Jamboree" were awarded prizes based on the sale of Tandberg tape playing equipment. First prize winner, Ray Bellinson of Airex Radio, received a new Volvo Sports Sedan. Second prize, a Norwegian mink stole, went to Marty Stern of Grand Central Radio.

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The PF-8 has a minimum gain of 26 DB over a folded dipole with a flat frequency response of ±¼ DB from 88 to 108 m.c. It features a built-in TV-FM coupler and has eight elements with EXCLUSIVE "TAPERED T" driven element engineered to perfectly match the powerful transistor, direct coupled, *built-in* amplifier. It is available two ways—Model PF-8 for 300 ohm twin lead or Model PF-8C for 75 ohm coax.

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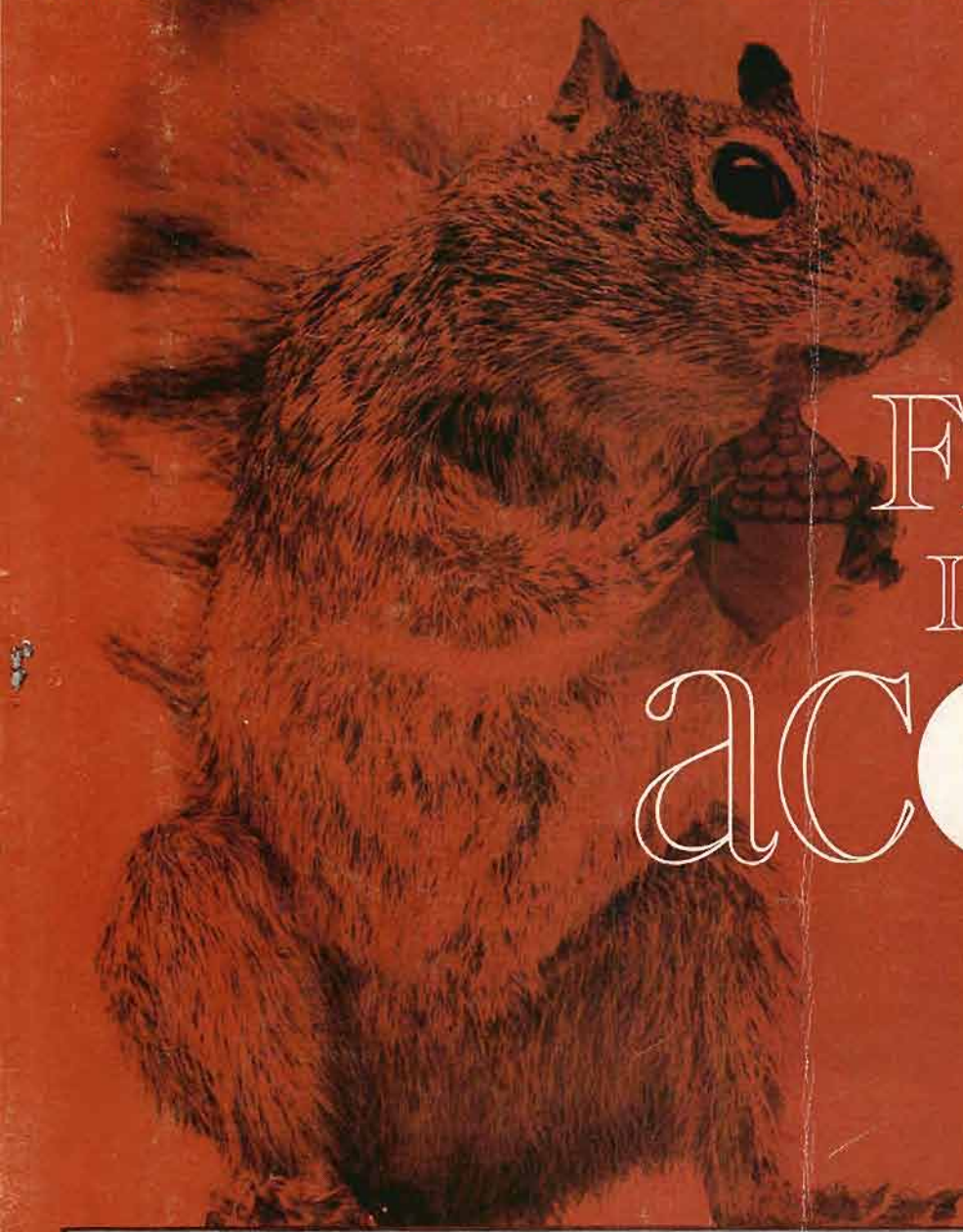

FROM little acORNS !

The FM-15 (top) and the S-15 (bottom) are available as separate units or in a handsome walnut or teak combined package. How? No heat means the tuner can be stacked with the amplifier without danger of drift.