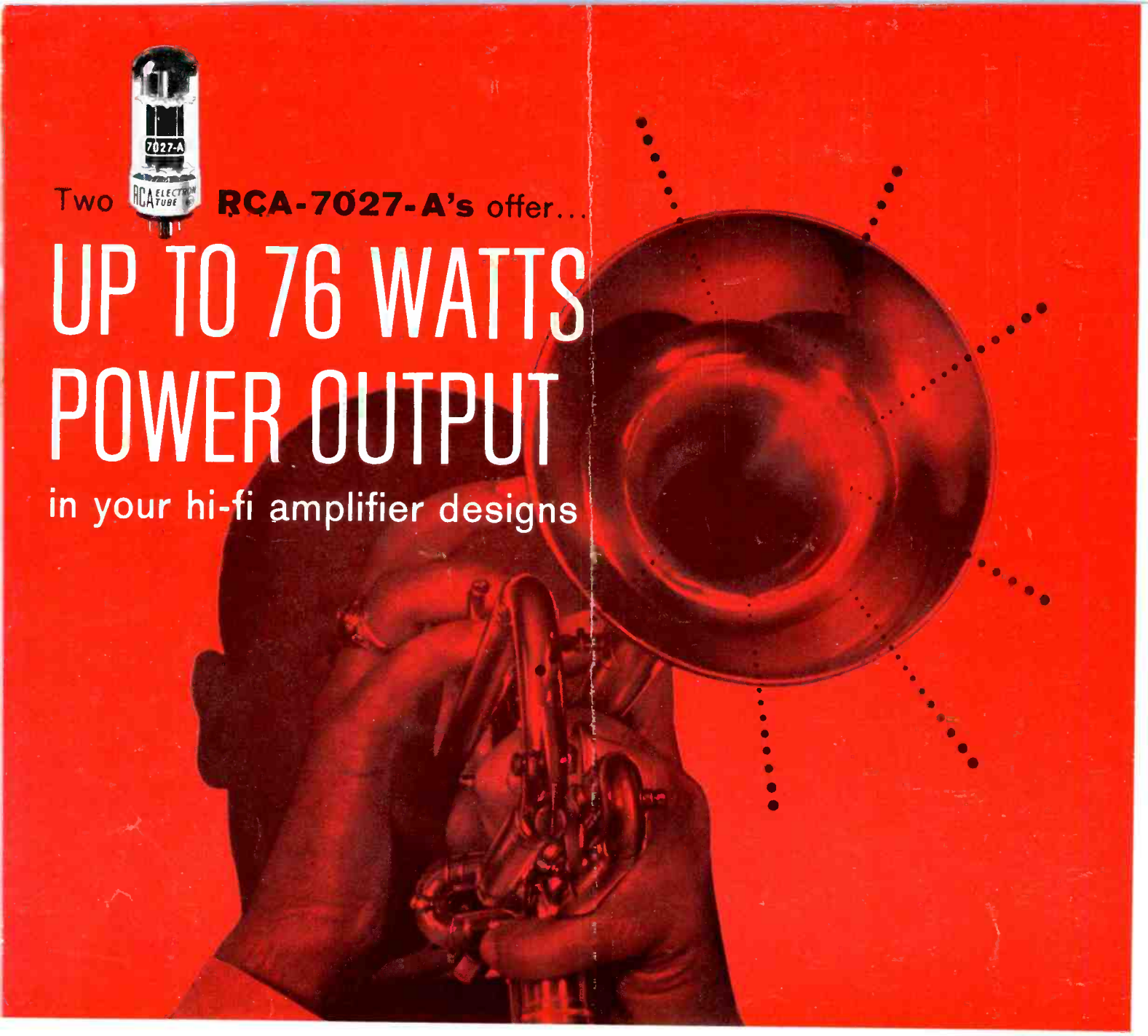
AUDIO

JULY, 1959
50¢

the original magazine about high fidelity!



Two **RCA-7027-A's** offer...

UP TO 76 WATTS POWER OUTPUT

in your hi-fi amplifier designs

"HOT" SOLO...and as he dips low, then soars high, the excitement mounts! Capturing the realism of a thrilling musical experience truly tests any high-quality audio amplifier you design. Meet the challenge with ease by designing around the RCA-7027-A. Two of these "star performers", in Class AB_1 push-pull service, for example, can deliver up to *76 watts* of audio power with *only 2% distortion!*

Structural features which make such performance possible include: heavy copper-core stem leads, low-thermal-resistance plate material, metal-base sleeve, radiating fins on control grid, and double base-pin connections for both control grid and screen grid.

So for high power and low distortion in your quality audio-amplifier designs, consider the RCA-7027-A. Check the data at right, then, for further information, ask your RCA Field Representative or write RCA Commercial Engineering, Section G91DE, Harrison, New Jersey.

RCA-7027-A beam power tube offers new high-power capabilities in high-quality audio amplifiers:

Design-Maximum Ratings:	
Plate Volts	600
Grid-No. 2 Volts	500
Plate Dissipation (Watts)	35
Grid-No. 2 Input (Watts)	5
Typical Operation in Class AB_1 Push-Pull Service:	
Plate Volts	540
Peak AF Grid-No. 1 to Grid No. 1 Volts	76
Total Harmonic Distortion (%)	2
Max.-Sig. Power Output (Watts)	76

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WEST: 6355 E. Washington Blvd.
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RADIO CORPORATION OF AMERICA
Electron Tube Division *Harrison, N. J.*

THE BRITISH INDUSTRIES

Sounding Board

on the matter of SERVICE AND SPARE PARTS

What makes Garrard Record Players the finest in the world?

One could say it is the patient attention to detail so apparent in any Garrard design...or, the painstaking quality control techniques followed in the manufacture of all Garrard products...but, an equally significant factor would be the matter of Garrard service and spare parts!

Like all other record players, Garrard models are mechanical devices, ultimately requiring some form of service or adjustment. But, unlike all other record players...a Garrard lasts longer before *needing* service...and

when the time comes, Garrard owners are taken care of magnificently. There is a nationwide network of authorized spare parts and service stations ready to serve at all times. Moreover, an all-inclusive storehouse of Garrard parts covering all models is rigorously maintained. Never has a Garrard owner failed to realize continued satisfaction from the Garrard player he purchased. Proof of this is contained in the files of our Service Department...a department with *its own* reputation in direct parallel to that of the Garrard product.

We are pleased to reproduce here excerpts from a few of the unsolicited letters sent to us...

***

"Last Monday I telephoned your office to request a selector arm extension cap to replace the one which had become displaced or lost on my Garrard changer. It arrived in the mail this morning, and to my additional pleasure, I see that you have supplied it without charge. This letter is to let you know how much I appreciate your sending it along so promptly. Such responsible servicing is unusual nowadays, and all the more satisfying when encountered. With Sincere Thanks."

W.N.J., New York

***

"I am sincerely at a loss for words in thanking you for the work and parts put into my Garrard changer #98 (purchased three years ago) sent in for examination. You have just inherited a living, breathing, walking testimonial and goodwill ambassador...for life."

E.J.B., Chicago

***

"Please accept my belated, but most sincere thanks for sending me a replacement for my speed control on my Garrard RC-98. This was a most unexpected pleasure. It shows that when one buys the best that one also gets better than best service. The Garrard player now works perfectly, thanks to you...and I love it."

K.F.B., Severna Pk., Md.

***

The Sounding Board

The Sounding Board

*"I have received and installed the Garrard **RC-80** motor and wish to report that it is in fine working condition. It is very rare nowadays that one finds a company such as yours that is willing to stand behind their product to the extent that you have and when one does, I must express sincere appreciation. When my friends discuss high fidelity equipment and the various components, I shall remember the fine treatment and personal service that the Garrard Sales Corporation has given me. Thanks again, not only for a fine product but for an equally fine company."*

R.D.E., Ann Arbor, Mich.

***

"It is a pleasure to do business with a firm such as yours that is ready to stand back of any service needs, and we would certainly recommend Garrard to anyone assembling their own record playing equipment."

W.E.C., Oak Park, Ill.

***

"Your organization is to be highly complimented for the manner in which you handled my problem, and you can rest assured Garrard products are tops as far as I am concerned and in my discussions with hi-fi users."

F.P., Anderson, Ind.

***

"...The RC-80 turntable you shipped out to me is almost as true as a transcription table....Before closing may I add that you, your service and Garrard will always remain high in my estimation. Thanking you again."

A.S., Brooklyn, N. Y.

***

"We wish to express our appreciation of the prompt and very satisfactory service given to us by Garrard in repairing and returning our record player."

H.L.H., Camp Hill, Pa.

***

"This letter is in regard to all of our correspondence. I should like to express my appreciation for the service which you gave me and your cooperation in this matter. It has been a pleasure doing business with your company."

F.A.O., Galesburg, Ill.

***

"...May I thank you again for your personal attention to this matter and for your extra kindness in invoicing the material rather than holding up delivery to me."

C.W., Brooklyn, N.Y.

***

"...I should like you to know that I am grateful to you for your kindness. When the opportunity arises you may be assured that I shall always have a praiseworthy word to say on behalf of GARRARD."

R.S.V., Brockville, Ontario

***

"...I am very happy with your handling of this matter, and I shall not hesitate to recommend your company to any of my friends who want a reliable concern."

D.H., Yoder, Ind.

***

"...I wish to express my sincere appreciation for your kind and prompt response in my behalf. Your effort to maintain good customer relationship will certainly be made known to all of my many audiophile friends."

V.R.M., San Rafael, Calif.

***

"I am completely satisfied as to your handling of this matter. Just last week (as a result of my own treatment) I persuaded a fellow officer to purchase your RC-98. I plan a similar purchase in June. I remain 'a hearty endorser of GARRARD'."

Lt. W.B.R., APO, New York, N. Y.

It may interest you to know that almost all of the units referred to in the letters are three or more years old. As a matter of fact, the Garrard Service Department often handles models that have seen as much as two decades of play. For example, the aristocratic RC30's and RC65's of the 78 rpm days, still in daily use, are brought in for checkups and adjustment from time to time. Convenient service and replacement of parts is, of course, the guarantee of continued satisfaction with any fine mechanism, and Garrard record players hold their pre-eminent position through the finest service facilities and spare parts stocks in the high fidelity industry... the facilities of British Industries Corporation.

For your free
Garrard Comparator Guide

Address Dept. GG 19

GARRARD SALES CORPORATION,
Port Washington, N. Y.

JULY, 1959 VOL. 43, No. 7

Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO: Convenience and flexibility are offered by the cabinet arrangement in an installation by Kierulff Sound Corporation, Los Angeles. The three Bryson cabinet sections may be rearranged as desired. As shown, the first section houses the loudspeaker system; second section houses amplifier, tuner, and records; third section accommodates Garrard changer and more records. This installation is in the home of Mr. and Mrs. Steve Kuseley.

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S. Possessions, Canada and Mexico, $4.00 for one year, $7.00 for two years, all other countries, $5.00 per year. Single copies 50¢. Printed in U.S.A. at Lancaster, Pa. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the act of March 3, 1879.

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AUDIOCLINIC??

JOSEPH GIOVANELLI*

For Your Information Again

Earlier readers of AUDIOCLINIC have read these words before. Because of our many new readers, however, a restatement of these ideas seems in order.

It is the policy of AUDIOCLINIC that all letters to this column should receive individual answers regardless of the suitability of the material for inclusion in the column itself. Because of the increasing volume of this correspondence, a quick response is not always possible. Please be patient; an answer will come unless, as sometimes happens, no reply is possible because of incorrect address, handwriting which cannot be read, and so on.

Enclosure of a stamped, self-addressed envelope will facilitate answering. Please address all mail directly to the writer at the address below instead of to AUDIO.

The following questions were submitted by Mr. D. M. Anglin, Seattle, Washington.

Amplifier Ground Systems

Q. *For stereo I wish to construct two identical power amplifiers on one chassis. I use a bus bar for the ground lead in all units I build, and ground it on the chassis at one point only. If I use one bus bar as a common ground for both units, would that be a hum hazard when this one-point chassis ground is used? Would it be better to use a bus bar for each unit and ground them both at one common chassis point?*

A. In regard to the use of bus bars, I recommend that you use two separate ground systems—one for each stereo unit. As a matter of fact, you can do a cleaner job by not using a bus bar system at all. It would be advisable to ground the wire to one point on the chassis, but rather than run it in the form of a bus, use insulated wire and run it along the chassis. Ground points may then be brought from this wire and connected to insulated tie lugs—which, in turn, can be mounted in the proper location with respect to the circuit elements.

Automatic Loudness Control

Q. *Would an automatic loudness control be of value in either a stereophonic or a monophonic system?*

A. I do not recommend automatic loudness controls. At a live concert, the listener has no means of automatic loudness compensation with changes in musical dynamics. Therefore, when such a device is introduced into a home music system, the results are artificial. This is true regardless of whether the material being listened to is monophonic or stereophonic.

Ganged Potentiometers

Q. *Can a ganged volume control be used successfully with a preamplifier whose balance is adjusted by means of the power amplifier's volume controls? May the bass and treble controls be ganged or should they be separate? Is there really so much difference in the bass and treble channels that a ganged control will fail to adjust it?*

A. Commercially available ganged controls rarely track properly. This means that the change of resistance in one section of ganged potentiometer with a given amount of shaft rotation will not be equal to the change of resistance of the other section of the potentiometer with the same amount of rotation. This holds for volume as well as tone-control circuits. It is the reason why Marantz and others have resorted to the use of ganged step switches in their equipment. Ampex uses potentiometers fitted with taps from which resistors are shunted to ground. These cause the potentiometer to track more uniformly. Therefore, if you wish to gang your tone controls, bear in mind that some compensation for tracking error may be required.

An added disadvantage of ganged volume controls stems from an inability to balance the two stereo channels with each other. A balance which is correct for one stereo tape or disc may not be correct for the next one played. I therefore recommend the use of either separate volume controls or a special balance control. An interesting balance circuit can be found in AUDIOCLINIC for June, 1959.

45-45 Stereo

Q. *Since the vertical channel seems to have less frequency response than does the horizontal channel, I am using my 12-inch speaker and a tweeter for that channel and my 15-inch woofer and a tweeter for the other. Will I be able to get some sort of match with that combination?*

A. Stereo discs are recorded with each channel 45 degrees from a horizontal line or, to put it another way, at 45 degrees from a vertical line. Therefore, each channel is identical, rather than one being vertically oriented and the other horizontally oriented. Since the two channels are identical, their frequency responses are identical. For this reason, you need no more frequency correction for one channel than you do for the other. Hence, your speakers should be matched as closely as possible. Your tone controls should be set to the same equalization point. The degree to which the sound in each channel can be matched depends partly upon the similarity of the speakers. For instance, when the two speakers are manufactured by the same firm there is often a family resemblance in their sound qualities regardless of their variation of operating parameters. When the speakers are dissimilar, sometimes a fair match may be achieved by varying the equalization of one channel or the other.

3-Pin Stereo Cartridge

Q. *Would a two-conductor shielded cable be useful when used with a 3-pin stereo cartridge?*

A. When using stereo cartridges employing three terminals, it is common practice to employ two-conductor shielded

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

"Nothing Short of Superb,"

says Raymond E. Ward, Distributor-Sales Mgr., Shure Brothers, Inc.

"That's our unanimous verdict on the results we have had with the Garrards used for laboratory testing of our new Stereo Dynetic Cartridges. Because we can rely on Garrard's precision construction and consistently accurate performance, we have been able to concentrate fully on developing the exceptional sound reproduction Garrard and Shure users expect...and get. Now, our sales records show that more of our new cartridges are being installed in Garrard Record Changers than in any other changer or turntable. This is only natural, because they work so well together."

SHURE STEREO Dynetic Cartridge in GARRARD SHELL

"Complaints from Garrard Users? Practically Zero!"

says Joseph Pickert, Mgr., Service Dept., Shure Brothers, Inc.

"That's right! Garrard owners who install the new Shure Stereo Dynetic Cartridge get such perfect sound reproduction that we rarely get a complaint. The exact fit of the cartridge in the Garrard shell, the precision mounting of the tone arm, the controlled arm action and tracking at the lightest specified weight mean longer life for cartridge and records...along with the finest audio for stereo and monaural."

"Garrard changers are eminently superior with SHURE stereo cartridges"

What Mr. Ward and Mr. Pickert say about the Garrard Changer—for stereo—is typical of its universal acceptance by component manufacturers and high fidelity enthusiasts.
In fact, more Garrard *Changers* are sold today as components for stereo—than all other turntables and changers combined! That's why—before you buy—you should see and hear stereo records played on a Garrard Changer such as the incomparable RC88.

The same reasons why Garrard Changers perform so well with Shure Dynetic Stereo Cartridges account for Garrard's popularity with all other manufacturers of fine stereo cartridges—Electro-Voice, Fairchild, General Electric, Pickering, etc.

- Vibration-free turntable.
- Vertical and lateral rumble completely inaudible. Wow and flutter far below exacting "broadcast tolerance" standards.
- Exclusive Aluminum tone arm precision-mounted at engineering works for optimum tracking angle, perfect sound reproduction.
- Unrestricted choice of stereo cartridges—any of them will track at the manufacturer's lightest specified weight.
- Record handling gentler than the surest human hand.
- The important convenience of manual play plus completely automatic operation without compromise in performance.

These are the FACTS, no one can deny them with authority—and they are backed by the 36 years of experience that have created Garrard's unique reputation for unsurpassed quality.

For the best in Stereo... Insist on a

Garrard CHANGER

THE WORLD'S FINEST!

Send for free Garrard Comparator Guide.

Your Name_____

Address_____

City_____ State_____

Mail to Dept. **GG-19** *at address below.*

B.S.I. ENDORSED QUALITY

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

GARRARD SALES CORPORATION, Division of British Industries Corporation, PORT WASHINGTON, N. Y.

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cable with the shield serving as ground for both channels. It would be better, however, to use three-conductor shielded wire with one of the conductors serving as ground for both channels with the shield grounded only at one preamplifier input. However, if this cable is too thick, the freedom of the tone arm to move will be impaired with a consequent increase in distortion and possible damage to discs.

About Transformers

Q. 1. *In power transformer specifications, does the phrase, "50 volts CT" mean 50 volts across the outside connections of that particular winding and 25 volts from centertap to either of the outside windings?*

2. *When the impedance of the primary of a coupling transformer is 100 ohms CT, does this mean 100 ohms across the complete winding or 100 ohms on either side of the centertap?*

3. *What is meant by the term given in coupling transformer specifications: "maximum unbalanced d.c. ma in the primary?" F. C. F., Aberdeen, Md.*

A. 1. When a power transformer is rated as being 50 volts centertapped, it means that this transformer gives 25 v. each side of center, and the full 50 volts appear across the winding.

2. The same situation holds for the primary impedance of a coupling transformer. If this impedance is 100 ohms centertapped, 25 ohms will appear between each end of the winding and its centertap. You might at first suspect that this impedance is 50 ohms each side of center, but this is not the case, because the impedance is equal to the square of the turns. This means that when the number of turns is doubled (which is the case of the complete winding in relation to one end of it and the centertap) the impedance goes up by a factor of 4.

3. The unbalanced current in the primary or secondary of a coupling transformer refers to the maximum d.c. which is passed through the winding of a single-ended circuit without saturating the iron core magnetically. The balanced current is always higher than the unbalanced current because the current in a push-pull circuit is oppositely polarized in each half of the winding. This cancels the magnetizing force to a considerable extent, allowing a higher current to be passed through the transformer winding without undesirable saturation.

Erratum

The March, 1959 installment of this column contains a discussion of loudspeaker efficiency in which it is stated that the efficiency of any device is equal to the power fed into it divided by its power yield. One of our readers pointed out that this word formula should read the other way around: Efficiency is equal to the power yield of a device divided by the power fed into it. He's quite correct, and we thank him for his observation. If there are others among you who wish to comment —good or bad—we will be sincerely interested in hearing from you. *J.G.* Æ

NEW LITERATURE

• **Jensen Manufacturing Company,** 6601 S. Laramie Ave., Chicago 38, Ill., will mail Brochure KK, an illustrated sheet covering the new DF-1 Duette speaker system, without cost or obligation. This latest Duette model is an economically priced full two-way system featuring wide frequency range with clean bass response down to 36 cps. It is well illustrated and thoroughly described in the brochure. **G-1**

• **Unimax Switch Division,** The W. L. Maxson Corporation, Ives Road, Wallingford, Conn., introduces an extensive line of subminiature switches which meet Military Specifications for a wide variety of rigorous services in Catalog No. 159. Convenient pictorial index shows where to find dimensional drawings, descriptions, force and movement specification tables, and electrical ratings for each Unimax switch listed. Data on bases, terminals, circuit arrangements and NEMA standard definitions of sensitive switch terms are also included. Requests for copies should be directed to the attention of Mr. J. Martinez. **G-2**

• **Atlas Sound Corporation,** 1449 39th St., Brooklyn 18, N. Y., illustrates and describes its complete line of commercial sound equipment in a 16-page two-color catalog which is now available. The catalog also commemorates the company's twenty-fifth anniversary as an industry leader in its field. Included in the publication are explanatory technical diagrams and full specifications on all Atlas loudspeakers, transformers, driver units, and speaker and microphone mounting accessories. Among new models introduced for the first time this year is a Decor speaker for attractive interior installation. Catalog No. 559 may be obtained without cost by writing to the address shown above. **G-3**

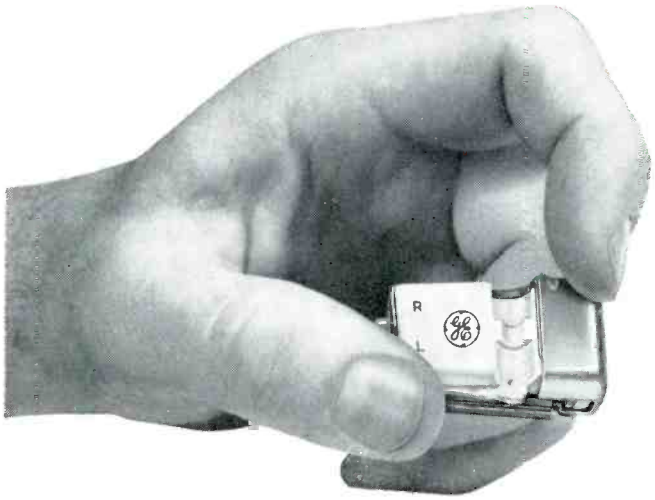
• **Lipps, Inc.,** a division of Lipps Engineering, 1513 Colorado Ave., Santa Monica, Calif., announces the publication and availability of a 4-page brochure describing a new replacement and repair service now available to owners and users of Ampex professional and instrumentation recording equipment. Requests for copies should specify Bulletin AM-22. **G-4**

• **Electro-Voice, Inc.,** Buchanan, Mich., is now releasing Bulletin 258A, a new sales folder describing the E-V line of public-address equipment. This publication gives full information on compound diffraction projectors, paging units, outdoor speaker systems, accessories, and microphones. A copy of Bulletin 258A will be mailed upon written request. **G-5**

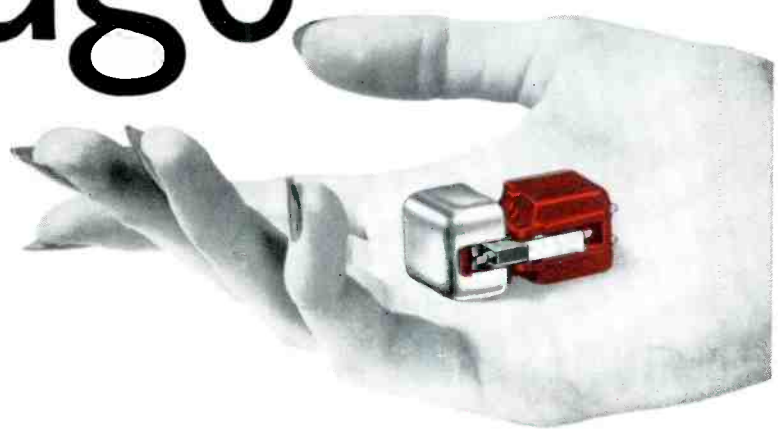
• **Telectrosonic Corporation,** 35-16 37th St., Long Island City 1, N.Y., describes and illustrates its new line of tape recorders in a 12-page consumer brochure which has just been published. The booklet is divided into two sections, the first of which is devoted to the enjoyment and advantages found in tape recording. Section Two is concerned with the five consumer models now made by Telectro. The brochure is amply illustrated with photographs and descriptive line drawings showing the units and the operation of their various features. Available free upon written request. **G-6**

• **The Tape Recorder Club,** 73 Grand Parade, Harringway, London, N.4, England, has published the latest issue of its Club Bulletin. A large number of the Club's members are "very keen to make contact with American tape recorder owners," and with this thought in mind D. V. Lane, Principal, has asked that we bring the matter to the attention of our readers. Letters of inquiry should be addressed to Mr. Lane at the address shown above.

the all-new VR-22 stereo cartridge



VR-225 .5 mil diamond stylus. For professional-type tone arms, **$27.95.**



VR-227 .7 mil diamond stylus. For record changer or turntable, **$24.95.**

Now, outstanding in all four critical areas of stereo cartridge performance—Compliance—Tracks precisely, not a trace of stiffness. Channel Separation—Up to 30 db for maximum stereo effect. Nothing higher on the market! Response—Smooth and flat for superior sound from 20 to 20,000 cycles (VR-225), 20 to 17,000 cycles (VR-227). Virtually hum-free—triple shielded against stray currents. This is our masterpiece. We urge you to hear it.

GENERAL ELECTRIC

Audio Components Section, Auburn, N. Y.

LETTERS

Stereo Thoughts and Queries

SIR:

Herewith a few long-repressed notes on a variety of topics, mostly stereophonic.

1. I won't buy compatibility with AM-FM stereo as an argument for left-right FM stereo because I won't buy AM-FM stereo at all. If one of your earlier letter writers has problems, as mentioned in last December's issue, I have several. Of an even dozen "good music" or educational FM stations I listen to with fair regularity, no less than five schedule AM-FM stereo. Not one of the corresponding AM stations is receivable with usable quality on good equipment in this area. Pure frustration.

2. WJBR in Wilmington, Del., carried experimental Crosby-system stereo for several months. I have heard them regularly for about two months on a home-grown adapter (courtesy of a couple of your articles). Quality, both monophonically and stereophonically, has been excellent.

3. Some time ago, WASH in Washington, D. C., began experimental multiplex stereo broadcasts, with the right channel on 67 kc. They have also done AM-FM of the same programming with WDON (AM) of Wheaton, Md., which I can't receive. The broadband adapter gets only noise for them yet, but appropriate modifications are planned.

4. On the basis of lots of forced listening to only one side of stereo transmissions, I must admit that to this one set of ears one-channel-only does not sound bad. However, where both have been available, the mixture of the two channels has been found far preferable to either one alone for monophonic listening.

5. I have some slight qualms about the action of the "Dimension" control on the Crosby-system adapters. $S \pm D$ undoubtedly gives $2L + 2R$, and $S \pm \frac{1}{2}D$ would appear to give $1\frac{1}{2}L \pm \frac{1}{2}R$ and $1\frac{1}{2}R + \frac{1}{2}L$, which would be expected to give "reduced separation," as would the use of a "blend" control. I'm not too clear on the effect of adding too much difference channel, i.e., $S \pm 2D$ to give $3L - R$ and $3R - L$. (*See page 22, however.* ED.) Without taking a stand on the mechanism of stereo orientation, it would seem that information corresponding to increased mike spacing would be missing. The relative intensities of various voices in the two channels are the same for $S + 2D$ as for $S + \frac{1}{2}D$, (3 to 1), but with a phase reversal of the off-channel component. The simple phase reversal is not equivalent to the complex frequency-dependent phase shifts that would result from increasing mike spacing. There might be some sense of increased *speaker* separation due to essentially out-of-phase signals, a partial case of the last word in augmented separation schemes, deliberately throwing the speakers out of phase. One expert, (ETC, November, 1958) has branded this approach as musically false. Also, it would seem that in-phase components in the $L + R$ channels would be partially cancelled, tending to cause a loss of low-frequency content. Am I missing a point?

6. Along the same line, what happens when a signal from a stereo cartridge connected out of phase to allow use of a "Two-Way Stereophonic Amplifier" (October, 1958) is fed into a control unit with "blend" control? (Guess you don't have to use it.) (Or an argument for four-pin cartridges—flexibility at the expense of simplicity.)

7. When taping multiplex signals off the air, it pays to be sure the subcarrier gets well-filtered out before the end of the recording amplifier. If treble pre-emphasis doesn't cause overloading, the subcarrier may probably beat with the bias frequency.

J. DAVID DYKSTRA,
677 Plater St.,
Aberdeen, Md.

(Mr. Dykstra's letter indicates that he does some serious thinking on this subject. Perhaps some other equally or ± serious thinker can exchange ideas with him—preferably through this column for the edification of all our readers. Actually, the reason for the engineering tests of the various stereo broadcasting systems is to determine how they work out in practice, which is not always in accordance with how they work on paper. We are interested in other comments on the various stereo broadcasting systems. ED.)

We Never Expected This

SIR:

My husband renewed his subscription for two years through your representative at the Los Angeles High Fidelity Show in February.

May I take this opportunity to express our enjoyment of your excellent magazine? Yes—I, too, enjoy AUDIO though I am not a member of the engineering profession. I find it helps me understand the many projects my husband undertakes with his audio equipment. Your magazine has been of truly inestimable value to him.

JANE M. HALL,
(Mrs. Donald Q. Hall)
438 S. Falson St.,
Anaheim, California

(Gentlemen: We submit that this is the kind of a wife a man should have—one who will read a technical magazine so she can understand her husband's hobby better. We take our hat off to her. ED.)

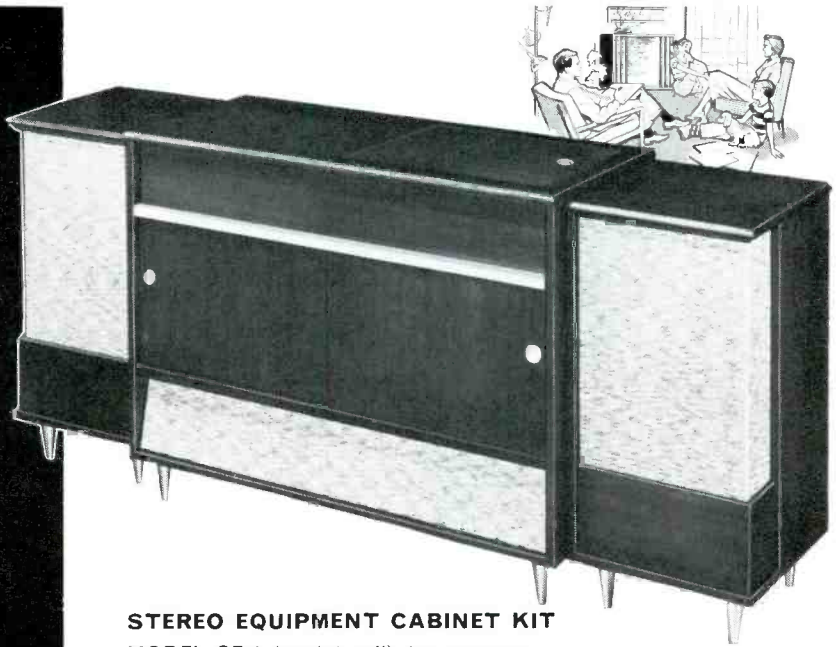
"Isn't it wonderful! Sounds just like our hi-fi set".

Easy-to-build

HEATHKIT

- style
- performance
- quality

costs you less!



STEREO EQUIPMENT CABINET KIT

MODEL SE-1 (center unit) **$149.95**
Shpg. Wt. 162 lbs.

MODEL SC-1 (speaker enclosure) **$39.95** each
Shpg. Wt. 42 lbs.

Superbly designed cabinetry to house your complete stereo system. Delivered with pre-cut panels to fit Heathkit AM-FM tuner (PT-1), stereo preamplifier (SP-1 & 2) and record changer (RP-3). Blank panels also supplied to cut out for any other equipment you may now own. Adequate space also provided for tape deck, speakers, record storage and amplifiers. Speaker wings will hold Heathkit SS-2 or other speaker units of similar size. Available in unfinished birch or mahogany plywood.

MONAURAL-STEREO PREAMPLIFIER KIT (Two Channel Mixer)

MODEL SP-2 (stereo) **$56.95** Shpg. Wt. 15 lbs.
MODEL SP-1 (monaural) **$37.95** Shpg. Wt. 13 lbs.
MODEL C-SP-1 (converts SP-1 to SP-2) **$21.95** Shpg Wt. 5 lbs.

Special "building block" design allows you to purchase instrument in monaural version and add stereo or second channel later if desired. The SP-1 monaural preamplifier features six separate inputs with 4 input level controls. A function selector switch on the SP-2 provides two channel mixing. A 20' remote balance control is provided.

World's largest manufacturer of electronic instruments in kit form

HEATH COMPANY
Benton Harbor, 25, Michigan

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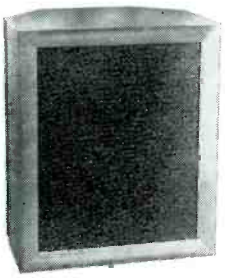

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Edward Tatnall Canby

1. QUARTER-TRACK

I'm still waiting. Waiting, that is, for the RCA Victor tape cartridge, a year old and not yet born. Here it is the first anniversary of my enthusiastic article on the subject and it might seem, as of now, that my direct alternative guess had come true —"the RCA cartridge will pop onto the market—in the middle of a sea of stereo discs—fizzle awhile and die with a wet plop."

It didn't even get to fizzle; it hasn't had the opportunity. "Maybe its coming was timed unfortunately," I continued, and was I right. It was timed so that if the stereo disc succeeded, it wouldn't have a chance.

Last I heard, RCA was going to make a big pronouncement on the cartridge during May. Not a peep yet and May is departed. Before that, it was to be out for the Xmas rush, 1958. It wasn't. But, as mentioned before, the spark of life is still aglow; RCA engineers have been actively demonstrating their cartridge right through this spring in various hi-fi clubs, engineering gatherings, and the like.

Nope, I don't expect the RCA cartridge is dead yet, in spite of the 100 per cent official silence, up to this writing. And I still think it's good. Having read over my remarks of last July (AUDIO ETC) I find them still convincing and don't feel inclined to take back a single word of the basic argument.

Moreover, though the cartridge itself is incommunicado these days, the technical development in tape recording that made it possible is very much alive—the quarter-track tape system, as it is now called.

Things aren't standing still at all in quarter-track. Indeed, RCA aside, the developments have been quite fast and furious. To begin with, most of the 1959 home tape recorders came out with provision included for playing quarter-track tapes, and for recording the same, mono or even in stereo. Though RCA got the cold shoulder, the quarter-track system itself didn't. Quarter-track recorded stereo tapes are out, too, on ordinary reels.

The smaller quarter-track heads—the main technical revolution involved—are being used dual-purpose, to play the older half-track tapes as well as their own kind, via mechanical adjustments that are relatively clumsy but, for the time being, effective enough. In some situations, the opposite is being promoted, i.e. the playing of quarter-track recordings by existing half-track heads—a poor idea since a half-track head scans too much blank tape and thereby produces an uncomfortable quantity of background hiss. (This from a helpful correspondent who tried it. He also says that one track plays at a lower level than the other, making for more hiss in the balancing.) Anyhow—the quarter-track system has invaded the home machine field in force and it's there to stay.

We've only seen the beginning. I feel now, as I did a year ago, that we are in for another complete revolution here and I suspect that in a few years quarter-track tape will entirely replace half-track for home use, whether in an automatic magazine or on plain old fashioned reels or, perchance in some other arrangement still to be launched.

Our present standard half-track tape, along with its counterpart in two-track stereo, will gradually become less and less "standard", more and more secondary, like the 78 record and the 3-mil stylus. We'll have both systems for quite awhile, and maybe both magazine and plain reels in one machine, later on—but the quarter-track equipment will gradually take over until, one fine day, there'll be a rash of new home tape recorders that won't even play half-track tapes at all. Not too far off.

I'm about to acquire a quarter-track home recorder for experiment and expect to report on it, for whatever interest it may prove to have, later in the year. Meanwhile, though, I'm off on a prophesying binge—and I haven't even used a quarter-track machine. But the signs and circumstances are multiplying and I don't need to wait, in order to see fundamental sense in the new quarter-track standard, whether it is via magazines or the thread-it-by-hand system.

First, it obviously was not a public failure that held up the RCA quarter-track stereo tape cartridge. The public never got to try it, and few have ever heard it. A few hi-fi demonstrations, here and there, are hardly going to make or break such a development. Clearly, something didn't pan out as anticipated, and the only thing that matters, as I see it, is that the change in RCA plans should *not* be construed as affecting quarter-track tape's value, generally. Far from it.

Maybe RCA did hope to get its stereo cartridge in ahead of the then-doubtful stereo disc and so decided to launch the two at once in 1958 (the press got it in June, 1958), to cover any eventuality. Maybe the tape machine makers did put a crimp in the big plan by refusing to a man to rush forth with magazine tape players for 1959 (i.e., autumn, 1958). They declined (though they had the RCA specs back in January of 1958) and instead came out with the quarter-track heads, minus the magazine. It hardly seems as if this is what RCA had hoped for, to put it mildly. In any case, all this is now water under the bridge, tape past the capstan, and the tape cartridge, as of this writing, enters its second year in the deep freeze. It can still be of immense importance, just the same, and with quarter-track itself gaining ground, RCA's position is improving day by day.

Now howcome I'm so positive about all this? I bared a good deal of my thinking on the new system last July (look up your back copy) but it seems a proper time now, in the interim present, to point out again why quarter-track remains a good bet.

The biggest reason is simply that it represents a basic improvement in tape quality—that is, in quality relative to the amount of tape used. In this sense, quality has been virtually doubled, and doubled again, via the jump from two tracks to four along with the reduction of tape speed to 3¾ ips from 7½. This change relates to the similar change that occurred about five years ago with Ampex's narrow-gap heads.

Yes, I know that right now there's a big storm going on over the merits of 7½ vs. 3¾ ips in quarter track, but I'll wait until later for my own decision on that—the subject is still too half-baked. I'm more interested in the longer-range implications of quarter track, both as to width of track and speed.

Upward Revamping

What this amounts to, then, is another revamping upward in the whole tape hierarchy of speeds and qualities, a sort of slipping of a cog in the basic ratio, towards better performance. I don't need to bother with the technical details except to mention the ultra-narrow-gap quarter-track head that is the prime ingredient. (Better tape, better transport mechanisms, more know-how in the mechanical configurations of tape heads, are other factors that come to mind.)

In effect, the basic quality of the older 7½-ips home tape now is available at half the speed and on double the tracks. Maybe it isn't quite equal, yet—and the groans of many a hobbyist are to be heard throughout the land. But the solid work is already accomplished and a good deal of quarter-track sound is already equal to the run of half-track tape sound during the last few years.

Remember that when tape first came out for the home around 1948, the practical limit for the upper frequencies on 7½-ips tape was generally at from 7000 to 8000 cps. We all know how indefinite such terminology can be; but we all can remember, too, if we're old enough, the muffled sound of those first home 7½-ips tapes. Even the original Magnecorder, a pioneer home instrument though designed for professional use, didn't bother to claim much more than the usual 8000 cps top for its seven-and-a-half speed.

Then came Ampex's narrower gap, with the 400 and later the 600 line, and all at once we had sound at 7½-ips that was very nearly equivalent to that at 15, the professional standard. For the last few years, the speeds have been realigning themselves on this newer basis. In the home, 7½ ips is the high-quality, wide-range tape speed and 3¾ ips is the economy, not-so-hi-fi speed, taking the old 8000-cps limit over for itself. The original 3¾ speed, which I remember as unbearably muddy in the early days (and unsteady, too) with a top of around 4000 cps at best, is now the secondary speed that to all intents and purposes equals the original 7½. At the bottom, the lowly 1⅞ ips is the minimum-practicality, "voice frequency" speed.

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And now—quarter-track and another jump. Just as 7½ was hiked up to approximate the hi-fi sound of fifteen-inch professional tape, so 3¾ is now hiked up to approximate the new-standard hi-fi 7½. As far as I can judge, the jump is just as extensive as that earlier jump.

The bugs aren't gone yet by any means and quarter-track perhaps isn't yet as reliable as standard 7½. The background noise may sometimes be too high, the distortion level not as satisfactory, the frequency range a bit restricted, the alignment not always solid and sure. (Cross-talk is generally not a problem, since it occurs mostly in the heads themselves and quarter-track heads are spaced further apart—by one intervening track—than standard half-track heads.) These are all problems-of-the-moment. They've existed before. They'll be ironed out—they have been ironed out already in many new machines

Newer and Better

In the long run, then, what with constant improvement, there's every reason to suppose that quarter-track 3¾ ips sound may soon generally equal present standard half-track 7½ sound, right down the line. I can't see how it will be otherwise. There are inherent disadvantages to slower speeds and narrower tracks, but we must prove that they are insurmountable in practice before we condemn the new system as unworkable. I don't think they are.

Indeed, one of the most persuasive arguments in favor of quarter-track tape was suggested to me by the maker of some of the new quarter-track recorded stereo tapes and confirmed by an AUDIO correspondent who had bought one to try and had heard it played via Ampex quarter-track equipment. *"The quality seemed to me to be just as high as the best of the conventional stereo tapes, and a good deal higher than some I have heard—and own! The tape hiss is very low . . ."*, he writes, and there you have it in a nutshell. As the tape's producer puts it, the best argument of all in favor of quarter-track is simply *that it is new*.

The very factor of newness tends to put it ahead of older half-track sound, in spite of theoretical disadvantages. Newer, in these fast-moving days, means more advanced, even in the face of seemingly huge problems. It happens all the time. Engineering ingenuity being what it is, disadvantageous products one after the other tend to end up even better than their more favorable predecessors.

It happened with the LP, whose difficulties were so overwhelming back in 1948 that many engineers proved to themselves and all who would listen that it was unworkable and inferior. It was—just as they said. But it also had enormous potential advantages, notably in its musical and sales aspects, and its faults were soon overcome to the point where *in practice* it was far superior to the old 78. So, too, with the stereo disc, already. It isn't technically superior yet, but the much-groaned-over complexities of last fall already seem years back, and the best stereo discs are now pretty much equal to the best monos even though ideally the mono record is still the simpler, better product. Mind you, the 78-rpm disc (particularly microgroove) is still ideally better than any LP, in its basic potentialities. Practically, it's a very dead duck.

The stereo cartridge is perhaps a classic example. With four terminals instead of two, a double element, single stylus, a two-way response instead of one-dimensional, it presented appalling complications as compared to the relatively simple mono cartridge. Inherently, the stereo cartridge is a lulu of a problem; inherently, the mono cartridge is "better" by far. Yet already, in actual practice, our best stereo cartridges are as good as the best monos of a few years back—perhaps better. Inevitably, the stereo cartridge will end up well ahead.

So will quarter-track tape, for all its present faults and its inherent inferiorities. Just wait and see. It's bound to win even if RCA's tape magazine never gets launched at all. It'll win, first, because it is fundamentally "better", speed for speed, tape for tape, with sound quality to match standard two-track tape at a quarter the cost.

Secondly, it'll win because its inherent faults are inherently *reducible*—perfectible, if you wish. It'll get better and better; it *can* get better and better.

And thirdly, quarter-track tape brings all this and stereo too. It is the first tape development to equate stereo tape with stereo disc in terms of cost for the home. And it keeps the advantage of home recording, adds the new possibility of stereo recording as well.

We'll see. I may run into practical trouble when I myself get directly involved in quarter-track—who knows. I may curse and groan and wish I'd never tried it; but even a lot of trouble will leave me still convinced that this is the home tape system of the future. The bugs, when and if, are merely temporary, incidental, unimportant.

Let's hope I don't have to say that too often.

2. SUCCESS STORY

One of the headaches for us record collectors during the first seven or eight months of stereo disc was the obvious hassle going on within company after company as to what recorded material should be issued in stereo form, and when.

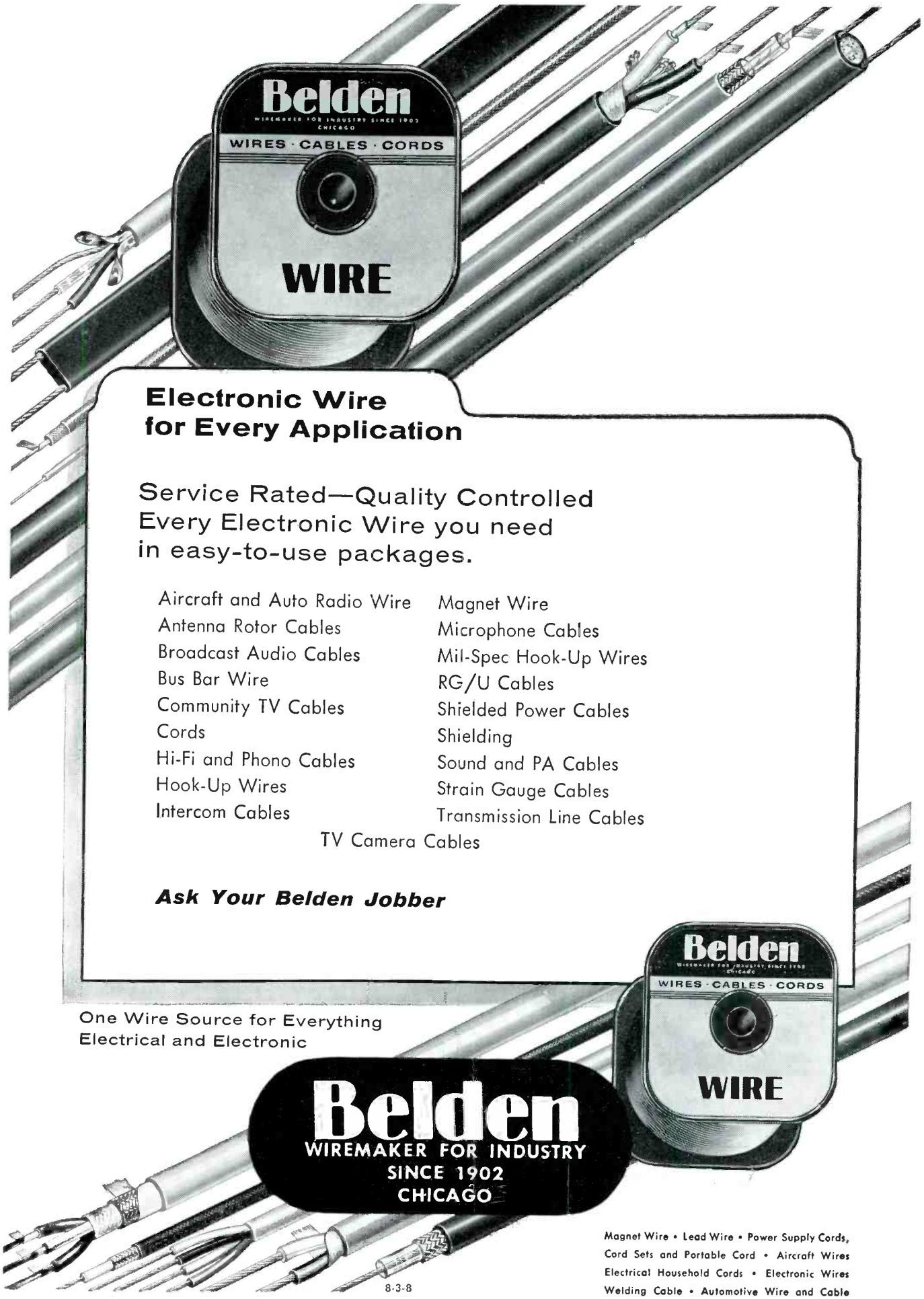
As everybody knows, there was a huge backlog of accumulated stereo material ready to go and virtually all new recording was being done both in stereo and mono form—to be sure. But how much stereo could be absorbed by the public, if released on disc? That was the BIG question.

And there were complications, too, in the fact that a large part of the backlog had been already issued in mono form (or on stereo tape) and thus was technically "old" stuff. How would the public take to these seeming re-issues of oldies, long familiar? And what was to be done about the brand new releases—would the stereo market take stereos one for one along with mono? Obviously not at the beginning. But when? And what should be done with the unreleased stereo versions that would keep piling up higher and higher, like surplus corn and wheat in the farm belt? More backlog with every day that passed.

Well, it was a matter for gray hairs. A few companies brashly jumped straight at the beginning into one-for-one dual releases—and surely lived to regret it, what with the sour stereo disc lemons that were squeezed painfully out of the presses during those first hectic months!

A few companies, London in particular and most notably, threw everything they had into a stereo-or-nothing policy, practically shelving the mono business right from the start. It could be managed—for awhile, at least, if stereo turned out a success.

But most record companies moseyed along with a variety of compromise policies, tinkering with every combination



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8-3-8

imaginable between the poles of no stereo and all-stereo. Only a few outfits dared come straight out with stereo-mono dual releases as a regular thing; the rest kept us wildly guessing—would there be a stereo version later on? Probably the company itself didn't know, hadn't decided; didn't want to decide—yet. If the market would bear it, maybe in a few months. . . And, 'tother way around, many a stereo disc spectacular was launched on its own, to see what might happen, with the mono version (if any) trailing far in the background, on a maybe basis.

All this time, mind you, and still as of this moment, there has been the continuing question, what shall we do with the earlier stereo master material, the big backlog? It has been coming out in driblets, or in small batches and, I'm forced to observe, the announcements haven't always been quite clear as to whether the stuff is new or "old." To tell the truth, it doesn't really matter, so long as the original tape was a good one and the disc is up to par too. Only the record reviewers tear their hair seriously about such matters. (Now, is this the one I reviewed in mono two years ago and said it stank? Or is it a new recording?)

It's only natural, I guess, for the genial sales people to cover their tracks a bit here, just in case, playing hocus pocus with numbers and cover art so you really can't tell the new releases from the re-releases. It does indicate a certain lack of confidence in the wary record buyer, who may decide that anything older than three months must be utterly unplayable. Just don't tell him, then, and he'll never know.

Yet the fact is that many of the older stereo master tapes stand up extremely well to later competition, even on a mere two tracks. They can pass for brand new, strictly on their own merits. But a much more important thought is simply that if the original mono versions are still available in the catalogue, then the stereo alternative should most certainly be there too—since it brings with it a decided musical improvement in the impact of the recording.

If you'll look at it in this light, I am sure you'll be delighted to rush out and buy up the stereo re-releases of as many of your favorite monos as appear in that form. A bargain! After all, most record buyers get to know their favorite items like familiar friends. Imagine being able to replace that Number One, top-rated war horse you bought years ago, the one you've played so many times it practically wheezes, with a brand new disc of the self-same performance, as familiar as ever, but now in stereo. Terrific.

I recommend this line of thought to the record companies' public relations people.

And with that thought I come to the item that started all this, the new policy at Capitol, which embodies all I have said in a highly satisfactory re-vamping of its former system of releases. Formerly, Capitol (and Angel too) released stereo and mono discs more or less separately, as the developing market seemed to allow. New stereo discs for each month were listed apart from new monos; you weren't always sure whether both versions were being released together even when in fact they were. All a part of the inevitable hocus pocus mentioned above, and what with a mono and a stereo release list, popular and classical (and some other categories too), for each of three labels every month, things were getting really pretty complicated. (Fortunately, the stereo tape releases of some of the same material slacked off as the discs increased.)

Now, Capitol puts all its "cards" straight on the printed page for all of us, each month. Every recording is listed with two columns of record numbers off to its left, headed *Monophonic* and *Stereophonic*—and the catalogue numbers, incidentally, are the same, as with RCA Victor and a few others. Better still, though, the notation *Previously Released* is put under the mono column when the stereo is a re-issue—and no shilly-shallying about it. Capitol has faith in its older recordings (and so do I).

If there is no stereo version, for one reason or another, the notation *none* is put down, plainly for all to see. After all, there's still a lot of top-notch mono material being issued.

I've just been through my own card catalogue and am gratified to find that a number of the April, 1959, Capitol stereo releases were out in mono form as far back as 1956. Some of the best records in the Capitol catalogue, at that.

Why, somebody may be asking me, don't you mention the other companies that do the same thing in their announcements? Vox, for example, or RCA Victor. Both of these companies have listed mono and stereo releases side by side for quite awhile.

Well, you see, it's significant to me that Capitol *didn't*—and now does. It indicates a very important development in Capitol's thinking and, by reflection, an even more important development in stereo disc itself, these last crucial months.

Stereo, my friends, is a success.

3. SENATORS ON LIMB

Seems even the *New York Times* agrees with me about the publicity barrage in the mail, as described here in the April issue. A nice little news article with the above title appeared recently. Utterly dead-pan, it described something called the Keating-Javits press-release machine (the two Senators from New York). This monster, "long feared and respected as the fiercest on Capitol Hill, finally stripped its gears today and began racing wildly ahead of the news." All it did was to announce that the President had nominated a certain judge "today" but, alas, the date was still a week off and the President hadn't done a thing about it yet.

Ah, how easily this can happen, as we all know, in a fast-moving press release system! But ordinarily one doesn't involve Ike in such matters, if one can manage not to. Won't do at all. Frantic inquiries at the White House produced only one of those "we have no knowledge" statements that (suggests The *Times*) mean the W.H. doesn't want to say anything for the moment. (I.e. until it figures out what went wrong.)

Things were presently untangled via a phone call from a "harried operator" of the Keating-Javits machine—which had gone all-out in praise of the judge-nominee. Yes, the man would indeed be nominated "early next week," said the White House, upon hearing this, but would the machine please hold onto itself until time caught up with it.

The Times didn't quite feel like stopping at this point and neither do I. It went on to say that "close observers of Keating-Javits press releases were stunned to find genuine news among them, but there was little surprise upon hearing that the machine had slipped its governors.

"Since Congress' opening in January it has been turning out releases by the ton. The volume and variety of its productions, out-stripping the most prolix other Senators' by 5-to-1, made it inevitable that overhauls would be needed by spring." End of *The Times* comment, with no further comment needed. Æ

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EDITOR'S REVIEW

TAPE TO THE FORE—AGAIN

SEVERAL YEARS AGO, magnetic tape was the only satisfactory means by which we could have stereo reproduction in our homes, and tape people—both those who made equipment and those who made recordings—prospered. Then came the stereo disc, and the tape industry went into a lean year. Fortunately this happened just about the same time that TV tape recording boomed so strongly, so at least some of the equipment manufacturers went merrily on. But the market for recorded tapes dropped badly, as we all know.

Now it is a well known fact that tapes at 7½ ips *can be* of better listening quality than LP records, but the investment required for playing them is certainly more than is needed for the less expensive discs. The dual-track monophonic tape *on a good tape machine* offered better quality than the average disc, but the cost of the tape was greater. Four-track tape at 3¾ ips has it all over discs for cost, but this observer, at least, has not heard any that were considered comparable from a quality standpoint to the LP. Four-track 7½ tape of today is easily comparable to two-track 7½ of two years ago, and better than single-track 7½ of six or eight years ago. Maybe—and that's as far as we will go—*maybe* four-track 3¾ will get up there, but the disc manufacturers are not going to stand still—they too will make improvements.

As we see it, it is likely that the four-track 7½ tape will end up as of slightly better quality than the disc—particularly for stereo—and the cost should be about the same, minute for minute. As a matter of fact, that is about the way the economics of the subject will force it to be. If the reproducing equipment is of the highest grade, the tape will undoubtedly be much superior.

But where does all this get us? Certainly a Rolls Royce gives a better ride, a more luxurious one, than any of the "lowest priced three," but does that mean that everyone is going to buy a Rolls? Not for a minute—not all of us can afford the difference even though we realize the advantages. Many others just don't think the extra cost is worth it for the results to be gained.

We don't think for a minute that a $75 tape player is going to compare with a $950 one—which is about the same percentage difference as between the automobiles mentioned. We believe that there will always be some who think that the extra expense *is* justified for the better quality just as there are those who prefer to be filled up on a six-dollar porterhouse instead of 85 cents worth of hamburger.

However, now that the tape industry has rolled with the punches, it has come up with a high-quality product—four-track 7½ recorded tapes—and a new division of Ampex Audio has been formed to distribute nationally the products of the many tape producers. This division—United Stereo Tapes—will put tapes back on the dealers' shelves, and tape will again become the leading medium for top quality of reproduction.

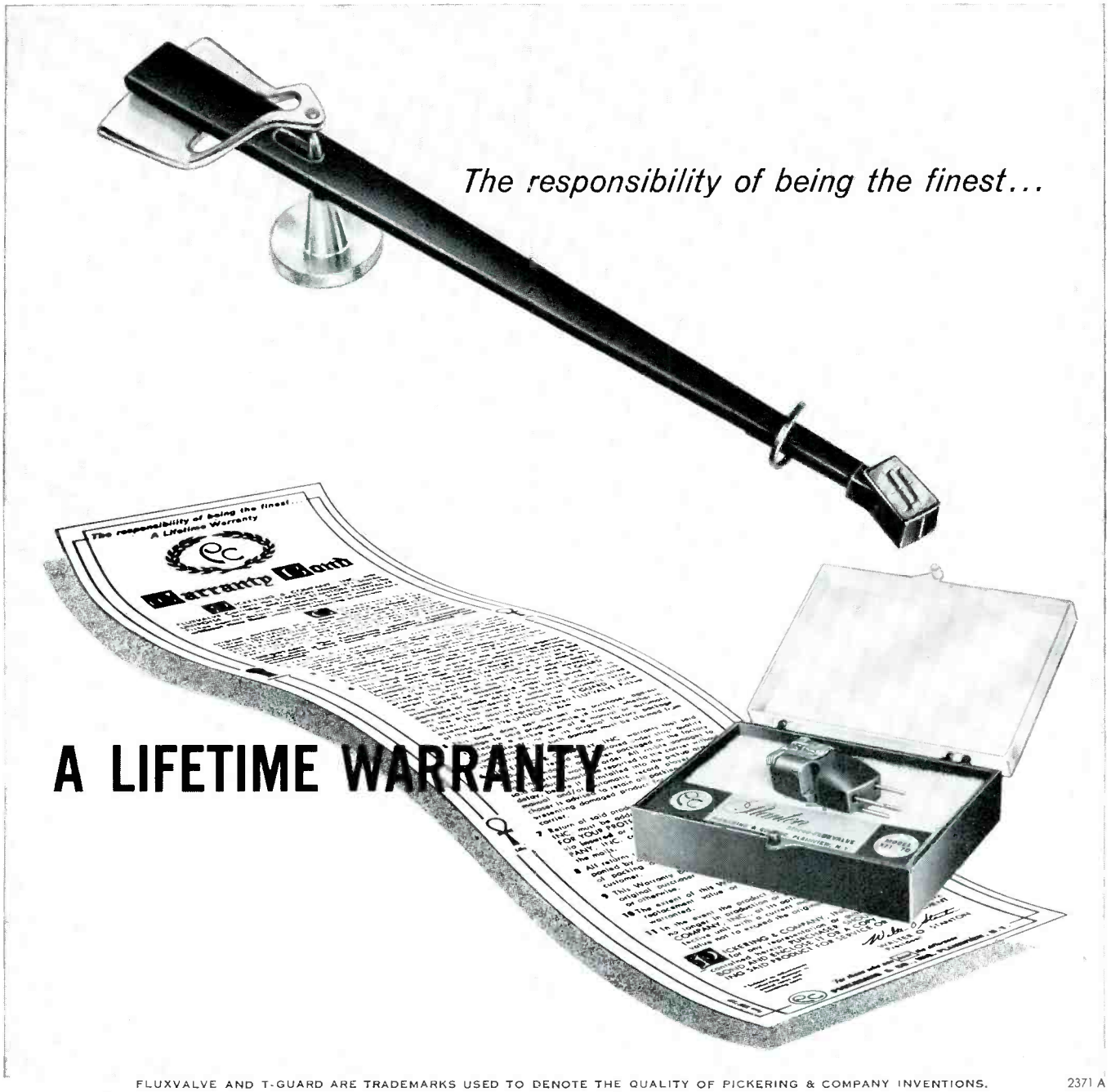
And just as a reminder of our interest in the best in sound reproduction, please note that we established a new section—THE TAPE GUIDE—beginning with the May issue this year. This section has for its principal aim the improvement of tape usage in the home, and any serious tape user will find something of interest in the GUIDE. And many will continue to offer their own experiences and suggestions for the help they may be to others—incidentally receiving some loot for their trouble, which same can be plowed back into more and better tape equipment in their own installations, or even in more recorded tapes.

We look forward to the tape industry's best year in the next twelve months.

JAZZ FROM KJAZ

Don't try to pronounce that—even though some New Yorkers try a phonetic pronounciation of WQXR, resulting in something like "kewkser." KJAZ is a radio station in the San Francisco Bay area that finally got tired of the conventional "top 40" programming common to today's AM station, local and network alike, and decided to devote itself to jazz. From noon to midnight every day, the schedule shows some real ingenuity—with such programs as "Jazz for Housewives" in the afternoon with a medley of jazz vocalists and low-pressure swinging; "Dinner Jazz," with "oh so polite, yet swinging" background to evening meals; "Jazz Conversations" with visiting artists; and even "Jazz Goes to Church," featuring spirituals and gospel songs. Pat Henry and Dave Larsen, the originators of this idea, are to be complimented on their brainchild. Maybe some other AM broadcasters will think up some innovations to set them apart from the usual programming—the kind where you can't tell what station you are listening to until they announce the call letters because they all sound alike.

We even miss the several hours of radio whodunits that the networks used to carry in the evening hours—we just aren't interested enough to stare at TV programs several hours a week.



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"PACKAGING" MICROWAVES FOR MOUNTAIN TOPS

"TJ" radio-relay station at Black Mesa, Arizona

In Arizona, the telephone company faced a problem. How could it supply more telephone service between Phoenix and Flagstaff—through 135 miles of difficult mountain territory?

Radio offered the economical answer: a new microwave radio-relay system recently created at Bell Telephone Laboratories. Operating at 11,000 megacycles, it was just right for the distance, and the number of conversations that had to be carried.

But first other problems had to be solved: how to house the complex electronic equipment; how to assemble and test it at hard-to-reach relay stations way up in the mountains; and how to do it economically.

On-the-spot telephone company engineers had some ideas. They worked them out with engineers at the American Telephone and Telegraph Company and at Bell Telephone Laboratories. The result: a packaged unit.

The electronic equipment was assembled in trailer-like containers at convenient locations and thoroughly checked out. The complete units were then trucked up the mountains and lifted into position.

The system, now operating, keeps a watch on itself. When equipment falters, a relay station switches in standby equipment, then calls for help over its own beam.

The new Phoenix-Flagstaff link illustrates again how Bell System engineers work together to improve telephone service. Back of their efforts is the constant development of new communications systems at Bell Telephone Laboratories.

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FM-Band Reception in Fringe-Areas

W. N. COFFEY

When the best antenna installation you can make is still not sufficient to bring in those distant FM stations, try this booster unit which is designed for low-noise amplification at signal frequency.

ARE YOU A CONSISTENT FM listener with cosmopolitan tastes? Do you draw on program material from a number of stations? If you are fortunate in living in or near a metropolitan area, you probably are satisfied in this respect. However, if you are located beyond the primary service area of many stations, and are limited to listening to just a few stations, this article will be of interest. In fact, this article is addressed specifically to the "fringe area" listener, the individual who lives, say, 100 miles or more from the nearest FM stations. The principal concern of this type of listener may be to improve the efficiency of his receiving equipment. Let us consider now what an effective fringe-area receiving station should include.

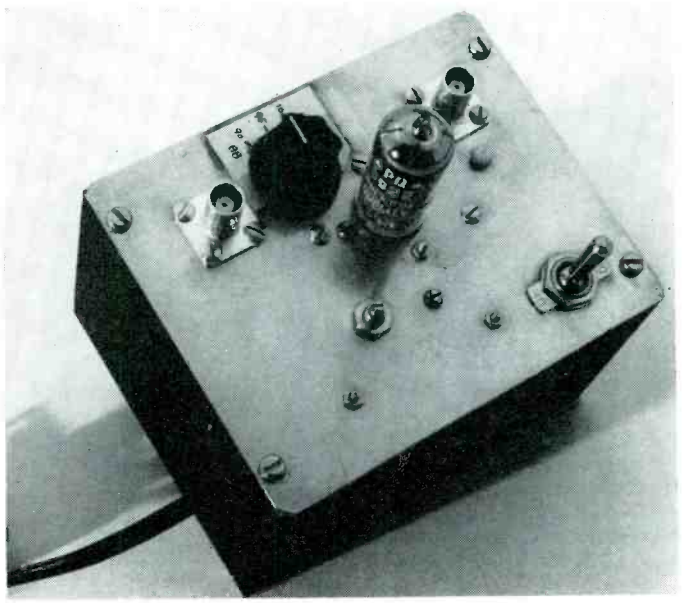

Fig. 1. External appearance of the author's FM booster amplifier.

Antenna System

First, one should take utmost advantage of the antenna system to provide maximum signal voltage delivered to the antenna terminals of the tuner. In order to accomplish this at FM-band frequencies, the antenna should be placed in the clear and at a sufficient height above the ground. A minimum height of 20 feet should be maintained, and a continuing improvement with increasing height up to 40–50 feet may be realized, depending on local topography.

A single six-element Yagi antenna designed for the FM band should give around 7–10 db gain over a single one-half wavelength dipole. A pair of such antennas fed in phase and stacked with ½–1 wavelength vertical separation should provide around 10–14 db gain over the dipole. Several antennas of this type are available in radio parts stores. When it is remembered that 10 db of antenna gain means that, in effect, the power of all stations received would be increased by 10 times, one can appreciate the advantage of using high-gain antennas.

Then, too, the added directivity characteristic which goes hand-in-hand with higher gain is an effective aid in reducing co-channel interference provided the interfering stations do not lie in the same direction with respect to the receiving antenna. When using such an antenna, the optimum heading to a particular station can be found by rotating the antenna until maximum signal strength is obtained, as evidenced by the signal strength indicator on the receiver, or by the point of maximum quieting. Even a short treatment on optimum antenna design is beyond the intent of this article; however, several excellent sources[1] are available for those who may care to pursue the subject more thoroughly.

Transmission Line

The transmission line which connects the antenna to the receiver is an important link in the equipment chain. To insure that the signal suffers minimum attenuation in finding its way to the receiver, a low-loss line should be used. Tubular 300-ohm line is excellent in this respect and is inexpensive. Where a long line must be run, a 300-ohm open-wire line is preferred because of its extremely low attenuation constant. Although even less expensive than the tubular variety, it may be more difficult to install. It is important to keep all parts of the 300-ohm line at least 6 inches away from metallic objects such as roof gutters, down spouts, water pipes, heating ducts, and so on. Coaxial cable has the advantage that since it is a shielded line, it can be run anywhere, even buried in the ground, or carried along a water pipe. However, it is more expensive than 300-ohm line, and in sizes ½ inch in diameter or smaller it has more loss.

Since most FM antennas and receivers are designed to work in conjunction with a balanced 300-ohm line, special impedance-changing transformers called baluns (*bal*anced-to-*un*balanced transformers) should be used when connecting a balanced 300-ohm line (or antenna, or receiver) to an unbalanced 75-ohm line (or antenna, or receiver). For the protection of your equipment, your dwelling, and yourself, the antenna system including the mast should be grounded properly. However, make

* *9 Cortland Drive, Ballston Lake, N. Y.*

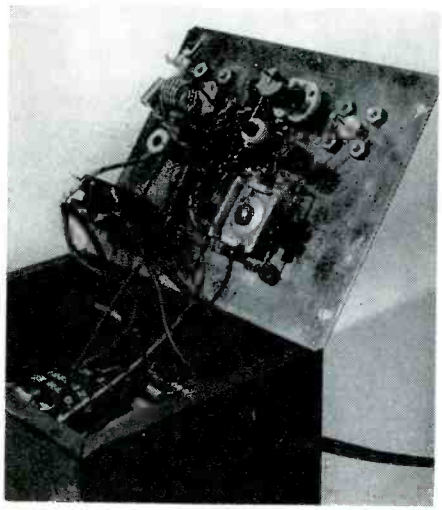

Fig. 2. Internal arrangement of parts for the booster amplifier.

certain that the lightning arrestor does not by-pass some of the FM signal to ground, thus reducing the effectiveness of the antenna system.

The Tuner

One of the requirements of the tuner is that it should have sufficient amplification to bring the desired (and usually weak) signal up to full limiting. Most of this amplification is ordinarily obtained in the intermediate frequency (i.f.) amplifiers and amplifier/limiter stages operating at 10.7 mc. The amplifier should also provide the necessary adjacent-channel rejection by virtue of its selectivity (or band-pass) characteristic. Some readers may have improved the performance of their gain-starved receiver by adding another amplifier/limiter stage.

This type of improvement can be carried only so far. Eventually a point may be reached where the over-all i.f. gain has become so great that positive feedback from the last stage back to the front end of the amplifier (over feedback paths wholly unsuspected) becomes comparable to the magnitude of the input signal. If this occurs, either the amplifier tends to oscillate on a permanent basis, or if this feedback is somewhat milder in nature, it will tend to distort the over-all band-pass characteristic of the i.f. amplifier. Methods of preventing this type of feedback include stage-to-stage shielding, adequate decoupling of those circuits common to all i.f. stages (such as heater and d.c. supply leads), or employing a second frequency converter in the i.f. system (double-conversion receiver).

Limitation Due to Tube Noise

Nevertheless, as still higher i.f. gain is realized without instability due to undesirable feedback, another limitation is eventually reached, i.e., the level of noise generated in the tubes preceding the i.f. amplifier. It is true that all the amplifier stages generate noise. However in any stage, *following the first,* the signal has been brought up to a level so high compared to the noise generated *in that stage,* that the contribution of noise from that stage is insignificant.

Most FM receivers consist of an r.f. amplifier, followed by a frequency converter or a mixer, which is followed in turn by the i.f. system. Because frequency converters and mixers are inherently noisier than amplifiers, the first stage must provide a large signal amplification so that the amplified signal overcomes the noise generated in the mixer. Obviously the r.f. amplifier itself should generate a minimum of noise. Earlier it was stated that the i.f. gain should be high enough to allow full limiting even on weak signals. Therefore the smaller the amount of noise generated by the tuner, the smaller the signal can be before it is lost in this noise. Actually the i.f. gain should be sufficient to produce limiting on this noise.

One may well ask now, "What generates this noise?" Some of this noise is generated thermally in the effective generator resistance of the device (in this case the antenna) driving the first stage. Some of the noise may enter the antenna from extra-terrestrial sources, such as galactic, cosmic, and solar noise. Man-made electrical noise from such sources as motors, lamps, automobile ignition systems, and the like, may also be present depending upon the particular situation. In the usual case the main component of noise is generated within the amplifier tubes, and in a well designed tuner, within the tube immediately following the antenna circuit.

In the frequency range of interest, 88–108 mc, tube noise, in triodes, consists of shot noise and induced-grid noise. In pentode and other multigrid tubes an additional component called partition noise is generated. It is for

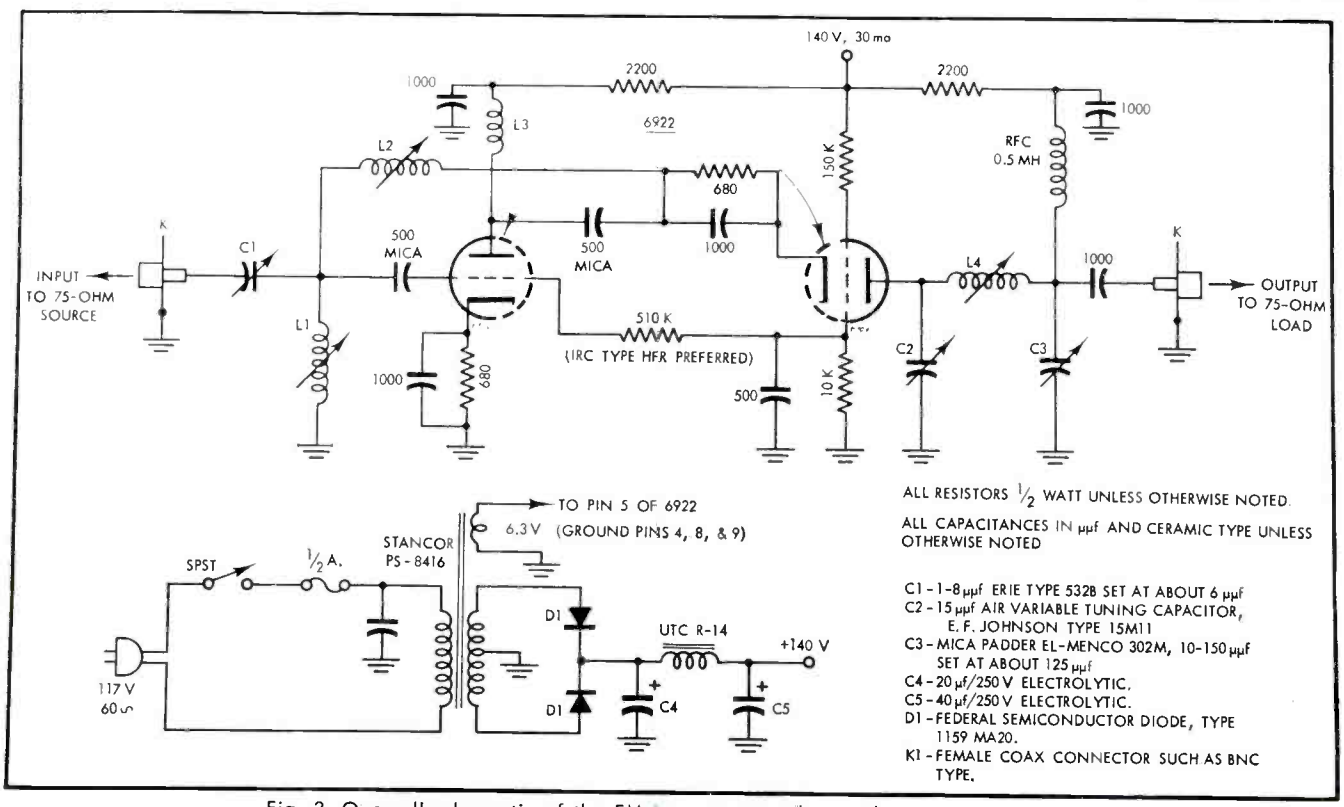

Fig. 3. Over-all schematic of the FM booster, together with its power supply.

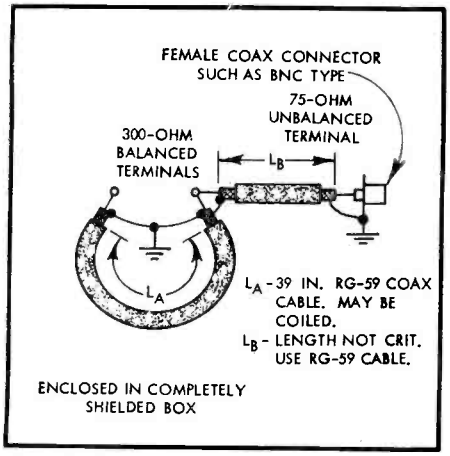

Fig. 4. Coaxial-type Balun—an impedance transformer from balanced to unbalanced lines.

this reason that triodes are preferred as first-stage amplifiers since they are, at this frequency, less noisy. A description of the physical processes that underlie the several types of noise generated within vacuum tubes is beyond the scope of this article. However several excellent references[2] are available which cover the field quite completely.

The usual method of describing the relative noisiness of an amplifier is by means of the noise figure, F.

$$F = \frac{P_S + P_T}{P_S} = 1 + \frac{P_T}{P_S}$$

where P_S = that portion of available output noise power from the amplifier due to thermal noise in the source resistance.

P_T = that portion of available output noise power from the amplifier due to noise generated within the tube or tubes.

Thus F is a dimensionless quantity, a power ratio that is usually expressed in decibels. If one has a perfect (ideal) amplifier that generated no noise itself, then $P_T = 0$ and $F = 1$ or $F = 0$ *db*. Suppose one uses a more practical example for the amplifier. If at the output terminals of this amplifier there is 1 microwatt of noise power due to the thermal noise of the source resistance for every 9 microwatts of noise power due to tube noise, then $F = 1 + 9/1 = 10$ or $F = 10$ *db*. The lower F can be made, the less tube noise there is to "smother" the weak signals until (neglecting extra-terrestrial and man-made noise) antenna noise finally sets the limit on tuner sensitivity. FM tuner A is better than FM tuner B if, all other things being equal, A has the lower noise figure. For example, suppose A has $F = 3$ *db* and B has $F = 9$ *db;* then A can detect a signal with ¼ the power that B can detect. Likewise, if one can improve the noise figure of his own tuner by 6 db, the net *apparent* increase in power of all stations would be four times.

The author has never measured the noise figure of a representative cross section of FM tuners. What few have been observed range from 7 to 20 db. In other words, after the user has installed a first-class antenna system he probably still has a good chance of improving his tuner sensitivity by improving its noise figure.

Description of Preamplifier

To be described is a single-tube preamplifier operating at signal frequency to be used ahead of the FM receiver. It employs the new 6922 tube in a cascode[3] circuit. It has a measured noise figure of 3.5 db at band center, a gain of about 30 db, and has improved the sensitivity of several tuners with which it has been used. More about performance later.

Its construction is straightforward and should be no problem for the audiofan who has had some experience in building his own equipment. Use only rosin core solder and, because it is a high-frequency amplifier keep connecting leads as short as possible. The completed amplifier is shown in *Fig.* 1. The amplifier is built on a 4″ × 5″ copper panel, and this mounted on a 3″ × 4″ × 5″ crackle-finished steel box. A self-contained power supply mounted in the box provides the necessary heater and plate voltages. It is not feasible to get this power from the FM receiver.

It is suggested that the arrangement of components shown in *Fig* 2 be followed. The circuit schematic is shown in *Fig.* 3. It will be observed that the preamplifier is designed to work from and into an impedance of 75 ohms unbalanced. If, as in the usual case, the line impedance is 300 ohms balanced, a balun must be used to provide the necessary impedance transformation. A coil balun such as the TACO Model 1570 is quite satisfactory, or one can make a coaxial line balun as described in *Fig.* 4. In the interest of simplicity an L-type network, comprising C_1 and L_1 is used to couple a 75-ohm source to the input of the first tube. For minimum noise figure C_1 should be around 6 μμf. Coil L_2 resonates at mid-band with the grid-to-plate capacitance of the grounded-cathode stage. L_3 permits shunt feeding of d.c. to the plate of the first tube. The output impedance of the grounded-grid stage is transformed down to a level of 75 ohms by means of the pi network consisting of C_2, L_4, and C_3. If it is desired to work the preamplifier into a 300-ohm line, a second balun will be required at the output. As the capacitance of C_3 is increased, the bandwidth of the output network decreases and the gain of the amplifier increases so that the gain bandwidth product remains about constant. With C_3 set at about 125 μμf the over-all gain is about 30 db and the bandwidth about 7 mc. Coil winding data is shown in Table 1.

Initial Tests and Alignment Procedure

The preamplifier should be turned on in order to check operating voltages. The power-supply voltage after filtering should run around 130 to 140 volts positive with respect to ground, and the voltage at each plate should be about 100 to 110 volts positive with respect to ground. The cathode voltage on each tube should be in the vicinity of 10 to 11 volts positive with respect to ground.

In order to adjust the tuned circuits, a signal generator is set to the mid-band frequency, 98 mc. Although not preferred, an FM station in the vicinity of this frequency can be used. The generator should be equipped with a 75-ohm source resistance. Once a strong enough signal is available at 98 mc, turn C_3 all the way in (maximum capacitance) and back off a turn or two. Adjust C_2 for maximum output. This can be determined by observing the rectified voltage from a diode detector connected at the output terminals if a signal generator is used. If an FM signal is the source, one can use the signal strength indicator on an FM tuner connected to the output of the preamplifier. The inductance of L_4 should be adjusted by means of the slug so that signals at both the low and high ends of the band can be peaked by means of C_2.

Once the signal is peaked again at 98 mc disconnect the plate supply voltage to the first tube by lifting the 2200-ohm dropping resistor from the B+ supply. Adjust the slug in L_2 until *minimum* output signal is obtained. Reconnect the

(*Continued on page 59*)

TABLE I

COIL WINDING DATA

L_1 0.2 μh—5 turns No. 15 AWG copper wire 0.395 in. I. D., with turns spaced to give a winding length of 0.4 in., and self supporting. Tune by lengthening or shortening coil.

L_2 1.2 μh—13¾ turns No. 23 AWG enameled wire, copper close wound on Millen 69043 ceramic form. Tune by Ferrite slug.

L_3 0.3 μf—7 turns No. 18 AWG enameled copper wire, close wound on 0.31-in. diameter form. Use Ohmite 1-megohm, 2-watt resistor. Untuned.

L_4 0.4 μh—6¾ turns No. 18 AWG enameled copper wire, close wound on Millen 69043 ceramic form. Tune by Ferrite slug.

A Continuously Variable Stereo Dimension Control

PETER A. STARK*

Surpassing the conventional "blend" control in versatility, the "dimension" control permits both decreasing and increasing the stereo effect of a record or tape.

DESPITE CLAIMS TO THE CONTRARY, stereo is not perfect—yet. There are astounding differences between different records and tapes, even those from one company. This is the reason behind the Phasing, Channel Reversal, and Blend controls on many of the best stereo amplifiers. The first two, Phasing and Channel Reversal, can be dispensed with once all tapes and discs are properly standardized since both are simple right-or-wrong propositions; however stereo blend is a matter of taste and depends on many factors.

Blend controls were originally introduced to combat the "ping-pong" or "hole-in-the-middle" effect present in many of the first stereo records and tapes due to the record companies' attempts to overemphasize the stereo effect. These were simple potentiometers bridging the two channels to permit mixing of the signals of the two channels.[1] As such, they could destroy the stereo effect, but could not increase it. Yet many discs could obviously profit by an increase in their stereo effect. This prompted the design of the dimension control.

A glance at the diagram reveals a striking similarity to the matrixing circuits which would be used in a multiplex converter for receiving FM stereo broadcasts using the Crosby multiplex system. Basically, the left and right channel inputs are applied to V_{1a} and V_{1b} respectively. Since V_{1b} is a split-load phase inverter, its outputs are 180 deg. out of phase. The four 100k resistors mix (matrix) the signals to provide a "sum" signal and a "difference" signal. This difference signal stands for the difference between the left and right channels and therefore contains all the stereo information. The "dimension" potentiometer acts as a level control for the difference information and therefore controls the over-all stereo effect. A voltage divider in the grid of V_{2a} slightly attenuates the sum signal thus permitting a relative increase in the difference level at high settings of the dimension potentiometer.

The variable dimension control is designed to be used between the preamplifier and amplifier of a stereo system. It is essential, however, that the input levels of both channels be exactly equal; if the left and right channels are not of the same level, additional volume controls may have to be inserted to equalize the channel volumes. Likewise, all components in the circuitry associated with V_1 should be matched within very close tolerances to assure exactly equal levels at the matrixing network.

Adjustment is very easy. Feeding a signal into the *left* input, adjust the dimension pot for zero output from the *right* speaker. If very careful matching was done in choosing the components, this should be possible. Otherwise, a very sharp null will be observed. Now check that a signal in the *right* input produces no sound in the left speaker, *at the same control setting*. Mark the position of the control. This is the neutral setting which does not change the stereo effect either way. A lower setting of the potentiometer will produce stereo suppression until, at a zero setting, a complete mixing of channels takes place. A higher setting of the control increases apparent depth and separation within reasonable limits. Needless to say, even this control can't make something out of nothing: monophonic discs will still be . . . monophonic. Æ

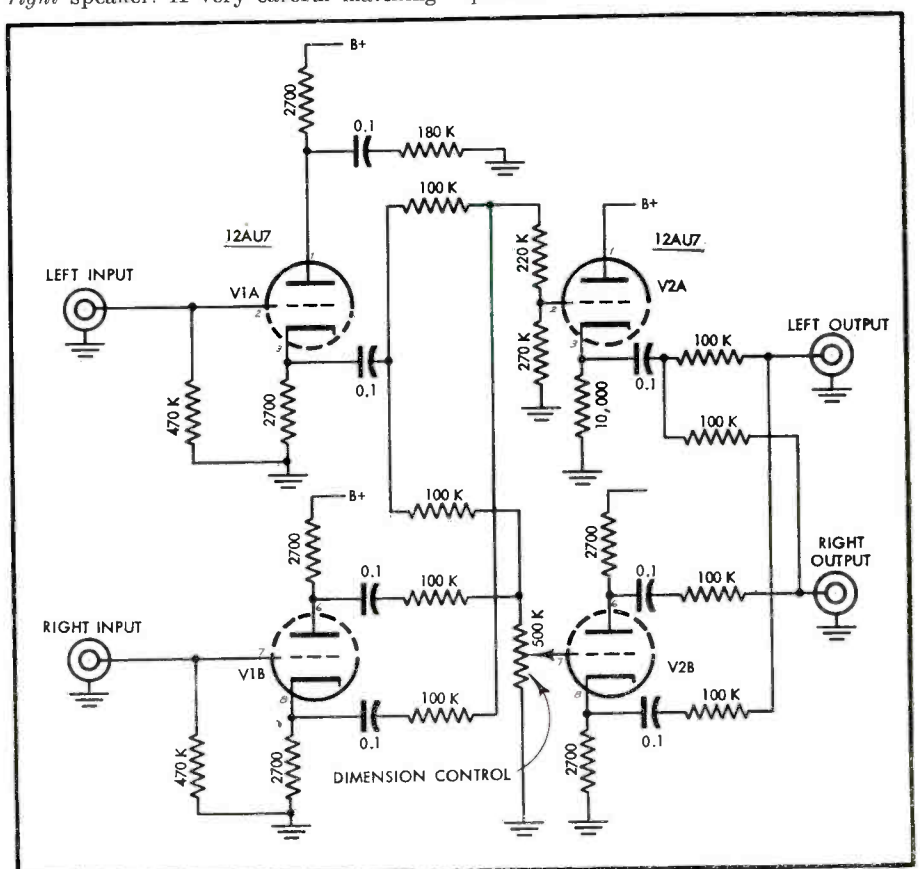

Fig. 1. Schematic of variable stereo dimension control, affording versatile control of stereo separation both sides of normal

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1 D'Errico, "A Variable Stereo Suppression Control," AUDIO, August 1958.

Audio Oscillator Circuits, Old and New

NORMAN H. CROWHURST*

A discussion of various types of audio oscillators which were explored in a search for an extremely stable unit intended for very low frequency applications.

THIS INVESTIGATION was instigated by the need for rather-low-frequency audio oscillators for two particular applications, both of which required descending below 20 cps, down into the region of 1 cps. The requirements for both applications were similar, so an investigation was carried out into the properties of different circuits for this purpose. A sinusoidal output of variable frequency is required, preferably with push-pull balanced output. While the development work carried out in connection with this investigation was specifically directed toward an oscillator for the very-low-frequency range, there is no reason why the results should not be applied to conventional oscillators covering the more normal audio-frequency range.

The first thing obvious for the very-low-frequency range, however, is that the frequency control must be a variable resistor, or ganged variable resistors, rather than variable capacitors, because the reactance of variable capacitors in available sizes at the very low frequencies becomes prohibitive.

The first possibility investigated was that of a phase shift oscillator using the circuit of (A) in *Fig.* 1. It is not practical to vary more than two of the resistors as a maximum for two reasons. One is the limitation in availability of multigang resistors. The more important one is that variation of more of the resistors would drastically vary the loop gain of the arrangement due to the impedance variation of the whole circuit.

The best possibility of obtaining variable frequency proved to be using a stepped, or tapered R/C arrangement, in which the successive values of R and C are stepped up in impedance. Using this arrangement, preliminary calculations showed a change in frequency approaching the change in resistance value can be achieved. However, even with this arrangement the loop gain changes drastically with resistance setting and some means is required to maintain uniform gain so that the waveform is reasonably consistent.

An ingenious possibility in this direction utilizes a fixed component of resistance that modifies the gain in a manner inverse to the change in loop gain due to the relationship between phase shift and attenuation. This is shown at (B) in *Fig.* 1. Choice of circuit parameters makes the attenuation accompanying the requisite 180-deg. phase shift the same at both extremes of resistance control. This is achieved as follows:

When the attenuation is a maximum due to the resistance divider action, the attenuation accompanying the phase-shift network is made a minimum by making all of the R/C elements of identical time constant. Increasing the frequency-control-resistance value reduces the attenuation of the resistance divider and at the same time shifts the phase/attenuation relationship of the successive networks so there is greater attenuation at the 180-deg. point. The fixed portions of the resistance divider are adjusted so the attenuation is the same at 180-deg. phase shift for both extreme settings of the control.

The disadvantage is that this method allows the attenuation to be equalized at only two points. While the frequency analysis of such a network assumes that individual frequencies are transmitted around the loop, the actual behavior is one determined by the instant-to-instant changes in electrical charge in individual stages of the network. As a result, the nonlinearity of the tube characteristic can become quite exaggerated and the frequency shifted because the circuit does not behave as a frequency-analytical device but as a differentiator or integrator network according to which way the R/C combinations are arranged.

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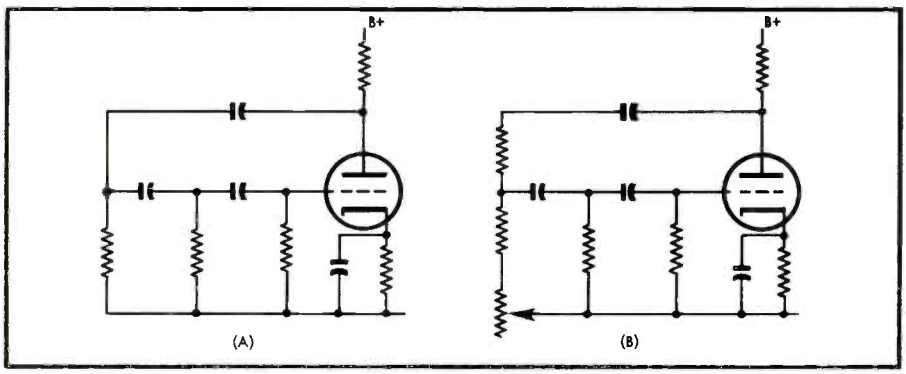


Fig. 1. One version of the simple phase-shift oscillator circuit: (A) in basic form, and (B), arranged so change in loop gain with varying frequency setting can be compensated.

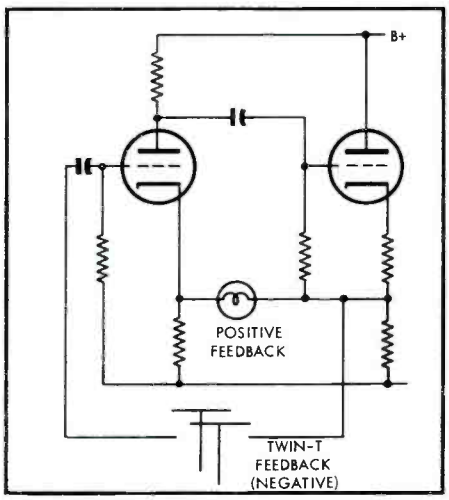


Fig. 2. Basic positive/negative feedback circuit, using the twin-T for frequency selection in the negative feedback.

Twin-T Feedback

The next type to be considered was the twin-feedback type using a twin-T in the negative feedback and resistance elements only in the positive feedback. Use of a large forward gain enables the twin-T to apply very considerable feedback at harmonic frequencies and to give a good null at the oscillation frequency. The positive feedback is then used to maintain oscillation at this frequency (*Fig.* 2).

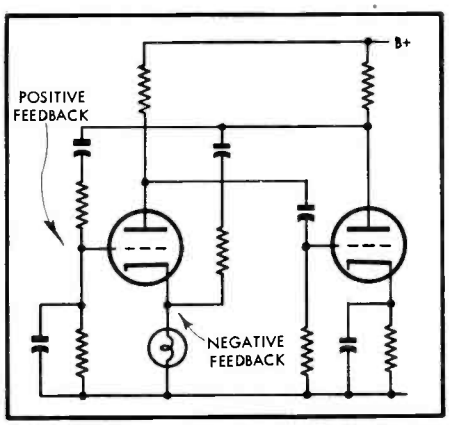


Fig. 3. Basic positive/negative feedback circuit, using a half Wien bridge in the positive feedback for frequency selection.

As is well known the positive feedback requires automatic control using a lamp filament in order to make it self-adjusting so that the circuit maintains itself at the correct amplitude of oscillation to avoid clipping. Operating at very low frequencies this circuit suffers from the disadvantage that the lamp filament changes temperature cyclically during the waveform. This results in considerable waveform distortion in the positive feedback. This gives the negative feedback an almost impossible task of cleaning up the waveform.

Acquisition of adequately high gain without phase shift also becomes somewhat difficult at these low frequencies. Only one stage, of triode type, can be used with a cathode follower and direct coupling in the cathode circuit for the positive feedback, along with direct coupling from the plate of the gain stage to the cathode-follower grid and feedback from the cathode follower through the twin-T to the grid of the gain stage. Use of more stages than this involves us in additional phase shifts due to coupling capacitors.

The practical difficulty in achieving high gain with this arrangement occurs due to the problem of achieving high voltage gain in the gain stage and at the same time having sufficient current output from the cathode follower to operate the filament lamps over a useful part of their characteristic. The degeneration available for harmonic reduction is dependent upon the gain obtainable in the gain stage, since the twin-T can only give 100 per cent feedback as a maximum and this does not occur for second or third harmonics.

The defective gain might conceivably be increased by the twin-T itself at oscillation frequency by using values other than the conventional 2 to 1, so there is positive feedback at the critical frequency instead of a null. However, this still leaves the objection that a limited negative feedback is available for harmonic reduction.

The next circuit investigated was the half Wien bridge type of *Fig.* 3. This again uses a lamp as the automatic adjustment feature but in a different configuration. Here the positive feedback uses the frequency selective elements while the negative feedback uses a lamp to control the amount of feedback. While this circuit could be made to work, it too suffers from the disadvantage that the lamp shows cyclic variation of resistance when the frequency gets much below 20 cycles. As the lamp is in the negative feedback, the intention of which is to clean up waveform, cyclic variation of resistance results in waveform distortion.

The Author's Circuits

Some years ago the author wanted a very simple, single-tube oscillator with stable output and good waveform and developed the circuit of *Fig.* 4. This utilizes a pentode diode tube in which the "triode" portion of the pentode, consisting of the cathode, grid and screen grid, acts as an oscillator circuit using

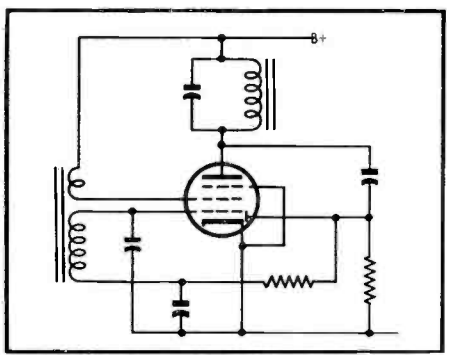


Fig. 4. An L/C circuit developed some years ago by the author, with d.c. feedback for stabilizing.

a tuned grid LC arrangement with small coupling from the screen. In this way the screen voltage is almost constant, having only a slight fluctuation due to the voltage drop across the few turns necessary to maintain oscillation. So the rest of the tube functions like a pentode amplifier.

Output is taken from the plate which merely uses a tuned circuit as an additional means of securing a very pure waveform. In the particular application for which this circuit was developed, further coupling was incorporated between the plate circuit and the following stage, to achieve a positive feedback arrangement that produced a virtual-infinite-impedance source.

The useful feature of this circuit for the present application was that a pentode amplifier with appreciable gain provided a large output from which to control the bias so as to maintain steady oscillation in the "triode" portion without running to clipping. This was obtained by utilizing the diode as a means of biasing, deriving the signal for the diode to rectify from the plate circuit. This circuit achieved very steady oscillation conditions and an extremely sinusoidal waveform.

To apply this to very low frequency, obviously inductors are not practical. They would have to be iron cored with a very small air gap and this would mean the inductance would be nonlinear throughout the oscillatory cycle, which would result in distortion. So another arrangement utilizing an adaptation of the half Wien bridge principle was built around a twin triode. This is shown at *Fig.* 5.

The circuit looks deceptively simple but its operation provides quite a stable waveform and good control of both frequency and amplitude. In this case we have both positive and negative feedback as well as a means of controlling the bias of the gain tube for maintaining oscillation.

The gain and phase inverter halves of the oscillator are R/C coupled. But, because the phase inverter is of the split-load type, the effective grid input resistance is extremely high and consequently a very long time constant can be achieved in this coupling without the necessity for a very large capacitor.

Bias for the phase inverter is achieved by grid current. This means the bias will be strictly proportional to signal magnitude. Consequently, the d.c. voltages appearing at the cathode and plate of the phase inverter will vary with signal amplitude. Fortunately, the half Wien bridge which takes the feed from cathode and plate circuit of this tube back to the grid of the gain tube has a d.c. return path through the coupling from cathode.

Assuming the first half tube had infinite gain, so a hypothetical condition can be considered as a design starting

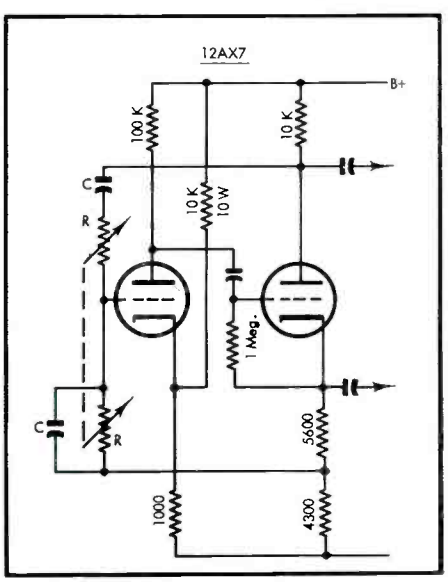


Fig. 5. This circuit combines positive, negative, and d.c. feedback in the same elements, and gives balanced push-pull output as a bonus.

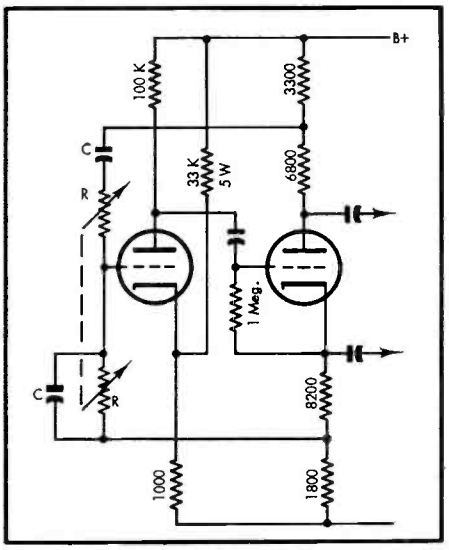


Fig. 6. A variation of the circuit of Fig. 5, to give bigger output at slight sacrifice of purity and stability.

point, we can evolve some basic relationships. If identical R's and C's are used in the frequency network, and the positive feedback is taken directly from the plate, the negative feedback can be taken from half way up an equal cathode resistor and a null should appear at the grid of the gain tube.

By sliding the tapping point a little bit further down the cathode resistor, the residual feedback appearing at the null point of the series parallel capacitance/resistance arrangement at the grid of the first tube has a residual positive component whose frequency is determined by the resistance/capacitance combination. This tapping point is chosen so the positive feedback residual at the grid of the gain tube is just slightly more than that necessary to start and maintain oscillation with a small negative bias on the grid of the gain tube.

This small negative bias condition is achieved by use of cathode biasing in conjunction with the d.c. feedback from the phase inverter under zero-signal conditions. The cathode bias is achieved by means of a resistance potentiometer across the plate supply, using values low enough to avoid excessive degeneration in the gain stage itself. This does not require a very high dissipation if a low-current tube such as a 12AX7 is used for this service. A working gain of the order of 30 to 35 with the degeneration can quite readily be achieved and this allows ample reserve for adequate feedback to clean up the waveform.

Alternatively, by making the R's and C's in a 2:1 relationship so the junction is a center tap between positive and negative feedback, the cathode load tapping can be nearer 100 per cent, yielding a bigger d.c. bias control.

The advantage of this arrangement, whichever value combinations are used, is that both positive and negative feedback utilize the same circuit elements and, consequently, do not impose excessive loading upon the output stage of the arrangement. The previous Wien bridge circuit, where the negative feedback was applied to the cathode of the gain stage, invariably necessitated an extremely low impedance value loading on the output stage and an inordinately large capacitor for coupling it if very low frequencies were required.

In this new arrangement each capacitor has a useful function in the operation of the circuit. The capacitor coupling from phase-inverter plate to grid of the gain stage is part of the frequency selective arrangement. The capacitor shunting from grid of the gain stage to the tap of the cathode load is also a part of the frequency-determining network. The coupling capacitor from plate of the gain stage to grid of the phase inverter serves as a bias storage element for the grid of the phase inverter, which by direct coupling through the cathode load controls the bias point of the gain stage so as to maintain oscillation at a steady level.

With these values an extremely stable oscillation can be attained at quite low level (of the order of a few volts) using whatever high voltage supply happens to be available. It is quite easily possible to increase the output from this arrangement by tapping down both cathode and plate portions for the take-off of the frequency selective network, as shown at *Fig.* 6. This means the output builds up to a larger amplitude before the necessary negative bias is achieved to reduce gain to the balanced operation point.

This can be carried far enough to produce an output in the region of 50 volts, peak-to-peak, at plate and cathode of the phase inverter, using a supply voltage in the region of 250 volts. However, the effective positive and negative feedbacks are considerably reduced by this modification so that operation is somewhat more critical and slight deviation from correct values can more readily result in distortion or complete cessation of oscillation, than is the case in the circuit intended for lower output.

An important feature in designing such a circuit for variable oscillation is that the positive and negative feedback elements should not introduce appreciable loading across the phase-inverter loads, or the portions across which they are applied. This is relatively easy to achieve because fairly low resistance values can be used in the plate and cathode circuit of the phase inverter without materially interfering with the phase inversion function. It is quite possible to use a 12AX7 with cathode and plate resistors in the order of 10,000 ohms. If the frequency-selective network uses a fixed resistor of 100k ohms and a ganged variable resistor of 1 meg, it is possible to achieve 10 to 1 frequency change with negligible loading on the phase inverter to throw this out of balance. So far so good.

Transistorization

Now came the difficult question, a transistor version. For both the applications mentioned it was desirable that the possibility of transistorization be considered.

Most of the foregoing circuits can be converted to transistor operation, at least for one frequency. The difficulty encountered for transistorizing the very-low-frequency type oscillator is due to the fact that the variable control has to be a resistance rather than a capacitance. In a tube circuit the variation in impedance at oscillation frequency is taken care of quite conveniently by making the frequency-selective network of quite high value relative to the source resistances from which it feeds. The grid of the gain stage is always operated in negative region, so voltage division only has to be considered.

In a transistor circuit this does not prove to be quite so easy. The output loading of any feedback circuit is basically a current loading. This fact promoted quite considerable thought to the possibility of changing circuit parameters so as to use a current operation base instead of a voltage operation. However this is figured, the position of C's and R's seems to be difficult for the purpose of producing a variable arrangement using a change of R values to control frequency.

Using current division in place of voltage division as the basis for design, the logical thing would be to couple a collector of a stage into the tapping of a series/parallel circuit and take the output from the top end. (*Fig.* 7). However, this has two unsatisfactory aspects.

(1) If the variable resistance in parallel at the input is used to control frequency, this will vary the collector load of the input stage, and

(2) The series capacitor at the output end is not particularly desirable since it blocks the d.c. connection to the base of the stage to which the circuit feeds and necessitates some provision for bias by other means.

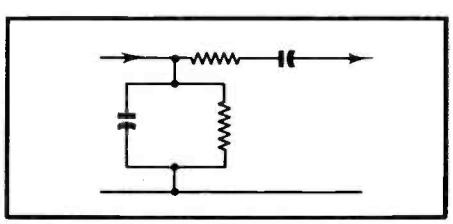


Fig. 7. A logical transposition of the frequency-selective elements, when the design is based on current division rather than voltage division.

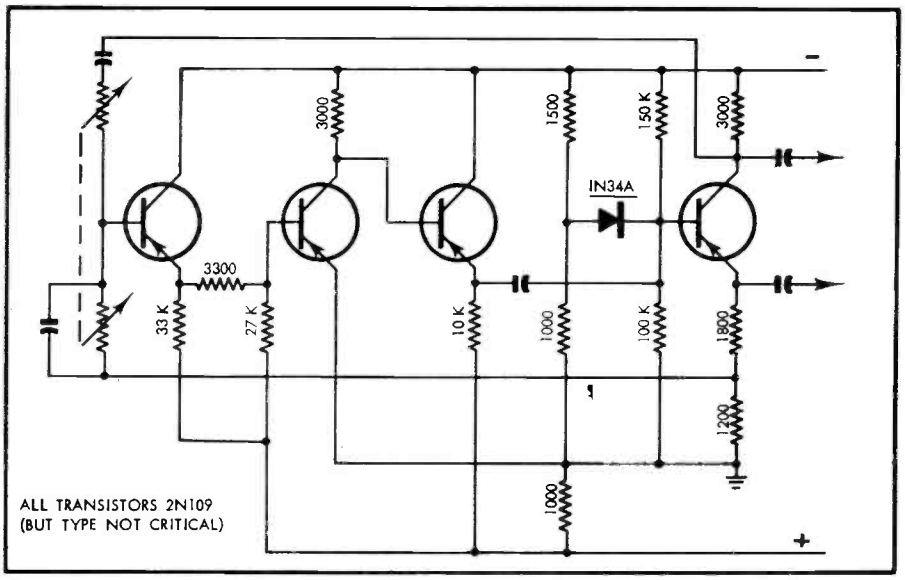


Fig. 8. A complete transistor version of the circuit of Fig. 5. For method of development see text. Values not indicated on this and other circuits are those that will depend on operational frequency, or frequency range.

Undoubtedly the complete dual equivalent of the tube circuit, utilizing inductors in place of capacitors, as well as the other conversions, could be derived and such a circuit might conceivably work, except for one important limitation: linear inductances for use at very low frequencies are much harder to come by than are linear capacitors.

So, nice as the idea might be to change our thinking from the conventional voltage source basis we have used with tubes to a current source basis more suitable for transistor application, it does not seem to work out for this particular application. To transistorize this oscillator circuit we must think in terms of adapting the arrangement we have deduced for tubes. This is achieved by the circuit of *Fig.* 8, which works quite well.

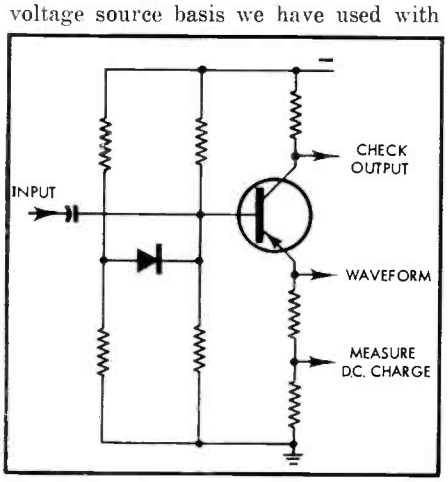


Fig. 9. How the phase-splitter stage was set up to obtain the required d.c. feedback component.

The first step in making the circuit work was to discover how the transistor's curvature might be utilized to provide an adjustable gain to permit the circuit to use automatic control so it will just oscillate. Taking the transistor's dynamic curve at various collector loads showed there were two areas of curvature. One at saturation and the other at cutoff.

The curvature in the region of saturation is such that, whatever collector load is used, the *voltage* output in the curvature region must always be very small. The curvature in the region of cutoff is quite small under most normal operating conditions, so as to look like clipping. However, by reducing the emitter resistance to a low value, this curvature can be considerably extended and appreciable swing can be utilized in the curved region. This is achieved by operating the gain stage with virtually zero external emitter resistance. Then internal emitter resistance degeneration being non-linear is what results in the curvature.

Having determined that we want to bias the transistor toward cutoff when the signal builds up, we know which way we want to produce the bias from the phase inverter. This cannot be achieved conveniently by use of the phase inverter's internal characteristics, as in the case of a triode tube. The natural return point for a bias resistance from the base of a transistor is not the emitter, but some point negative (using the conventional PNP types).

The phase inverter stage was set up with a biasing arrangement incorporating a diode, shown in *Fig.* 9. By biasing the base so that, without signal, the phase-inverter transistor is passing a maximum current with a margin to operate as a phase inverter, and phasing the diode so that signal biases the base more positive, so as to reduce the transistor current, a satisfactory d.c. component can be obtained. Utilizing a bias point for the other side of the diode suitable for this purpose, the phase-inverter current swings quite conveniently in proportion to the signal amplitude being handled.

One thing more is necessary at this point. When this is coupled to the gain stage, the diode current introduces distortion in the form of clipping on one side of the waveform. To obviate this, the diode needs feeding from an emitter follower through a capacitor.

The other emitter follower, shown at the extreme left of *Fig.* 8, is needed to avoid the change in impedance due to frequency adjustment from materially affecting the loop gain. This emitter follower has the effect of transforming the impedance on both sides of it by a ratio proportional to the current gain of the stage.

Now we come to the difficult part. How to operate the gain stage with zero external emitter resistance? The first method tried was to reduce this resistance to a very low value, by using a potentiometer biasing on the emitter, similar to that shown in Fig. 5 for the tube version. Values down to 8 ohms be-

(*Continued on page 58*)

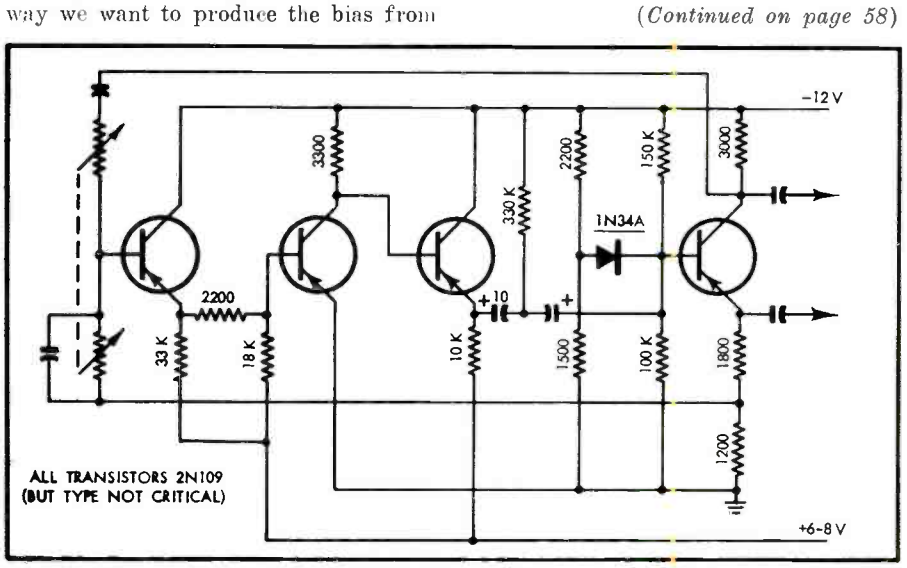


Fig. 10. An alternative version of the circuit, to utilize two separate supplies, instead of the common resistor method of Fig. 8.

Radio Interference in Audio Equipment

JOHN C. RICE*

The author describes some sources and effects of radio-frequency disturbance in audio circuitry and suggests methods by which these effects may be eliminated or reduced.

UPON THE RECENT ADDITION of a new preamplifier and low-level magnetic cartridge to a stereo system, an annoying buzz was noticed. In this particular case, the cause was traced to radio-frequency interference from a nearby television station. These experiences and hints are intended for those who are troubled by radio-frequency disturbance in their music systems.

Sources of Interference

To understand the following it is necessary to realize that interference is introduced to the amplifier or other audio equipment as an r.f. signal. In the equipment the signal is demodulated into an audio-frequency noise.

The first two obvious sources are that of radio and television. Interference of this type is found in strong-signal areas, usually in cities or around transmitting towers. Broadcast stations (and local amateurs) can be recognized by their program content, although sometimes more than one station will be heard simultaneously. In cases of TV interference, the amplitude-modulated TV picture transmission is heard, after demodulation, as buzz. The cable placement in the audio equipment is critical and a person's position near the equipment may have an effect on the buzz. In fact the input cable behaves in much the same manner as a pair of TV rabbit ears in its placement.

A second source of interference is spurious radiation. Generators of this noise would be electrical equipment, motors, switches, (including the phonograph switch), and neon and fluorescent lamps. Fluorescent lamps are radiators of r.f. which carries a modulation of hum or buzz at the power frequency. Additional generators of this type would be ignition systems, including oil burners.

The origin of still other problems lies in external electronic equipment. For instance random oscillation of one stage in a neighbors TV or radio set may have surprising effects. His set may radiate a tone or perhaps an electrical noise present in his area. His equipment may even receive, detect, and retransmit the entire program content at another frequency.

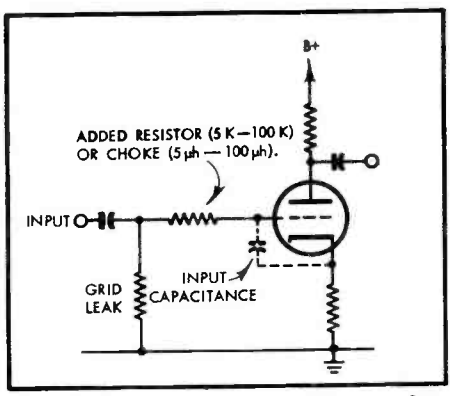


Fig. 1. Location of grid filter in first stage of preamplifier.

Injection of Interference

To become an audio disturbance, the r.f. signal must get into the equipment and be detected. Signal introduction can occur in a number of ways. One path is through the shielded low-level input lead, which acts as a VHF antenna. If this is the case, the signal level at the first tube must reach a voltage greater than the bias grid rectification (and subsequent detection) to occur. After detection the noise will appear at every following stage.

However, interference need not be introduced at the first stage. Other leads may introduce a signal to a later tube. An unshielded tube may receive the radiated noise directly; or perhaps the filament line itself may carry the signal. If the signal is injected at a stage other than the first it will generally have to be at a very high level to begin with. First, because bias on successive stages is higher, and second, because the lower amplification it will receive in the fewer remaining stages will reduce its apparent level.

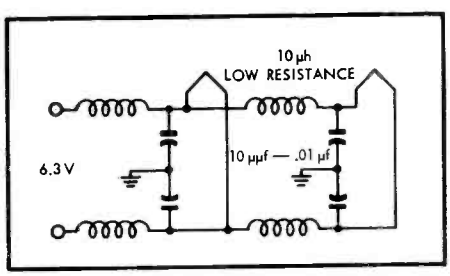


Fig. 2. Method of adding r.f. filtering to filament circuits.

Elimination of Interference

To remedy the annoyance, the troublesome amplifier stage must first be located. This can be done by simply starting at the output and removing tubes until the interference stops. The r.f. signal, once located, is then removed with shielding or a filter of some sort.

An r.f. signal present on the grid of a tube may be removed by an r.f. choke or a resistor (*Fig.* 1) which, in combination with wiring and input capacitance of the tube, forms a low-pass filter for the removal of the r.f. The value of the added component is chosen to provide, with the capacitance of the tube, the necessary filter action for the frequency you desire to attenuate. An additional small-value capacitor could be connected between the grid and ground to provide a lower filter cutoff frequency. There is usually no harm in the addition of a resistor, because whatever grid current there is flowing is exceedingly small. However the series combination of filter and grid resistor should not exceed the manufacturer's maximum specified grid resistance. A small value r.f. choke in place of the resistor might result in an oscillation which, although inaudible, could cause distortion at that amplifier stage. Caution should be used when adding components to avoid affecting audio response.

Filament radiation may be corrected by the addition of r.f. chokes and/or capacitors to the filament line in the manner of *Fig.* 2. Most r.f. interference on the power line will not pass a good electrostatically shielded power transformer. However under-chassis lead capacitance may effectively bypass the shielding. In these cases a power line interference filter could reduce the noise problems considerably.

If the annoyance is caused by television synchronization buzz coming in

(*Continued on page 64*)

* *55 Vassar St., Rochester 7, N. Y.*

Loudspeaker Distortion Due to the Doppler Effect

VIRGINIA RETTINGER*

Why does a two- or three-way loudspeaker system usually sound better than a single-unit radiator? The authoress shows how the action of a loudspeaker cone carrying two frequencies simultaneously results in a form of distortion.

THE ACTION of a loudspeaker cone is sometimes likened to that of a flat, weightless circular piston vibrating in an infinite baffle, or to that of a pulsating sphere whose radius periodically increases and decreases, or to that of an oscillating sphere whose radius remains constant while the sphere moves forward and backward. None of these concepts coincides accurately with existing conditions as far as the movement of the paper cone of a direct-radiator loudspeaker is concerned. Hence, while in the following the concept of a vibrating piston in an infinite baffle will be employed, it must be understood that there are limitations to the applied theory, and that calculations may or may not coincide precisely with corresponding physical measurements.

Under the excitation of a low-frequency electrical current, a woofer cone moves, more or less, as a unit. Under the excitation of a high-frequency current, however, it is generally the central portions of the diaphragm which vibrate most intensely. But what happens when a low-and a high-frequency signal are simultaneously actuating the speaker? The answer is that the high-frequency radiator (central part of cone) is moving back and forth in space at the rate determined by the low-frequency signal. This phenomenon, considered a form of distortion, has been termed frequency-modulation distortion, and was first examined by G. L. Beers and H. Belar.[1]

This type of distortion is directly proportional to the excursion required by the speaker cone to execute its low-frequency travel for a given power input, and to the modulated, or high, frequency. Mathematically this relationship is given by

$$D.F. = .033\, d f_2$$

where

$D.F.$ = distortion factor
d = amplitude of cone motion (each side of mean position) in inches at the modulating, or low, frequency.
f_2 = modulated, or high, frequency

The derivation of the equation, given in the noted reference, is rather long and complicated, and cannot be repeated here. Suffice to say that it is based on the concept of the Doppler effect and the well known analysis of frequency modulation. A frequency-modulated wave can be considered to consist of a carrier and an infinite number of side-bands. The carrier has a constant amplitude, and the side-bands are located symmetrically about the carrier and are spaced at intervals equal to the modulating frequency. Depending on the degree of modulation, however, the amplitude of the carrier is less than that of the original wave. The distortion factor is defined as the ratio of the square root of the side-band power to the square root of the total power.

The Doppler effect is also well known, and is characterized by a change in sound pitch due to the relative motion of the source and observer. When a sound generator and a listener are approaching each other, as in the case of a train coming towards one, the noted pitch is higher than the actual frequency of the sound source. Similarly, when generator and observer separate, the observed pitch becomes lower.

Mathematically the Doppler effect may be expressed by

$$f = \frac{v - v_o}{v - v_s} f_2$$

where

v = velocity of sound in medium
v_o = velocity of observer (assumed to be zero for this case)
v_s = velocity of source
$= K f_s \cos 2\pi f_s t$
K = constant
f_s = frequency of source, or modulating frequency
f_2 = modulated frequency
f = observed frequency

Substituting these values in the above equation, we obtain

$$f = \frac{v f_2}{v - K f_s \cos 2\pi f_s t}$$

$$= \frac{f_2}{1 - \frac{K f_s}{v} \cos 2\pi f_s t}$$

$$= \frac{f_2}{1 - \frac{K}{\lambda_s} \cos 2\pi f_s t} \left(f_s = \frac{v}{\lambda_s} \right)$$

The relationship for the amplitude of a vibrating piston in an infinite baffle is given by

$$d = \frac{1.185 \times 10^5 \sqrt{W}}{f^2 D^2} \text{ (inches)}$$

where

D = piston diameter, inches
W = acoustic power, watts
f = frequency

Figure 1 shows this relationship graphically, for one acoustic watt output on part of the piston.

To appreciate what large cone deflections are involved in the case of the really low frequencies, consider a 16-in. diameter piston radiating 0.25 watts of acous-

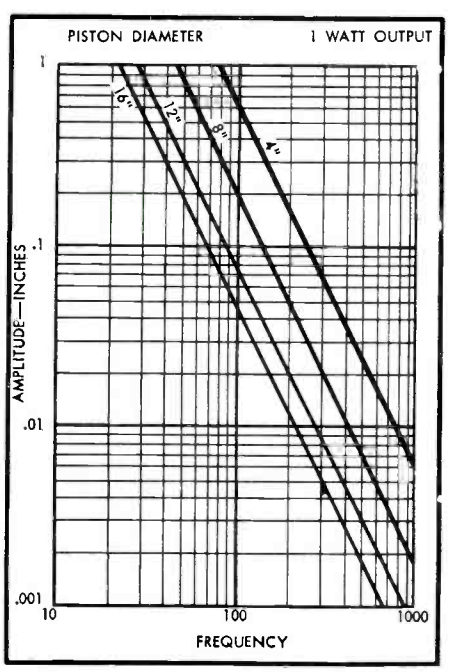


Fig. 1. Amplitude of vibrating piston for one-watt acoustic output.

* *5007 Haskell Ave., Encino, Calif.*

[1] G. L. Beers and H. Belar, "Frequency modulation distortion in loudspeakers," *JSMPTE*, April, 1943; p. 207.

pioneer

THE STEREOMASTER!!

The "Small-car" of the audio world

SM-R151

A car doesn't have to have 200 or 300 horsepower to function adequately. Witness the popularity of small low-powered imported cars. In much the same way, an amplifier will still provide ample volume for home systems even though it may produce less power than most amplifiers now on the market. From PIONEER of Japan comes the STEREOMASTER, a stereo amplifier with an output of 15 watts. It incorporates on a single compact chassis a sensitive FM-AM-short wave/medium wave and stereo preamplifier and power amplifier, thus providing unequalled versatility and simplicity in assembling a stereo system for the home.

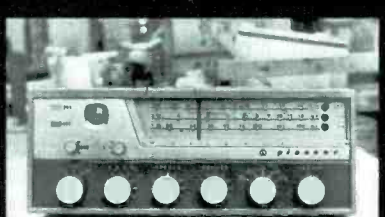
OUTSTANDING FEATURES :

- Low distortion, low noise and unexcelled high sensitivity tuned circuit
- Provides tape playback directly from tape playback head
- More than enough power for home applications
- May be used as channel amplifiers for HI-LO two-channel system

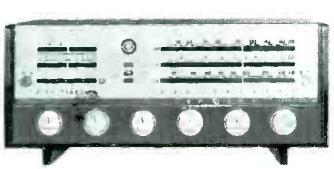
SPECIFICATIONS

Range : AM 535 to 1,605 kilocycles
3.8 to 12 megacycles
FM 80 to 108 megacycles
Rated Power : 15 watts (7.5 watts × 2)
Frequency Response : within 0.5 db from 20 to 20,000 cps
Crossover Frequency: 3,500 cps (6db per octave attenuation)

SM-R150
15 WATTS STEREO AMPLIFIER



FM-R301
AM-FM TUNER AMPLIFIER



FM-P300
15 WATTS AM-FM TUNER AMPLIFIER

5 Otowacho 6-chome, Bunkyo-ku, Tokyo

FUKUIN ELECTRIC, TOKYO, JAPAN

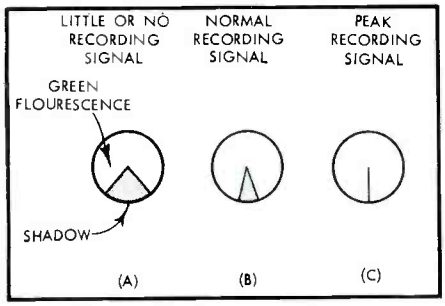


Fig. 2. Magic eye indicator.

allowance has to be made for the difference between the meter indication and the actual (higher) level of the transients.

The Magic Eye Tube

While there are several versions of the magic eye tube, the most common type employed in tape recorders is that represented in *Fig.* 2. With no signal applied to the tube (grid), a green fluorescent glow suffuses about three quarters of the face of the tube, as at (A). The remaining quarter is in shadow; in other words, the eye is open. As audio signal is applied to the tube, the shadow narrows, as indicated at (B). If sufficient signal is applied, the eye closes completely, as at (C), or even overlaps.

The problem—of the manufacturer or service technician—is to correlate the amount of signal fed to the magic eye tube with the amount of signal impressed on the tape so that when the eye barely closes this corresponds to maximum permissible recording level. On home recorders, the maximum level is usually between 3 and 5 per cent harmonic distortion, corresponding roughly to 30 per cent or more of intermodulation distortion. This is a tremendous amount of IM distortion, but occurs only—or is *supposed* to occur only—on peaks. At normal levels, which are typically 10 to 20 db below peaks on audio material, intermodulation distortion will drop to levels consistent with fidelity standards.

Figure 3 shows how the magic eye indication is tied in with the signal going to the record head and thence onto the tape. At a suitable point in the record amplifier, the audio signal is tapped off and fed to the magic eye tube. This signal goes through a voltage divider, which supplies the proper proportion of the signal required to drive the indicator. This proportion is experimentally determined by the manufacturer of the tape machine. It is more the exception than the rule to find a variable voltage divider in home machines so that one can adjust the amount of signal fed to the record-level indicator. However, a few home machines do contain a control—usually accessible internally—which permits the service technician or any other person equipped with the necessary instruments and knowledge to adjust the signal going to the magic eye tube so that its indication will correspond with maximum permissible distortion on the tape.

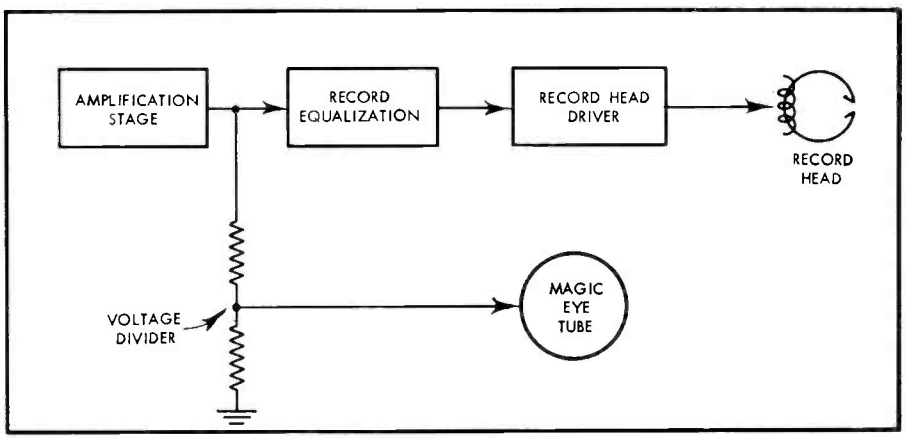


Fig. 3. Feeding the audio signal to the magic eye indicator.

Assuming that the magic eye tube is properly calibrated, optimum results are obtained if the operator allows the eye to close just barely on audio peaks. If the eye overlaps once in a great while, there is probably no significant harm. But if the eye completely closes or overlaps many times a minute, then the recorded signal is apt to take on the roughness and mushiness symptomatic of excessive distortion. On the other hand, if the eye seldom or never quite closes, the chances are that the recording level is too low, which means an unnecessary sacrifice in signal-to-noise ratio; and there is none of this to spare in any machine, much less one of the home type.

To some extent, the permissible recording level will vary with the nature of the program material. Ordinarily, more distortion is tolerable on speech than on music. And on certain kinds of music a given amount of distortion is less offensive than on others. This is where experience and skill in recording enter into the picture.

As mentioned before, a prime advantage of the electronic indicator is that it responds instantaneously to transients (usually responsible for the peak audio levels), so that one obtains a correct indication of how much signal is going onto the tape. On the other hand this immediate response is not only an advantage but can also be a source of difficulty. When the transients are strong and frequent, the magic eye will fluctuate so rapidly that the operator finds it difficult to discern its meaning and to set recording level properly. The extent of this difficulty, depends of course upon the nature of the program material being recorded. A fiery composition is apt to offer much more of a problem than quiet, relaxed music.

To minimize the problem, a number of tape recorders, as indicated in *Fig.* 4, incorporate a "floating action" circuit which maintains the eye for a brief period at the maximum degree of closure. This circuit may be described as a "one way street." It permits the eye to respond (to close) very quickly when a transient comes along. But it does not permit the eye to open with the same degree of rapidity. Thus the high reading is maintained for a short while. A typical floating action circuit may allow the eye to close in about one-thousandth of a second, but may not allow it to open for about one-twentieth of a second. Although one-twentieth of a second may seem extremely brief, yet it is long enough to increase substantially the facility with which the magic eye can be read. If the persistence time were increased greatly, it would become difficult to judge the frequency of transients and make a corresponding adjustment of recording level, bearing in mind that this adjustment depends not only upon how great the signal peaks are but also how

(*Continued on page 35*)

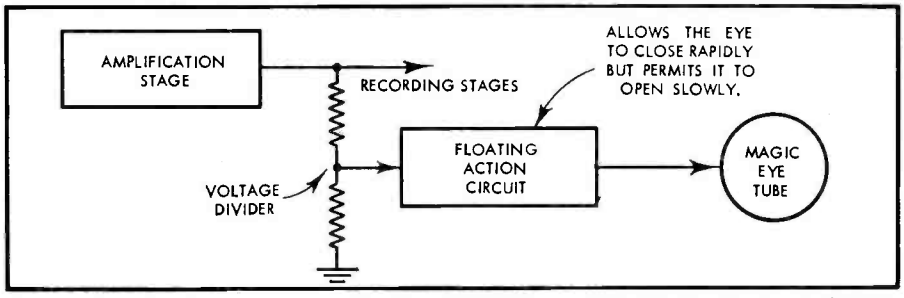


Fig. 4. Use of a floating action circuit to facilitate reading the magic eye indicator.

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The C 20 COMPENSATOR FOR STEREO

Simplicity, flexibility, and beauty have been integrated by careful engineering and design in the McIntosh C-20 Stereo Compensator. The greatest listening pleasure in stereo or monophonic reproduction is assured as a result of over a year of careful and diligent research in the requirements of a new preamplifier designed for stereo. Full stereo flexibility has been provided plus built in protection for your investment in monophonic records. McIntosh has designed in the C-20 Stereo Compensator the necessary features required to give the finest monophonic reproduction the keenest listener may require.

Complete satisfaction is yours in monophonic and stereophonic with the McIntosh C-20 Stereo Compensator.

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FACILITIES

Mode Selector: 6 positions including Stereo, Stereo Reverse, Left channel on left speaker only, Right channel on right speaker only, Left channel on both speakers, and Right channel on both speakers.

Monophonic: Internally parallels and decouples a stereo phono cartridge to offer best quality reproduction from monophonic records.

Tone Controls: Treble: boost 13 db at 20,000 cycles attenuate 18 db at 20,000 cycles
Bass: boost 16 db at 20 cycles attenuate 20 db at 20 cycles

Trim Controls: Separate channel back panel controls to balance the frequency response of the system independent of front panel controls.

Equalization: Separate bass and treble 6 position switches, including NAB tape and flat for mike or any other low level flat source.

Aural Compensator: Fletcher-Munsen compensation, continuously variable.

Rumble Filter: Rolloff to reject low frequency disturbances such as rumble.

High Frequency Cutoff: Two positions, 9 KC and 5 KC to suppress high frequency hiss and noise.

Phase: 180° phase reversal to compensate for out of phase speakers or source material.

Balance: Attenuates alternate sides of center 40 db each channel to balance for unequal source material.

Tape: Front panel jacks, push button switch controlled, to permit the addition of a portable tape recorder without disrupting the equipment permanently installed.

Tape Monitor: To permit instantaneous monitoring of tape before and after recording.

SPECIFICATIONS

Power Requirements: 117 VAC; 35 watts

Input Sensitivity and Impedance: Auxiliary, Tape, and 2 Tuner 0.25 V at 470K
2 Phono, Low: 2.5 MV at 47K
High: 12.5 MV at 47K
XTal: 0.1 V, very high
2 Tape Head, Low: 1.25 MV at 47K
High: 6.25 MV at 270K
Tape Monitor: 0.25 V at 130K

Frequency Response: ±0.5 db 20 to 20,000 cycles

Distortion: Less than 0.2% at rated output, 20 to 20,000 cycles

Hum and Noise: High level inputs: 85 db below rated output
Low level inputs: less than 2 microvolts at input terminals (—115 dbm)

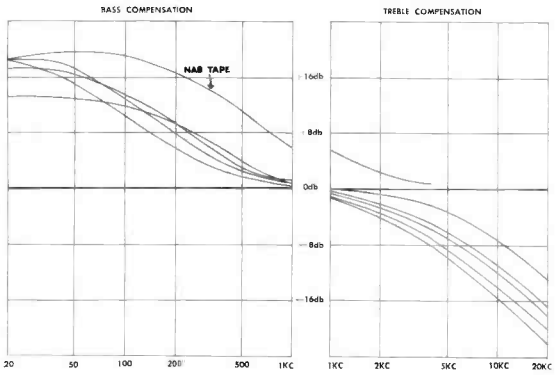
Outputs: Main: 2.5 V with rated input
Tape: 0.25 V with rated input

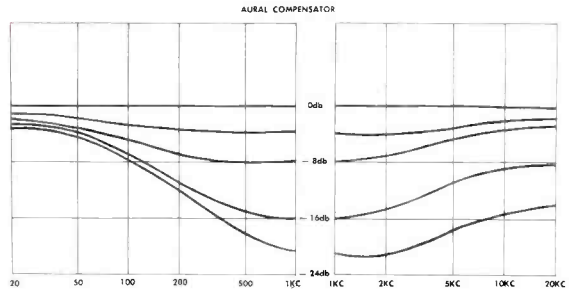
Gain: Low level inputs: 1000-1 Main Output
Low level inputs: 100-1 Tape Output
High level inputs: 10-1 Main Output
High level inputs: 1-1 Tape Output

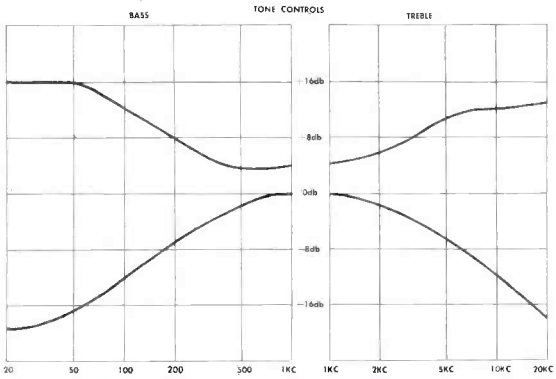
A.C. Aux. Outlets: 1 unswitched for tape machine or turntable and 3 switched

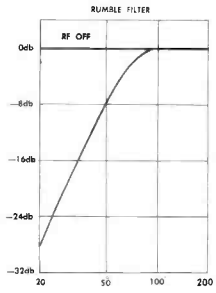
Size: Chassis: 14½ inches wide; 4¼ inches high; 12 inches deep
Front panel: 14¾ inches wide; 4¼ inches high

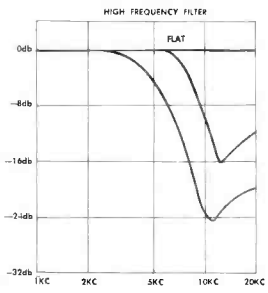
Weight: 17 pounds

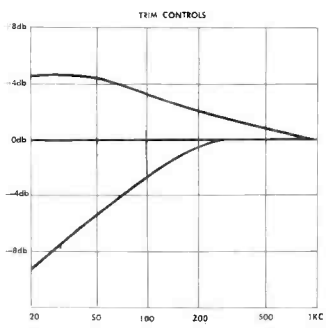












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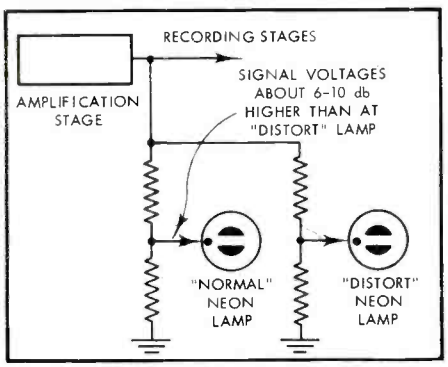

Fig 5. Use of two neon lamps as record-level indicators.

(*Continued from page 32*)

often they occur. In other words, increased persistence time would cause the transients, as they appear on the magic eye tube, to become a blur.

The Neon Lamp

Least expensive of all record-level indicators is the neon lamp. This is an on-off device, with no intermediate indication. It produces an indication only when the recording level is at or above a certain point. If the recording level is too low (with signal-to-noise ratio unnecessarily reduced), the lamp does not indicate how much too low. Even the magic eye tube, with its varying shadow, provides some indication of the extent to which the recording level is below normal. If the recording level is too high, the neon lamp fails to indicate by how much. The magic eye tube provides a little information in this respect, as indicated by eye overlap. The only indication of over-recording in the case of the neon lamp is how frequently it ignites.

The greatest flaw is the failure to provide an indication when recording level is too low. However, this is corrected in some machines by using two neon lamps, as in *Fig.* 5. One, called the "distort" lamp (or similar term), ignites at the maximum permissible recording level. The other, called the "normal" lamp (or similar term), ignites at a lower level—usually about 6 to 10 db below the acceptable distortion point. The objective for the operator is to try to adjust the recording level so that the normal lamp is ignited most of the time but the distort lamp is ignited as seldom as possible. Again, the nature of the program material must affect the operator's decision concerning recording level.

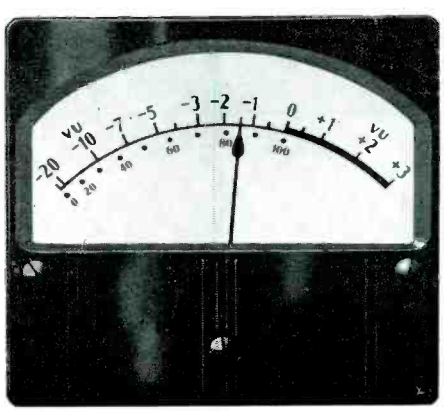

Fig. 6. The VU meter, Type A scale.

The neon lamp has inherent floating action. That is, the signal required to fire the lamp is appreciably greater than the voltage at which the lamp goes out. Accordingly, the glow produced by a transient lasts longer than the transient.

The VU Meter

The VU meter—or a similar type of meter—is most commonly found in semi-professional and professional tape recorders, although on occasion it also appears in the so-called home machine. As a matter of fact, there has been an increasing trend toward use of meters in home-grade machines, and some familiarity with the operation and characteristics of meters as record-level indicators is therefore all the more likely to be useful to the home recordist.

Characteristics of the VU Meter

VU means volume units. These units are simply decibels. The zero point on the scale (see *Fig.* 6) is an arbitrary reference level; when the VU meter is connected in the standard manner—with a 3600-ohm series resistor across a 600-ohm line (See *Fig.* 7)—a 0 reading denotes 1.23 volts of signal at the source (or 2.5 milliwatts of power in the line). All other readings on the VU scale are simply in terms of decibels above or below the 0 reference level. For recording purposes, the reference level is significant only in *relative* terms, denoting that maximum permissible recording level has been reached, after which point tape distortion becomes excessive. The *absolute* meaning of the reference level—1.23 volts—is of no consequences for recording purposes.

As may be seen in *Fig.* 6, the VU meter also contains a 0 to 100 (per cent of maximum permissible voltage) scale, which some users may find more convenient for recording purposes. In fact, in some VU meters the positions of the two scales are reversed, as shown in *Fig.* 8.[1]

The VU meter has been designed not only to have a certain sensitivity but, much more important, to have certain characteristics that facilitate the operator's understanding of the nature of the audio signal. For one thing, the standard VU meter must have a frequency response within ± 0.2 db between

[1] Both are "Standard;" Type A is usually employed where levels are being read in db. Most recording and radio studios choose Type B, which then shows "percentage utilization" of the channel. Ed.

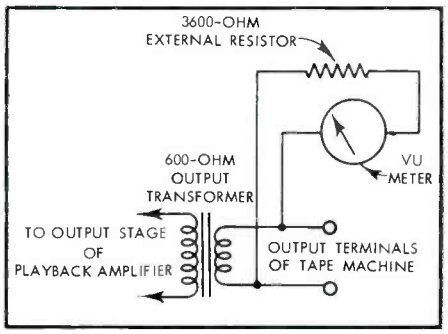

Fig. 7. Standard method of connecting a VU meter.

35 and 16,000 cps. It must respond quickly to audio signals; the standard requirement is that when a sine wave of 2.5 milliwatts power is suddenly introduced in the line, the pointer should reach 99 on the percentage scale within 0.3 seconds. On the other hand, sudden application of power should not cause the meter to overshoot and give a false indication; here the requirement is that sudden application of the same signal should cause overshot of no more than 1.5 per cent. The meter, furthermore, must be a hardy device. It should be able to withstand continuously five times the voltage that produces a 0 VU indication, and it should be able to withstand for one-half second a ten-fold voltage overload.

Advantages of the VU Meter

Compared with electronic record-level indicators, the VU meter has the following advantages for tape recording purposes.

1. It provides a quantitative indication of the extent to which the recording level is above or below that corresponding to maximum permissible distortion. Thus the recordist can vary the recording level by a desired amount. To illustrate, he may know from experience that he should record a certain type of program material about 4 db below the usual level in order to keep distortion satisfactorily low. With the aid of a meter indicator, he can achieve a db

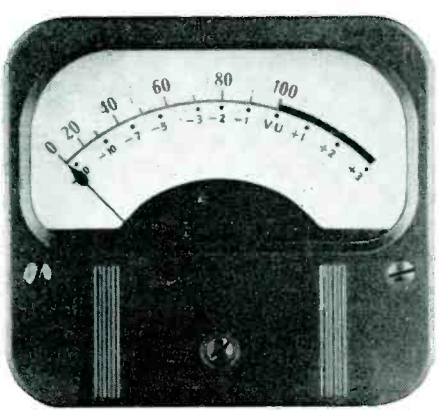

Fig. 8. Type B VU meter scale, which features units showing percentage of maximum permissible voltage.

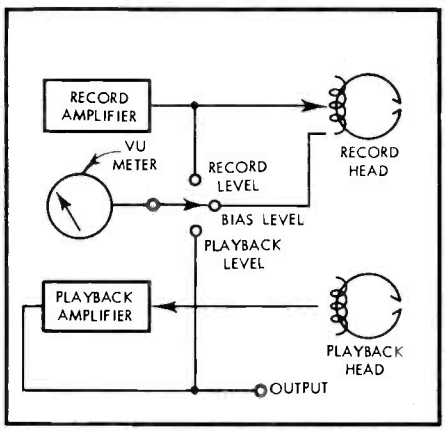

Fig. 9. Use of the VU meter to measure bias current and playback level, in addition to normal use in measuring recording level.

reduction quite closely. With an electronic indicator, however, he could not be sure whether the reduction is of the correct amount.

2. The VU meter, if made by a reputable manufacturer, is a standard and relatively uniform product, so that one meter provides essentially the same indications as another. If the meter must be replaced (much more likely due to accident than normal usage), the new one will provide very nearly the same indications as its predecessor. This is not nearly as true of electronic indicators, where the tolerances are such that significantly different readings may be obtained between two magic eye tubes or two neon lamps for the same signal. Thus one neon lamp may fire at a voltage 3 db higher or lower than another neon lamp of the same kind.

3. The characteristics of the VU meter remain stable with use and the passage of time.

4. If one insists upon top quality recording in terms of low distortion and wide frequency response, accompanied by a high signal-to-noise ratio, and if at the same time one wishes to record at speeds below 15 ips, the value of bias current supplied to the record head is quite critical. It is very important then to adjust bias current to the correct value as indicated by the tape recorder manufacturer or as determined by the recordist equipped with the instruments for checking frequency response and distortion. Assuming that the correct bias current is known, it is highly desirable to be able to check quickly and easily whether the actual value corresponds to the desired value. In many high-quality machines containing a meter, a switching arrangement is incorporated that permits one to use the meter to measure bias, as illustrated in *Fig.* 9. The machine will also have a control (usually on the rear panel or internal) that permits bias current to be adjusted if its value proves to be incorrect. (However, enough warmup time—15 minutes or more—should be allowed for bias current to stabilize.)

The electron-ray tube and the neon lamp are not sufficiently accurate in their characteristics to enable them to be used for measuring bias current with the necessary precision. If bias current is too great, high-frequency response will suffer, although distortion usually will decrease at the same time. If bias current is too low, there will be considerably better high-frequency response, but at the expense of more distortion. Thus the correct value of bias represents a fairly critical compromise point.

5. In some situations, as in a recording or broadcast studio or in other instances where professional equipment is employed, it is necessary to know the level of the tape playback signal to insure that the following equipment is being neither overloaded nor supplied too little signal for proper operation. Therefore in semi-professional and professional tape machines it is the practice to have a switching arrangement that enables the meter to measure the playback level, also shown in *Fig.* 9.

On the other side of the coin, there are also disadvantages to the use of a meter as a record-level indicator. One is that the meter is relatively expensive compared with electronic indicators. Another is that the meter requires special circuitry to drive it properly and to isolate it from the recording signal (a low impedance source is required), which further raises the cost. A third, as already mentioned is that the meter does not follow transients but lags behind them; this important problem is discussed at greater length in the next section.

Calibration of the VU Meter

Due to mechanical inertia, the meter pointer cannot follow very sudden and strong impulses. Thus one may obtain a meter indication as much as 10 db, and on some occasions as much as 20 db, below the true signal level, as illustrated in *Fig.* 10. Therefore in calibrating the VU meter so that its indication corresponds to maximum permissible recording level, a different procedure may be in order than for electronic indicators. In the case of the meter, it is desirable to make an allowance for the difference between the pointer indication and the actual level.

Accordingly, a number of manufacturers of tape recorders adjust the calibration so that the meter will read 0 VU when a sine wave (usually 400 cycles) is being recorded at a level substantially less than that which causes maximum permissible distortion on the tape. The safety margin is usually between 6 db and 10 db, depending upon the tape recorder in question. In other words, the meter is "set ahead," so that on a steady signal it indicates distortion "too soon." But on program material, where the meter fails to keep up with transients, the amount by which the meter is set ahead more or less compensates for the amount that it lags behind.

It is not absolutely necessary that the meter be set ahead in the manner described. In fact, some tape recorders fail to do so at all. It then becomes necessary for the recordist to make full allowance for the lagging nature of the meter. This means that he should not allow the pointer to exceed approximately the –10 VU mark. However, this crowds the operating range of the meter into a relatively small part of the scale.

It should be clear from the above discussion that if one acquires a tape recorder with a meter type of indicator, it is important to the user to find out if the meter is set ahead and by how much. To illustrate the point, a recent review of a tape machine employing a meter emphasized that clean recordings could be obtained with this unit only if the pointer were kept below the –10 VU mark.

Whether or not the meter is set ahead, the adjustment of recording level is far from a mechanical operation. Instead, experience and judgment must be brought to bear. The relationship between average levels, as indicated by the meter, and peak levels, which the meter cannot follow, will change in accordance with the material being recorded. As previously indicated, peaks may be as much as 20 db higher than the program average. Or they may be only 6 db higher. Thus in some cases the recordist may allow the VU meter to hit 0 VU or even higher without incurring audible distortion. For other program material, he may find it necessary to hold the pointer well below 0 VU in order to keep distortion inaudible.

Other Meters

Not all meters found in tape recorders are VU meters. In some instances, particularly machines of the home variety, the manufacturer has incorporated an inexpensive meter that simulates professional appearance without professional performance. Its main virtue is that it wriggles. The writer has

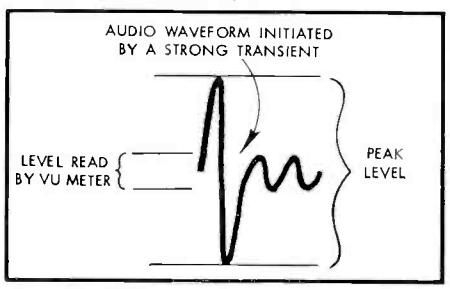

Fig. 10. Difference between actual signal level and VU meter indication.

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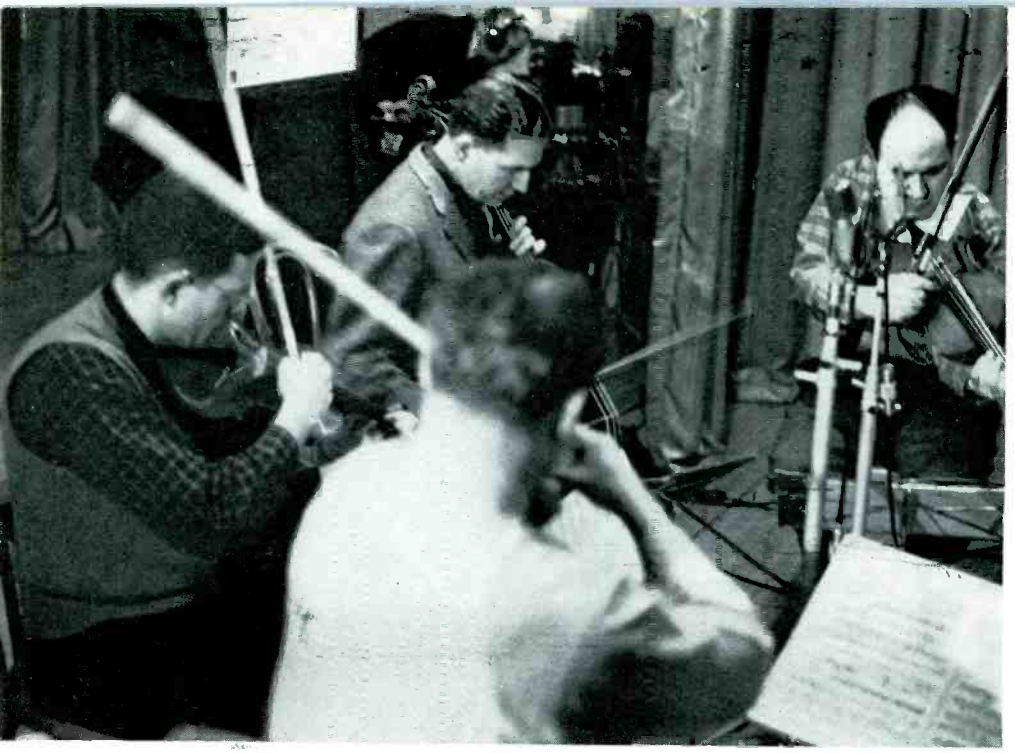

Recording the pizzicato movement of the Bartók after a long, grueling session to determine recording techniques most suitable for the special problems involved. It is 3:00 A.M. the day of the concert.

LIVE *vs.* RECORDED CONCERT *at* CARNEGIE RECITAL HALL

On January 10th, 1959, a "Live vs. Recorded" concert was given in New York City; protagonists were the internationally famous Fine Arts Quartet and a pair of AR-3 speaker systems in stereo, driven by Dynakit preamplifiers and Mark III amplifiers.

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Excerpts from reviews of this concert appear on the facing page.

Leonard Sorkin, first violinist of the Fine Arts Quartet, listens critically to trial recording.

The formal concert, during one of the "live" portions

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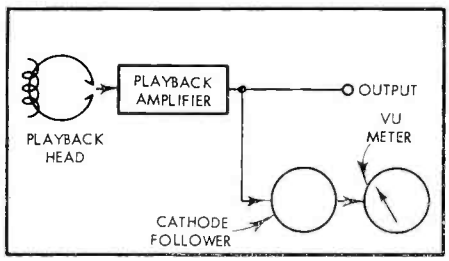


Fig. 11. Isolating the VU meter from the playback circuit to minimize distortion.

come across instances of this kind where not only was the meaning of the meter reading open to serious question, but the meter was connected to the circuit in a manner seriously deleterious to operation of the record amplifier. The user would have been far better served by a magic eye tube or neon lamp indicator.

On the other hand, a meter does not have to be a VU meter in order to render equivalent service. In some tape recorders, a meter of moderate sensitivity is driven by a vacuum tube amplifier in order to achieve the same sensitivity as a true VU meter. And the meter movement, obtained on special order, is designed to have the same characteristics as a VU meter with respect to frequency response, speed of response, overshoot, and so on.

Loading Distortion

A meter is a non-linear device. That is, depending upon the voltage of the audio signal at a given instant and whether the voltage is positive or negative at this instant, the effective resistance of the meter changes. When placed across the audio signal, the VU meter presents a changing load, which results in distortion. That is why it is necessary to have a 3600-ohm resistor in series with the VU meter, as was shown in *Fig.* 7; this resistor helps keep the loading distortion suitably low. One of the standard requirements of a VU meter is that when connected in the manner of *Fig.* 5, it shall cause not in excess of 0.2 per cent harmonic distortion.

In some tape recorders, as an extra precaution, the VU meter is isolated from the audio signal by an extra tube stage, usually a cathode follower, as shown in *Fig.* 11.

Recording on the Basis of Playback Level

In some tape recorders, either through the operator's choice or through the design of the machine, the recording level is determined on the basis of the signal coming off the tape rather than on the basis of the signal going to the record head. As illustrated in *Fig.* 12, the VU meter is connected to the playback amplifier; a suitable proportion of the playback signal, obtained through a voltage divider, is fed to the meter so that the latter gives the proper reading. At the same time, the gain control of the playback amplifier is placed in a predetermined position so that the meter reading may correctly indicate recording level.

Through the above technique, one is judging recording level on the basis of the signal that actually gets onto the tape. When using different brands of tape or different lots of the same brand, there may be differences of a few db in tape efficiency; that is, for the same signal *presented* to the tape there may be different amounts of signal *recorded* on the tape. But the amount of distortion tends to vary with the signal recorded on the tape. Therefore it may be more desirable to set recording level in terms of the amount of signal on the tape rather than in terms of the signal presented to the tape. Furthermore, in a recording or broadcast studio there may be operational advantages in leaving the meter always connected to the playback amplifier (except when checking bias current).

On the other hand, there is at least one disadvantage to the above procedure. The level of the program material cannot be checked unless the tape is in motion and being recorded; otherwise there is no playback signal. Many recordists, however, will wish to evaluate first the level of the program material, adjust the recording gain control accordingly, and then put the tape into motion. Æ

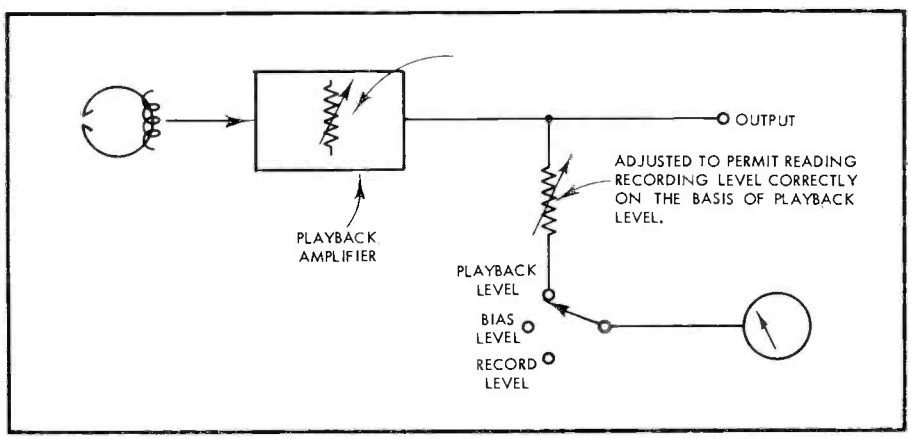
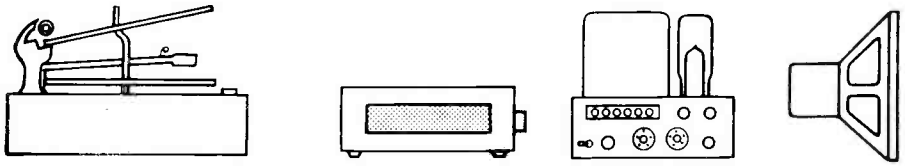


Fig. 12. Reading recording level on the basis of playback level.

EQUIPMENT PROFILE



AMPEX 960 TAPE RECORDER AND ASSOCIATED EQUIPMENT

By virtue of appearance, size, and simplicity of operation, the Ampex 960 is in the "home tape recorder" class. In performance it is professional. It is a highly versatile stereo machine capable of meeting almost any desired mode of operation. It operates at either 7.5 ips or 3.75 ips. It can operate monophonically or stereophonically. It can play either two-track or four-track stereo tapes. It has separate record and playback heads, desirable not only for monitoring purposes to ascertain whether the recording is a faithful imitation of the original signal, but also desirable to achieve various special effects that will be discussed later. It permits mixing of low-level and high-level signals that are being recorded. And so forth. About the only thing of consequence that it cannot do is to record four-track stereo tapes.

As a complete stereo machine the 960 contains four separate amplifiers, two for recording the left and right channels and two for playing the left and right channels. These amplifiers can be used in various combinations, depending upon the positions of a recording selector switch and a playback selector switch. For recording, there are altogether four gain controls. Two are for high-level input signals, one being for the left channel and the other for the right channel. These controls are coaxially mounted, and while they may be operated individually, they may also be operated as a single ganged control because there is sufficient friction between the shafts so that turning one will turn the other. Similarly, there are two coaxial gain controls for left and right microphone inputs. And there are two coaxial gain controls for playback, one for the left channel and the other for the right channel.

The playback selector switch has four positions: OFF (entire machine shut off), MONITOR, SINGLE, STEREO. In the OFF position the incoming signal from a high-level source is routed to the output jack; this is true for each channel. Frequently a tape recorder is connected to a control amplifier so that the recorder interrupts the path of signals going through the amplifier; instead, these signals are routed to the tape machine for recording purposes. At the same time, the only signal that can go through the control amplifier is that which comes from the output jack of the tape machine. Accordingly, in the OFF position the Ampex 960 provides for continuation of the signal path.

Exactly the same thing happens in the MONITOR position of the playback selector switch; also, the 960 is turned on in this and subsequent positions of the switch. By alternating between one of the subsequent playback positions and the monitor position, one can compare the quality of the playback signal, as heard through one's audio system or through headphones, with the original signal that is being recorded.

The next position of the playback selector switch, called SINGLE, is intended for monophonic playback. This routes the signal from the left channel into both output jacks, so that one may hear the sound on both speakers. The last position, STEREO, routes the playback signal from the left channel to the left output jack, and the signal from the right channel to the right output jack.

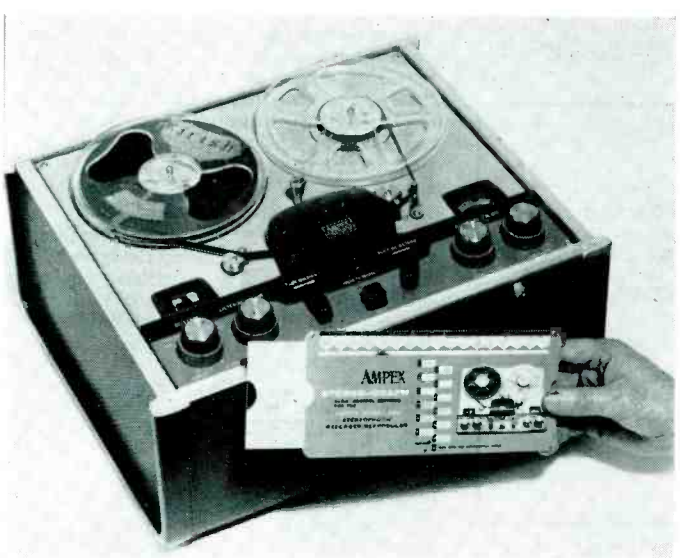


Fig. 1. The Ampex 960, shown with the Ampex Stereo-Graph, described in the text.

The recording selector switch has three positions, two for stereo and one for mono. There are two stereo positions, marked R and L. In either position, both channels are recording, provided one has pushed down the record button when turning the play-record knob to set the transport in motion. With the switch set to R, the record level meter reads the signal fed to the right channel; with the switch set to L, it reads the signal fed to the left channel. When the switch is set to single (mono), recording takes place only on the left channel. This prevents erasure of materials on the right channel.

The three heads—erase, record, and playback—are of the stacked two-track stereo type. However, for *playing* four-track stereo tapes, the playback head can be moved up slightly so that the two gaps will correspond to the tracks on a four-track tape. The head is moved by a small lever protruding from behind the head housing.

The record-level indicator is of the meter type. It is not a VU meter (although its action is similar) but is driven by a vacuum tube amplifier and rectifier. The dial is divided into two sections. About two-thirds of the area to the left is labeled normal, while the remainder at the right is called high. The recordist should adjust recording level so that at maximum excursion the pointer hits the limit of the normal area but does not exceed it; of course this will vary somewhat in accordance with the type of material being recorded. When the machine is set to RECORD, the meter is illuminated. This not only facilitates reading the meter but, more important, serves as a warning that the tape is being recorded and thereby guards against accidental erasure of a tape.

Like most professional machines, the 960 does not employ pressure pads to maintain close contact between the tape and the heads but depends upon the guide path and tape tension to maintain such contact. Avoidance of pressure pads helps minimize wow and flutter, particularly high frequency flutter, which is more objectionable and a greater deterrent to clean recording than low frequency flutter. The 960 routes the tape around a spring arm, which, when suddenly released as the result of the tape running out, stops the reels.

The recorder has internal adjustments for bias level, for varying the record-level indication, and for minimizing noise due to the bias frequency (by balancing the two halves of the dual-triode oscillator). These are all important adjustments which may be necessary when replacing the oscillator tube, the tube that drives the record-level meter, or the record head. The bias and record-level adjustments may also prove useful if one employs a tape with substantially different characteristics than the tapes commonly used, for example a high-output tape.

Equalization, contrary to the practice of many professional machines, is fixed. On the other hand, 5 per cent components are used in both the record and playback equalization networks to assure close conformity with the required curves.

In recording, the 960 produces about 1 per cent harmonic distortion at 400 cps when the meter pointer is at maximum normal position. At a level about 6 db greater—well into the high area—about 3 per cent harmonic distortion is generated, which nowadays is generally considered the maximum permissible recording level. (Some professional machines treat 1 or 2 percent as the allowable maximum; on the other hand, many home machines, including

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Fig. 2. The Ampex 880 stereo microphone kit (left), and the 881 stereo headset kit (right).

several of very high quality, treat 5 per cent as the allowable maximum.) Accordingly, the meter provides some 6 db margin, based on a 3 per cent distortion level, for the fact that the pointer lags behind transients. In other words, the pointer shows maximum permissible level when a steady-state signal is actually 6 db below that level. This is a reasonable margin of safety to prevent over-recording due to the inability of the meter to keep up with the signal.

Based on a 400-cps signal recorded at a level producing 3 per cent harmonic distortion, this observer measured a signal to noise ratio of 57 db in playback at 7.5 ips. Needless to say, this is remarkably good. The user will not have to worry about noise and hum marring his enjoyment, as is so often the case with home tape recorders. Even at very loud playback levels, and during quiet passages, noise and hum from the 960 are nonobtrusive; tape hiss is the dominating noise.

Frequency response was measured both by ear and by instrument. The ear is a better test. A high-quality mono phonograph record was simultaneously recorded and played back at 7.5 ips on the left (mono) channel. Monitoring the original signal against the tape playback signal, the writer could perceive only extremely slight differences from time to time, and when there was a noticeable difference he could not be sure whether he was listening directly to the record or to the tape playback, except for the telltale position of the playback selector switch. With someone else operating this switch, he was left in a quandary. In sum, the recording was close to a perfect facsimile of the original.

However, when recording on the right channel, there was a slight veiling of the high end. An instrument check revealed that frequency response was down 2 db at 10,000 cps and 12 db at 15,000 cps on the right channel at 7.5 ips, whereas response was but 2.5 db down at 15,000 cps on the left channel. The latter is very close to the Ampex specification of 2 db down at 15,000 cps. When operating at 3.75 ips on the left channel, there was a similar slight veiling of the sound. Nonetheless, the quality of reproduction could still be considered very good by all except highly critical ears. When recording and playing back at 3.75 ips on the right channel, the veiling effect became more definite. At 3.75 ips, response at 10,000 cps measured only 2 db down on the left channel and 9 db down on the right channel.

It is possible that the discrepancy between the left and right channels with respect to high-frequency response in the unit tested by the writer lies in the azimuth alignment of the lower and upper gaps with respect to each other in either the record or the playback head. Accurate azimuth alignment of the gaps relative to each other is very difficult to achieve, and it is to be expected that an occasional head will fail to measure up to the desired accuracy.

Sensitivity of the 960 appears to be quite adequate for microphones. However, it appears marginal for high level inputs inasmuch as 0.3 volt is required at 400 cps to enable one to record at a level sufficiently high to produce 3 per cent harmonic distortion. Playing a record with an ESL C-60 cartridge through a Dynakit control amplifier and feeding the 960 from the tape output jack of the Dynakit, the writer found it necessary to turn the high-level gain control of the 960 almost full on to obtain adequate recording level. It seems possible that on low-level records or weak radio or TV signals one might not be able to record at a satisfactorily high level.

Motion of the transport mechanism is very good, as checked by ear on steady signals and as observed on an oscilloscope. Speed is quite accurate for a machine not using a hysteresis motor. The writer measured speed as being about 4 seconds fast in a 10 minute run of a test tape. This is about ⅔ of 1 per cent error in pitch, which extremely few of us can detect.

On the whole the 960 handles well in terms of transporting the tape at operating speed and in terms of rapid wind and rewind. The writer found it virtually impossible to break the tape by changing quickly from one mode of operation to another, even when the motor is shut off during rapid wind or rewind, a difficult test to pass. However, he did find one mechanical difficulty of serious proportions, which may or may not be an aberration unique to the unit that was tested. If the machine were put into fast wind position, the stop button pushed, and—*before the reels had come to a halt*—the play-record knob actuated to move the tape at normal speed, this would cause a rubber belt in the drive mechanism to jam. The belt is the one that drives an idler wheel which in turn drives the takeup reel. When the takeup reel moves faster than the idler wheel and the two are brought together (by the play-record knob), this causes the belt to throw a loop to the right side, jamming it between the flywheel and the support for the record level meter. Extricating the belt is simple, but first one must remove the top-plate, which requires several minutes and is a nuisance. If the difficulty is characteristic rather than confined to a single machine, it seems the manufacturer could readily solve it by including an additional guide to prevent the belt from looping excessively. Of course, one *shouldn't* put any tape recorder in the play or record mode while the reels are moving, but it could be done by inadvertence.

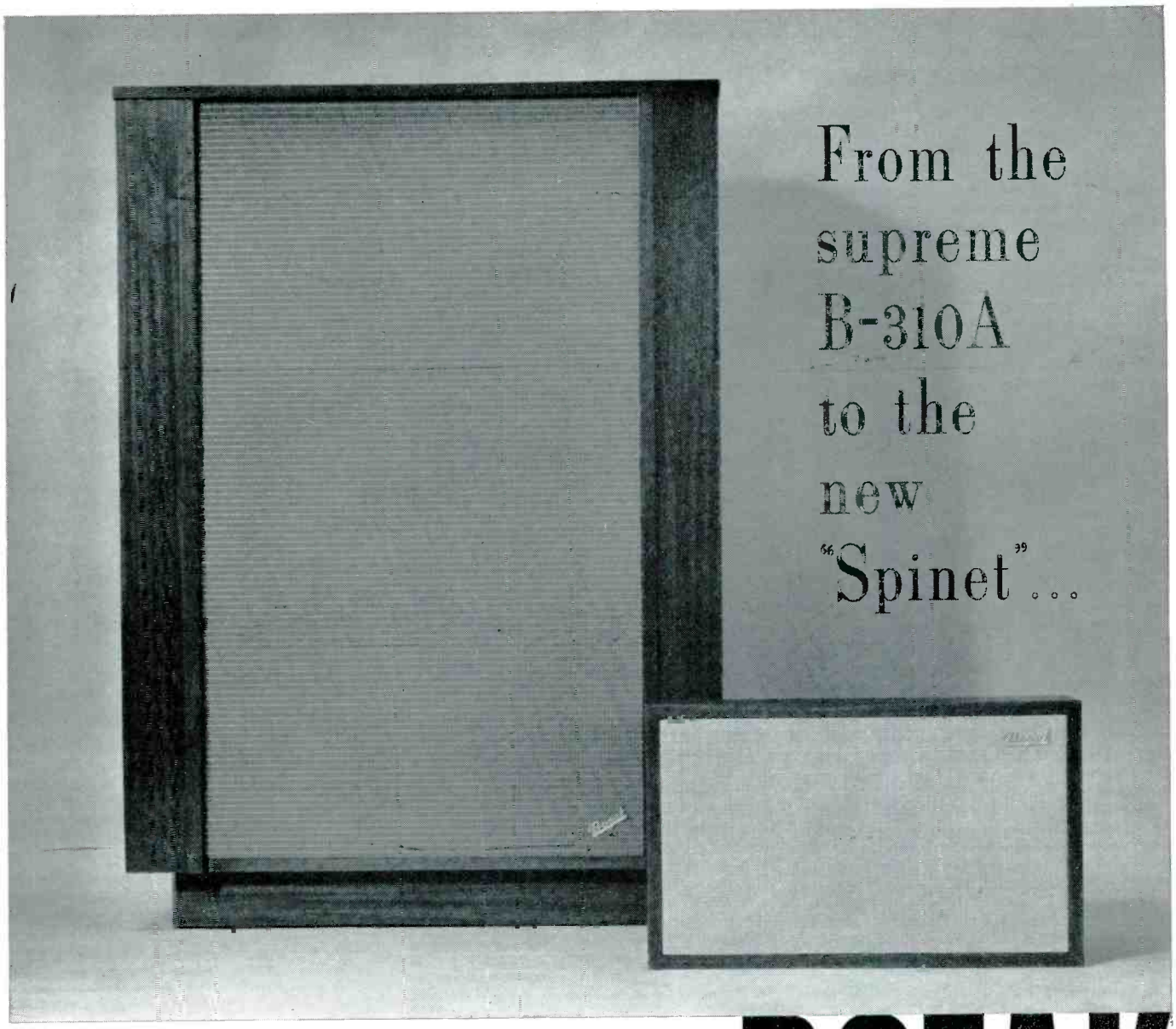
Some difficulty was also noted concerning the speed selector knob. The knob causes a rubber belt between the motor shaft and the capstan to move up and down, thereby riding either a large diameter (up) or small diameter (down) portion of the shaft. The "owners manual" supplied with the 960 has a note stating "Equipment must be on when changing speeds." This does not appear adequate for two reasons. First, the note is not displayed prominently enough; it appears nowhere in the instruction booklet or the "stereo-graph" accompanying the 960. Second, it is difficult to change from the 3.75 ips speed to the 7.5 ips speed (from down to up) if the equipment is on but the tape is in motion. One should attempt this speed change only when the equipment is on and the transport mechanism is in the idle position. If one attempts to change from 3.75 ips to 7.5 ips under other circumstances, there is danger of jamming the capstan drive belt. In fact, even when making the change properly, one will occasionally hear a protesting sound from the belt, signifying that it is not moving as intended. The thing to do is to push the speed change knob down again, then try once more, using a sure, quick motion to bring it up.

There is an interesting point worth mentioning in connection with the two knobs used for wind-rewind or setting the transport into the play-record modes. These are of flimsy construction, and deliberately so. They are intended as shear knobs that will break in the event the operator tries to force the transport into a mode of operation for which it is not intended—for example, if one attempts to turn the play-record knob when the transport is in the fast wind mode. This is characteristic of the intelligent design that is apparent when one looks "under the hood" of the 960 to inspect its mechanical operation.

Electronics

The record and playback amplifiers in the 960 are of simple, straightforward design. In recording, two triode stages are employed for amplification of high-level signals, the second triode serving as the record-head driver. All recording equalization—treble boost—is achieved by what is practically a standard circuit, consisting of a large cathode resistor which is bypassed

Fig. 3. With the 960, it is easy to learn a language with the instructor on one track and your own phrases on the other, facilitating home practice and providing immediate and direct comparisons.



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by a series resonant coil and capacitor tuned to about 15,000 cps. When recording from a microphone, two additional triode stages are used.

In playback, one dual triode provides all the amplification (for one channel). This is succeeded by a cathode follower to produce a low output impedance. Peak output is about 0.5 volt, which should be sufficient to drive virtually any home audio system. Playback bass boost is produced by plate-to-cathode negative feedback (from the second triode to the first), using a turnover frequency of about 3000 cps at 7.5 ips, which for practical purposes is NARTB equalization (the precise NARTB turnover is 3180 cps). For high gain and simplicity, the equalization circuit does not incorporate a turnover point at 50 cps, per NARTB requirements, but depends upon the characteristic "sloppiness" of the feedback curve at very low frequencies to level out the bass boost in the manner required by NARTB. The writer measured response down 2 db at 50 cps, which agrees with the Ampex specifications; the NARTB standard permits response to be down as much as 4 db at 50 cps.

At 3.75 ips, Ampex uses bass boost with a turnover of approximately 1500 cps, which is interesting to know in view of the industry's tendency to follow Ampex's lead.

As stated earlier, the 960 is a very versatile instrument. In addition to the variety of recording and playback modes already mentioned, it permits several special functions, such as echo-chamber effects, sound-on-sound recording, and language instruction, where instructor and student record on separate tracks and the results are compared.

The 960 is an attractive package and, considering all that it contains, a compact one, measuring about 17" wide (bear in mind that the distance across two 7" reels is 14"), 14" deep, and 9" high in the case.

In closing, it should be noted that the 960 is accompanied by extensive instructions in the form of a booklet that lists the various modes of operation and details the setting of each control for each mode. For the operator's convenience, these listings are also supplied in the form of a slide rule that Ampex calls a stereo-graph.

Ampex 2010 Amplifier-Speaker

The 2010 comprises a speaker and amplifier in a single case of the same dimensions and appearance as the 960 tape recorder. The speaker is about 8" in diameter. The amplifier is essentially the Mullard 520 circuit, employing an EF86 pentode at the front end directly coupled to a loug tailed phase splitter, a 12AU7, driving a pair of 6V6's operated as tetrodes. Negative feedback from the secondary of the output transformer to the cathode of the EF86 is frequency discriminating to compensate the losses of the speaker at the bass and treble ends of the audio spectrum. Ampex refers to this arrangement as an "electro-acoustic transducer." In addition, there is provision for varying the feedback network to provide either bass boost or treble boost by means of a single tone control on the front panel.

The front panel also contains a gain control and a selector switch, which turns the amplifier on and off and selects one of the following inputs: TAPE, TUNER, PHONO, and TV. Hence the amplifier can serve as a control center in conjunction with a tape machine, tuner, and other signal sources. The phono input is not intended for magnetic pickups inasmuch as the 2010 does not contain a preamplification and equalization stage. On the other hand, there would be some difficulty in accommodating piezoelectric cartridges inasmuch as these typically require a load impedance between 1 and 3 megohms, whereas the input impedance of the 2010 is only 0.25 megohm. By advancing the tone control toward the bass-boost position, one might obtain passable bass response from a piezoelectric cartridge.

The 2010 has a tape output jack for feeding incoming signals to a tape recorder. In any selector position but tape, the incoming signal is fed to the tape output jack. Thus the 2010 is a complete companion to the 960.

Performance of the 2010 at the bass end is surprisingly good. This is partly due to the bass boost incorporated in the amplifier to balance the speaker characteristics. It is also due to the acoustic loading of the speaker. About half-way between the front and rear panels is a thick rectangular pad of felt or felt-like material that partitions the enclosure. This serves to damp the speaker and prevent a substantial resonant peak from developing well up in the bass region due to the limited size of the enclosure.

Over-all the 2010 sounds well-balanced and pleasing on music, with the tone control at mid-position. To the extent there is a deficiency, this appears to be more at the high end than at the low end. On speech, the 2010 sounds definitely bassy. However, the tone control is available for correction.

The writer played several stereo tapes of good quality on the 960 in conjunction with two 2010's, and the results were highly satisfactory. One of the tapes was a violin concerto, and in the passages for full orchestra the sound had a breadth and depth that made it difficult to believe it was emanating from two relatively tiny speaker systems. The sound was completely disassociated from the speakers. It was true stereo.

There was no information in any of the materials accompanying the 2010 as to its power rating and other specifications. The writer wanted to make measurements, but found it very difficult to remove the amplifier from its case because of a tight fit, and gave up the attempt. This raises a question as to what the owner will do when he wishes to test and/or replace tubes.

Ampex 880 Stereo Microphones

The 880 is a set of two microphones, each with an 8-foot cable. They appear to be Electro-Voice 623 microphones, which are high-impedance dynamic units with a rated response of 60 to 12,000 cps. The cable is limited to 8 feet in order to prevent significant treble loss. The cable has about 500 μμf capacitance, which is about 60 μμf per foot. Should the user need to work at a greater distance than 8 feet from the tape recorder, he can substitute microphone cable with a capacitance of 25 to 30 μμf per foot, which makes a 15-foot length feasible.

The microphone does a very good job, consistent with the quality of the 960 tape recorder. When a tape was made with one of these microphones as the source, reproduction was quite life-like upon playback through a high-quality speaker system (although bassy when played through the 2010). The 880 microphone was compared with a more expensive Electro-Voice microphone that is very well regarded in audio circles, and there was not much to choose between the two. Some listeners preferred one and some the other. (Incidentally, this points up the fact that microphones, somewhat like speakers and cartridges, are better evaluated subjectively than objectively.)

Ampex 881 Stereo Headphones

The 881 consists of headphones with provision for feeding the left signal to one ear and the right signal to the other ear. It has a 5-foot cable and comes with an adapter having a 9½-foot cable, so that it may be used at distances up to 14½ feet from the tape machine. At one end of the adapter are two phone plugs that fit into the output jacks of the 960. At the other end is a small box with two jacks, in parallel. Each jack carries both the left and right signals and is designed to accept a 3-conductor phone plug. The cable of the headphones terminates in such a plug. The purpose of the extra output jack of the adapter is to accommodate a second pair of phones.

The Ampex 881 is the only item of Ampex's home stereo equipment that proved a disappointment to the writer, possibly because the unit tested was defective. The sound was tinny and not pleasant, in no way comparable with the quality of the 2010. The writer was reminded of some of the speakers he has encountered at outdoor movies. Moreover, wearing the headphones more than a few minutes proved oppressive and uncomfortable. Given a choice between speakers and headphones, the only reason that the writer can find for using the headphones would be for monitoring purposes or language instruction.

On the other hand, if circumstances compel one to listen through headphones, the Ampex 881 definitely proves a point: that stereo listening is far superior to mono listening.

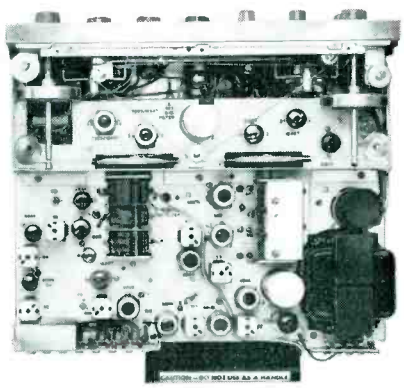
When listening to a properly-made stereo tape, having good center fill, the results are much more acceptable than when listening to a "fake stereo" or "ping pong" tape having extreme separation between sounds on the left and on the right. The writer listened to a "ping pong" tape of a Broadway musical, and it was irritating to hear a soloist in one ear and orchestra in the other, or a duet with each singer in a different ear. On the other hand, when listening to a stereo tape with good left-right fusion, the results were much better —but still tinny. **G-25**

PRECISE MARK XXIV "INTEGRA" STEREO AMPLIFIER

Combining many attractive and normally luxurious features into an economically priced stereo amplifier is somewhat of a manufacturing chore these days, but Precise seems to have done just that with the new "Integra" stereo amplifier, Mark XXIV. This unit incorporates two individual amplifier-preamps in a single compact unit, with each one capable of 20 watts output, or when paralleled, a total of 40 watts on the resulting single channel.

This amplifier, shown in *Fig.* 4, is built with an unusual layout—each section being essentially separate. The left three knobs in the top row pertain to the channel 1 amplifier, while the right three pertain to channel 2, with bass, treble, and volume controls. The lower left knob is a master loudness control affecting both channels, thus permitting independent adjustment of levels yet providing for a ganged control for convenience in operation. The lower right knob is the selector, with positions for stereo phono, stereo tuner, tuner with TV, TV alone, and tape amplifier. The slide switches, from left to right, are: power on and off, with a third position controlling panel illuminating lamps; contour, with normal, −10, and −20 positions; function, with positions for stereo, multiplex, monophonic, and mute—which silences the amplifier while you answer the

There are two ways to design a piece of equipment: One is to fix the cost and design around it. The other is the Pilot way: produce the finest unit possible and then price it accordingly. If we knew of another useful feature to add to our Pilot 690-A, you would find it in the list below. Not cost for cost's sake, but for performance's sake.



PILOT 690-A STEREOPHONIC FM-AM TUNER-DUAL PREAMP: $289.50

Tuner Section: A deluxe, professional stereo unit offering the ultimate in reception, even in difficult fringe areas. Its independent FM and AM sections may be used individually for FM or AM alone, or simultaneously for FM-AM stereophonic broadcasts. With an external Multiplex demodulator, the 690-A will provide FM Multiplex stereo reception. FM tuner features include 1 microvolt sensitivity for 20 db of quieting: low-noise, dual-triode golden-grid cascode RF amplifier with accurately tracked antenna and interstage circuit tuning. Freedom from drift is assured by means of a temperature compensated oscillator. Wide-band detector (1,000 kc wide) makes tuning completely non-critical. Audio output constant and independent of signal level. 3 I.F. stages and 2 limiters, dynamic gated beam and saturation type. Interstation noise suppression (muting) with control for optional muting defeat. Independent FM tuning meter for true center-of-channel tuning and precise station selection. Built-in FM power-line-cord antenna, and facilities for 300-ohm twin lead and 72-ohm coaxial cable included. AM Section: Sensitivity, 2 microvolts; employs germanium diode detector for maximum efficiency, lowest distortion. Features high-gain pentode RF amplifier, 2 steep-skirted I.F. stages with front panel bandwidth control and 10 kc whistle filter. I.F. interference rejection trap. Separate AM tuning meter. Built-in ferrite-core antenna. Dual cathode follower outputs permit long cables without signal loss.

Preamplifier Section — The preamplifier has two identical channels. Unique automatic shutoff enables record changer to optionally turn off entire system after last record has played. DC heater supply; feedback tone control circuits; audio and tape outputs. 4 independent tone controls with Pilot TroLoK for optional ganging. 14 inputs. 3 pairs of high level inputs for permanent simultaneous connection of FM-AM tuner, Multiplex adapter and tape recorder. 4 pairs of low level inputs for tape head, microphone and permanent connection of record changer and turntable. All inputs non-shorting to permit tape recording and playback without short-circuiting tape recording signal or changing of plugs. Electronic crossover for monophonic operation. Mono position on Mode switch automatically cancels out undesired vertical stereo cartridge response when playing monophonic records. 18 tubes, 5 diodes, plus rectifier. Size: 14⅝" wide x 5½" high x 14½" deep. Weight: 25 pounds. Complete with enclosure. **$289.50.**

Write for our Brochure describing in detail the Pilot 40th Anniversary Stereophonic Component Series: Stereophonic Tuners—$179.50 to $289.50. Stereophonic Preamplifiers—$89.50 to $199.50. Stereophonic Amplifiers—$89.50 to $139.50. Stereophonic Preamplifier-Amplifiers—$129.50 to $199.50. All prices slightly higher in the West.

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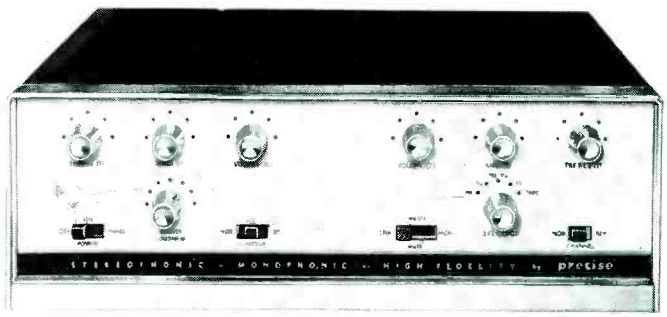

Fig. 4. Precise Mark XXIV stereo amplifier, the "Integra."

telephone—; and a channel reversing switch.

The chassis is arranged to accommodate a multiplex adapter inside the case, it being necessary only to make a number of connections after the adapter is installed physically. Thus no external devices must be added to make it possible to add multiplex operation to the amplifier.

On the rear panel are provided a phase reversing switch and a hum balance control, together with the inputs and outputs and an a.c. outlet. The phono preamp has inputs for magnetic or ceramic/crystal cartridges, and dual outputs are provided to feed a tape recorder.

Each amplifier channel employs two 6BQ5's (EL84's) (EL84A's), half of a 12AU7, and one and a half 12AX7's. Plate power is supplied by a 6AC4 (EZ81), while bias for the output stages is furnished by a germanium diode working in conjunction with a neon regulator tube to maintain a constant bias voltage. The effectiveness of this circuit shows up in the output figures.

Pe.formance

The unit tested measured 3 per cent IM distortion at 19 watts, but up to 12 watts the figure was below 1 per cent. The two channels were well balanced, both as to output and frequency response. The phono channels were within 3 db of the exact RIAA curve, and on the high-level inputs the response was flat within 1 db from 20 to 17,000 cps, according to our measurements. Sensitivity was sufficient to accommodate all but the extremely-low-output magnetic cartridges, and quite adequate for the ceramics. Hum and noise measured 48 db below 1 watt on the phono inputs, and 59 db below 1 watt on the high-level inputs.

One advantage of the completely separate volume controls in the two channels is that once the levels are set, the master loudness control operates on both channels simultaneously, avoiding the problem of non-tracking controls which has been encountered in some observed. Many users will find that the separate tone controls are somewhat of an advantage, although we would prefer to have them ganged *if*, and *only* if, they were closely matched. Undoubtedly there is more flexibility to be obtained from the separate controls than from any ganging combination, although for our own purposes, we have noted that we very seldom use a tone control at all. But that is why there are so many different "system philosophies" in the various amplifiers on the market—some like them one way and some prefer them another.

The 20-watt outputs of the Mark XXIV would not be considered sufficient for some of the low efficiency speakers, since the amplifier would be working up into the higher distortion areas much more of the time, but with speakers of reasonable efficiency this unit would serve quite well.

G-26

LESA RECORD CHANGER MODEL CD2/21

One of the newest record changers to reach these shores—meaning that it is an imported model—is the LESA CD2/21. This unit is made in Italy, and while it is not equipped with a host of features, it does a remarkably efficient job of record changing. However, while somewhat simplified, the LESA is fully automatic, runs at four speeds, intermixes 7-, 10-, and 12-inch records, can be operated manually, and works through its change cycle in six seconds regardless of the turntable speed. In addition, it has a four-terminal plug-in head and two output cables, and the outputs are shorted when the last record is played and the arm returns to the rest, stopping the motor and retracting the idler wheel.

The changer is finished in two tones of gray, and has only two controls—the speed-change knob, and the on/reject or stop knob. The latter retracts the idler whenever the unit is shut off, although if it is permitted to shut itself off at the end of the last record it retracts its own idler. The mechanism which determines the set-down point consists of a feeler arm which raises from its housing alongside the arm pivot during the change cycle. When a 7-inch record drops, it misses the feeler completely so the arm sets down at 7 inches. A 10-in. record pushes the feeler down just a little, and a 12-in. record pushes it all the way down, thus setting the mechanism to make the arm set down at the correct point. At the conclusion of the change cycle, the feeler arm retracts. The record balance guide drops to its lowest position when no more records are on the spindle, which causes the unit to shut off after the last record is played—thus it will play 7-in. records indefinitely if the balance arm is prevented from dropping completely by the insertion of a card, for example, near its axis to hold it above its resting point.

The change cycle operates through a set of Nylon gears completely independent from the rubber idler, which accounts for the constant cycle time, and this feature also removes the cycling drive pressure from the turntable idler. The motor is a heavy four-pole type; the turntable itself is quite heavy; the arm, metal, apparently has no resonances—at least, none in the important audio ranges.

One example of simplified construction is the method by which the stylus force is changed. The arm is spring-counterbalanced, the adjustment being made by positioning a small removable metal punching into one or another of a number of slots molded into the underside of the arm. The spring is removed from the punching, and the latter is pulled out of one groove and put into another by means of a pair of long-nose pliers. Admittedly not as quick as a screw or nut type of adjustment, but who changes stylus forces daily, or even weekly? Once the user has decided what cartridge he is going to use, he adjusts the stylus force and then leaves it alone, probably for months at a time. But the total cost of such a device is considerably less then some other types of adjustment, and this is reflected in the cost of the unit. The range of adjustment with a GE VR-22 cartridge is from well over 15 grams stylus force to less than zero, which indicates that the range will accommodate both heavier and lighter cartridges than the GE model.

Rumble level of the LESA measured at −32 db, in accordance with NARTB standards, and this is only 3 db below the standard for broadcast reproducing turntables. Actually, the figure seems relatively low, but the method of measuring specified uses a stylus velocity of 7 cm/sec as the reference (1.4 cm/sec at 100 cps) whereas the normal maximum stylus velocity is nearer 20 cm/sec, so the signal-to-noise ratio is actually 10 db higher.

We would consider the LESA as a high-quality medium-priced changer which would be particularly ideal in an installation where the user had both a single-play turntable and a changer—primarily using the latter for background-type music or for those applications where a changer was especially desired. It works smoothly and quickly, and with never a jam in 297 actual cyclings. In other words, it is an effective work horse of a changer which does its basic job of changing records well. No tricks, perhaps, but a consistent performer.

G-27

Fig. 5. The LESA CD2/21—a new record changer from Italy.

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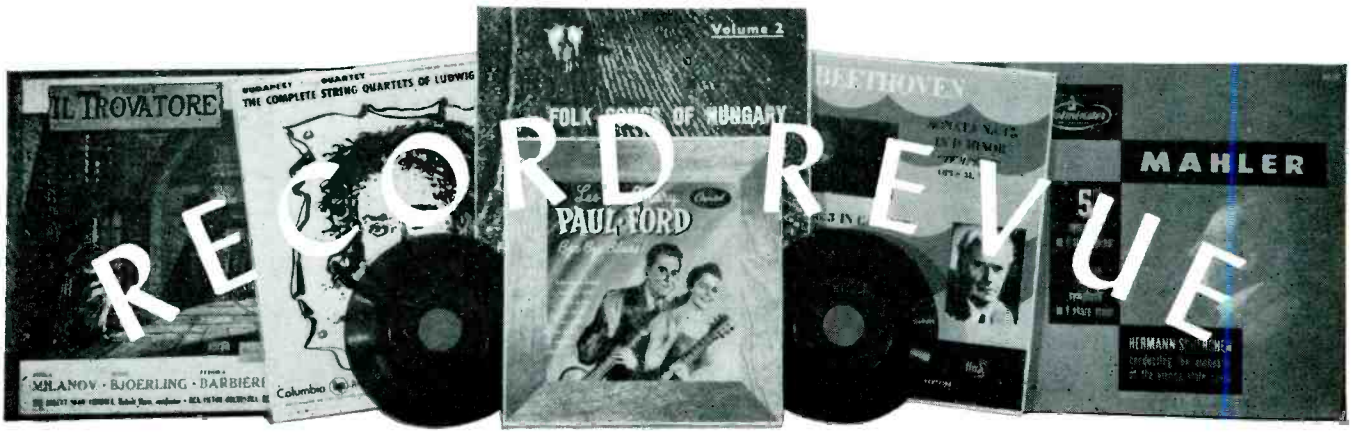

EDWARD TATNALL CANBY*

1. BIG NAMES

D. Scarlatti: Tetide in Sciro (Thetis in Skyros). Soloists, Angelicum Orch. of Milan, Janes. **Westminster OPW 1305 (3)**

This quite lengthy classical opera is a fine lesson in music appreciation, new-style, especially for those who have dabbled in that somewhat old-fashioned kind of music history. You always hear about the "old" or classical opera but you seldom, if ever, get to listen to an actual example. The piquant aspect of this one is that it is by *Domenico* Scarlatti, he of the hundreds of harpsichord sonatas, rather than by *Allesandro* Scarlatti the great master of "old" opera! This opera was rediscovered only a few years ago and it is the only such work of Domenico S. that is still extant.

Westminster, it seems to me, could have used a bit more imagination in packaging this music for home use. The opera, like others of its type, consists of a large number of single arias, each preceded by a stretch of recitative to the harpsichord. Each recitative introduces a new bit of the story, takes things forward a bit, makes clear another slice of complication —and the arias furnish the musical commentary on the situation. Without an understanding of what is going on at the moment, you'll find yourself listening to what amounts to an extended concert of Italian classical "songs." (Most of the old Italian music sung in solo voice recitals today originates in such operas.) Very nice, but too much of a muchness, what with six entire LP sides of the stuff! Even Scarlatti would have been horrified at the idea.

The libretto, of course, is what keeps you on the operatic track. With its help, you can enjoy the opera in its proper sense. (No opera was ever composed, remember, to be heard and not understood.) Westminster gives us the complete libretto in Italian and English side by side. The only trouble is that though the printed text is complete, the recorded opera is extensively cut in order to scale it down from the original evening-long entertainment to a mere three-record LP album. And each cut is its own booby trap.

To be sure, the cuts are studiously marked in the libretto by an X at the beginning and a very unobtrusive O at the end. But as you follow the music by ear and eye together, you are bound to be derailed at each X. The music jumps in a flash, while you flounder down the columns of the text trying frantically to locate the end of the cut—and if you don't work fast, you'll be lost, since the music doesn't wait.

I did my best, but I found that the pay-off was that you must necessarily read through the cut-out parts of the text if you are to make sense of the story. Some cuts are whole scenes long.

This, you see, is a problem that needs an ingenious solution, which it doesn't get here. Not easy, and I can only suggest that Westminster could have done something simple such as print the cut portions in Italics, for instant visibility. That's what I mean by imagination. Sure, it might cost a bit more, but why put the opera on records in the first place? Yes, it's a fine cultural monument on records and all that. Let's give Westminster all credit for making it available. But I'm the sort who insists (as you will) that this sort of recording be practical, as well as cultural.

The story isn't easy, at that, what with a passel of disguises—the hero, Thetis, dressed as a woman and named Arminda and oppositely, a lady named Antiope who is disguised as a man named Filarte! Everybody falls in love with everybody else, usually of the wrong sex, and the hand of fate and destiny takes a devious route before all is untangled and the right people pair off. And yet this ultra-serious plot, zany by itself for us today, is given dignity by the music and becomes beautiful along with it. That's why the libretto is so vital for a modern listener.

The music itself is lovely and will cause you no trouble at all, except in its quantity. Tuneful, dignified, expressive, it is sung here by a dedicated group, with good pitch and diction and only a suggestion of the Verdi-style operatic bellowing that is the natural style of Italian singers today. A small orchestra plays a pleasing orchestral backdrop in excellent style.

Gesualdo: Canzonetta, Madrigals, Gailliards, Sacrae Cantiones, Psalms (Vol. 2). Conducted by Robert Craft.
Columbia MS 6048 stereo

This second volume of music by the famed Italian eccentric nobleman of the early 17th century (he was a fine murderer) continues a movement towards a new kind of professional singing of today, that might almost be called anti-operatic. It is, as you hear it on these records, a kind of vocal chamber music, sung by perfectly matched, semi-anonymous voices that blend as smoothly as a string quartet, the individual singers barely maintaining any personality at all—indeed, they are listed only in the small type on the record's back side. The singers alternate with a string quartet, for variety in the listening.

Though I enormously admire the finesse of these performances, the perfect blend, the absolute pitch accuracy, the careful diction, I still do not feel that they represent the sense of the music very well. They sing dead-pan, these people, where to me the music is almost violently, explosively eloquent. They stress a gentle, steady beat, in the modern way, whereas there should be no beat, but only the dynamic shape of the actual words themselves.

You'll pardon me this opinion—I conduct my own group of singers in music of this sort and we do it quite differently. With all deference to Mr. Craft, who is one of the most brilliant conductors of contemporary music now alive and an extraordinary musician as well as scholar and writer, I feel that he reads a twentieth century instrumental neo-classicism into this music that is simply not there. It sounds like Stravinsky—which isn't at all surprising since Craft has been an outstanding interpreter of Stravinsky and a close associate of that master.

Ah! But the vocal tone quality, the perfection of blend, the organ-like harmonies! It's an experience to hear this group in Gesualdo's amazingly daring music, if only for the accuracy with which its actual pitch is reproduced for the listening ear.

The string quartet plays some unexpected instrumental bits by Gesualdo and does it poorly, in a choppy, unsteady fashion, without style. Not a very happy contrast.

Brahms: Symphony #4. Boston Symphony, Munch.
RCA Victor LSC 2297 stereo

Did I warm up to this record as it went along? Or does it begin with less impact than it ends? To be sure, the first movement opens quietly—but throughout it I felt that the restrained classicism of Brahms was something else again than this careful, held-in production, the high, double-octave string passages almost inaudible in contrast to many an old-fashioned performance where they almost squeal, all out of tune! The top impact of this recording comes in that most formal of structures, the great chaconne of the last movement based on an eight-note rising chromatic theme. There, it really hits.

The Boston strings never play out of tune, anyhow, no matter how high they must screetch; but I really think old Brahms would have liked a first movement with more warmth than this one. No guts, no freshness. (But how could there be, after thousands of playings? That's always the big question.)

Maybe it's right that this music should now lack freshness for American musicians, even though in Germany Brahms reigns forever, alongside of Bruckner. Could be that we have more progressive, less traditional ears. Could be that our musicians really do prefer something newer, more indigenous, more of the present. Just a thought in passing.

Brahms: Piano Concerto #2. Gilels; Chicago Symphony, Reiner.
RCA Victor LSC 2219 stereo

A splendid combo here, as in other cases where the steely Reiner has lent his fine discipline to a soloist with romantically poetic expressiveness.

By himself, Reiner tends to screw up the tension in Brahms to an unheard-of tautness, to stylize the warm, relaxed passages and pile on the climaxes until it hurts. But the Russian school of performance hasn't got to this stage yet (though their composers have)—the Russian playing of Romantic music is still remarkably lush and expressive. That's what Gilels brings to this huge concerto, an authoritative playing that is utterly disciplined and shaped in the largest mould, yet still remains easily warm where warmth and a sense of relaxation is the requirement. It's a dying art, this, and the fact that it has died sooner over here than in Russia might, perhaps, indicate faster "progress" here, towards newer musical expressions. Again, just a passing thought, in retrospect.

Mahler: Symphony # 10.
Walton: Partita for Orchestra (1957). The Cleveland Orch., Szell.
Epic BC 1024 stereo

I had never heard the Mahler Tenth before—two movements salvaged from his last, unfinished symphony. This recording (not the

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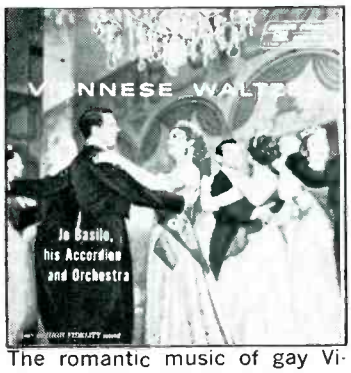

The romantic music of gay Vienna captured in all of its tuneful beauty by the artistry of Jo Basile and his accordion.

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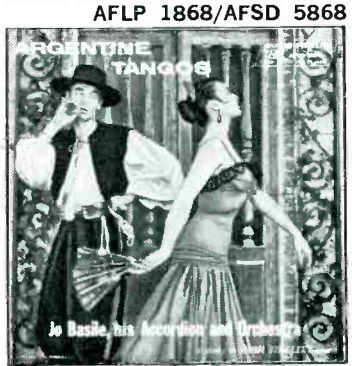

Jo Basile and his accordion are ideally suited for the rich and graceful mood of the sophisticated tango.

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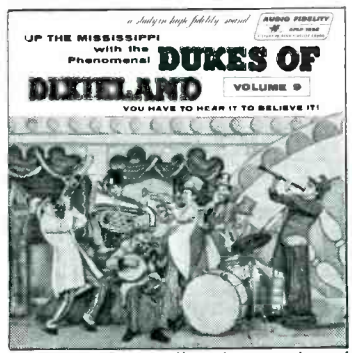
Jo Basile brings his skillful artistry to the haunting beauty of Italian song favorites for your listening pleasure.

AFLP 1871/AFSD 5871



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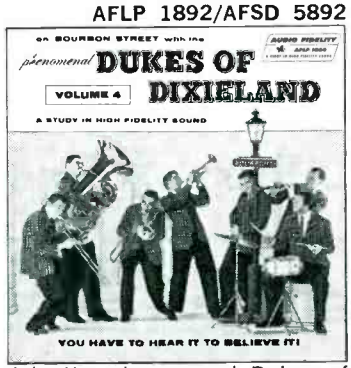

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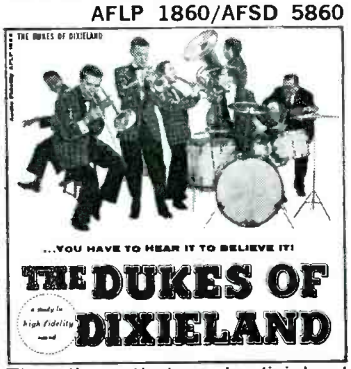

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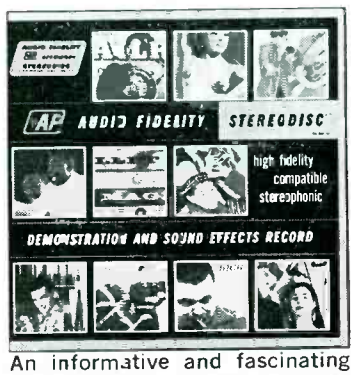

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first) simply bowled me over. If that man wasn't a top genius of musical expression, then I'm an idiot.

In experiences of the sort you'll have in listening to this music, nobody can say for you what your feeling will be. Either you hear what Mahler writes, or you don't. The tremendously poignant, moving, expressive lines of melody, the almost hysterically eloquent dissonance, that never resolves yet never becomes harsh, rather—somehow—more and more personal, the extraordinary "line" of these complex melodic shapes, leaving tones hanging, unfinished, in the mind, weaving a complex web of emotional tension through melody itself, the marvelously simple harmonies, so endlessly fresh—all this is the sort of thing that is felt, without words, *if* your ear can take it in.

What more is there to say? Try it and see. If your musical sense is experienced enough to catch onto Mahler's language, you'll never forget this piece. If not—then, I say, come back to it and try again later. I don't know what possessed the Cleveland orchestra and Mr. Szell here but to me they sound positively angelic; it is a superb performance and worthy to stand beside any recorded Mahler by such as the more famous Bruno Walter. Extraordinary team work, of a sort you rarely hear today.

The recent Partita by the Britisher, William Walton, is perhaps an unfortunate team-mate on this record. It's a nice, bright, beautifully orchestrated piece, full of pep and color and not a little triteness, perhaps out of Sir William's extensive experience in writing movie music. By itself it is just fine, but after Mahler's soul-tearing music, it seems utterly flat and almost a desecration. Better play it first!

Dvorak: Violin Concerto.
Glazounov: Violin Concerto. Millstein; Pittsburgh Symphony, Steinberg.
Capitol SP 8382 stereo

Here are two big Romantic concertos, in a recording re-released for its stero debut out of earlier Capitol material, and though the Dvorak is probably the most enduring work it is the Glazounov that makes the easiest listening.

It isn't that Glazounov is superficial so much as that he was a natural concerto man, whereas Dvorak was one of those composers who somehow flounder in immensity when they get down to concerto writing—they try to make their music lofty and timeless in the grand manner, where it would be better off in a simpler style. Oddly, it is in Dvorak's symphonies that he achieved the direct orchestral style that makes him so accessible to us today. For him, evidently the symphony was a less formal, more congenial medium than the concerto—which had to wear full dress, so to speak, as he conceived it.

You'll find plenty of good Dvorak lilt and melody here, but it won't hit you first-off, then. But perhaps after the tenth playing you'll be utterly bored with the more sensuous and colorful Glazounov, and delighted with Dvorak. Could be.

I almost left the performance and recording unmentioned; in truth, you can take it for granted as tops with these musical forces and Capitol's big, natural Pittsburgh stereo sound.

Chopin: Mazurkas (Complete). Nadia Reisenberg, piano.
Westminster XWN 18830/31/32

Reisenberg is one of those big, forthright lady pianists who manage to combine the feminine attributes of sensitivity and allure, pianistically speaking, with the masculine virtues of strength, authority, massiveness—also speaking pianistically. (You won't have to worry whether she weighs 110 or 210; you can't see her.) This is her second big set for Westminister, the complete Nocturnes having been already released.

I expected, somehow, to find these a bit on the hard side but I was delightfully surprised. Without sacrificing any part of her authoritative strength, Miss Reisenberg here plays with a bewitching and lovely tone, poetic, alive, lyric. There is give, elasticity, where too many newer pianistic virtuosos bang and whang away; there is songfulness but well-styled and controlled.

This set of records made me remember again that Chopin himself is said to have played in a fairly gentle style, all things considered, and I can't help remembering, too, that his music is always more for the salon than for the huge concert hall. It is styled that way by Reisenberg, though with all the strength you can want in the louder passages.

Westminster's recording is superb, though it does *not* produce the effect, noted in Westminster's standard blurb, of the listener's chair being "in the most favored seat, acoustically, in the concert hall." Instead, it is close-up, fairly dry in sound but wonderfully natural and, in the big moments, astonishingly clean. A fine recorded effect any way you look at it, and right in your own home salon.

Bach: Brandenburg Concertos (Complete). Members of the Cento Soli Orch. of Paris, Scherchen. **Omega OML 1039/40/41**

These three discs (available separately) are the first non-stereo Omegas I've received and I assume that stereo is also available—since all the other recent and excellent Omegas with this French orchestra have been recorded in stereo.

Here, in the umpteenth—umptieth, I should say—recording of the six Bach Concertos, we have an odd combo, an all-French orchestra and a noted, if somewhat eccentric, German conductor. The results are erratic if, on the whole, very listenable. Scherchen is most likely to be noticeable in his often violently eccentric tempi and dynamics. Here, the Scherchen touch, which I would in this case call the kiss of death, comes in the last Concerto, Number Six. It is done in abysmally slow time, straight through—even the normally bouyant movement at the end—and without the slightest trace of expression or phrasing, absolutely dead-pan. Is he serious? Undoubtedly. But then, that's Scherchen, All or nothing.

Most of the other works play along at normal-sounding speeds and in fairly natural stylings, the orchestration modern and relatively authentic, with harpsichord continuo, high trumpet and the rest. In listening to these works we ought to remember, I think, that they are essentially chamber music for a large "chamber" and do not really require the services of a conductor; a group of good musicians can play the stuff beautifully without external help. Indeed, the only "conductor" envisioned in the original would have been the man at the harpsichord, who would have merely given a helpful nod now and again at points of change. (Since the music was never played in Bach's time, he didn't get a chance to accompany it himself at the keyboard.)

The French touch is evident here in two ways. First, there is a somewhat brittle, bright quality to the sound that comes in part from French ways of playing, as contrasted to the thicker, sweeter German approach. Second, the French instruments themselves contribute a rather typical sound, especially the wind instruments, the more nasal oboes, for example. And, of course, there are the French horns, which in France are played with a vibrato and sound like saxophones. Odd—but who knows whether Bach's own didn't do the same?

2. ANYTHING GOES

Music and Song of Italy. Collected by Alan Lomax. **Tradition TPL 1030**

If you like your folk music styled for night-club and restaurant, stay away. This is real country stuff, from one of the most primitive parts of existing Europe—racey, raw, often ugly. The men yell and the women scream sometimes, though they'd call it singing; the harmony varies from none to the sound of the thirteenth century, plus suggestions of every age since then, preserved ever since in these outlaying and isolated areas of Southern Italy and Sicily.

I gather that this is material more or less left over from the huge Columbia series of folk recordings done by Lomax. It seems to fit in with that material, anyhow, and of course Lomax made hundreds of hours of tape for each bit that found its way onto the final discs. This, in any case, is fascinating stuff and my only complaint is one that can't be answered—how to put enough of each item down, and yet cover the ground. Too many fade-outs just as things get interesting. But some of these items would be good to hear the long night straight through, as they were probably heard in the original!

Música Flamenca. Niño Ricardo, guitar. **Epic LC 3556**
Flamenco España. Bernabé de Morón (with other guitars, mandolin, dancers). **Hifirecord R811 stereo**

These two came in together and I was intrigued to note that the second man was a student of the first. Not being a flamenco expert, I can't tell you which of them plays the better music—but the two records are interestingly different.

The Epic recording of Niño Ricardo is made close-up, with no liveness at all—it is in effect an absolute recording, the instrument itself without acoustic room coloration. The single guitarist plays alone, minus singing (though at this close range he can be heard producing a slight wheeze or groan along with his playing). For my ear, there's an uncomfortable feeling of restraint. We are much too close for pleasure and the man seems somehow to be out of his element, playing not for dancers and listeners but for the impartial microphone in some dead and formal studio.

Flamenco experts won't mind this a bit and I expect the music itself is spontaneous enough. But the rest of us will find this Epic recording easiest to listen to at a distance—in another room or around the corner, rather than face to face. That adds at least a bit of atmosphere and space to the sound, even if it is only our own home-style acoustics.

You have here a fine demonstration of absolute recording itself (I coined the term for my own convenience a long while back) but, even more important, a good illustration of our universal need for *non*-absolute recording—i.e., some species of liveness or atmosphere *built into the recorded sound and reproduced along with it*. Absolute recording is clinically revealing but strangely unconvincing.

The Hifirecord stereo adds just this element, in a number of useful ways. First, it is clearly made within an audible space, as you listen, and stereo helps to strengthen the effect. Second, the extra guitars (spaced out in stereo) plus the contrasted metallic sound of the mandolin every so often, make for the excitement of musical teamwork, a vital part of this type of music. Finally, a group of dancers is heard in the background, sometimes as a loud castanet accompaniment, sometimes in the actual foot work; the excitement of their actions is beautifully conveyed in the recorded sound.

Exact coordination of dancers and instruments in many of the shifting flameco rhythms shows us, too, how these dance-and-music patterns are known traditions, shared by all the performers.

Both records are of excellent quality. The Hifirecord is one of the best stereos I've heard in sheer sound perfection, with superb string and footwork transients and a phenomenally quiet, rumblefree background.

African Jazz. Les Baxter & His Orch. **Capitol T-1117**

If Les Baxter is African, then I guess this is African music, but it sure wasn't recorded in the jungle. More likely in the Capitol Tower, Hollywood & Vine.

You see, I got this one by accident: it was resting demurely inside an album cover labelled "Five Centuries of Spanish Music" with Victoria de los Angeles. Imagine my surprise. But I'm always ready to take Capitol up, surprise or no. . . .

Anyhow (am I right, Mr. Robertson?), this is moderately cool and sophisticated jazz of a mildly progressive sort, replete with a number of exotic instruments and sound-effects which, I suppose, might be termed African. Very nice recording and I wish Capitol had tricked me in stereo, instead of mono. Very nice music, come to think of it.

Five Centuries of Spanish Song. Victoria de los Angeles. **Capitol-EMI G7155**

I wrote right back to Capitol and got them to send me another Five Centuries' worth, this time with the right disc inside. If I am right, this is a reissue of the recording that was once available on RCA Victor (from before the demise of the RCA-EMI hook-up), refurbished and improved in sound.

De los A. is not only a superbly musical singer but also an unusually widely versed musician, interested in more than the mere sound of her own voice. This collection is done in a somewhat old-fashioned way (with a neutrally modern accompaniment and a good deal of arranging) but it doesn't matter; what counts is the superb quality, the gentle accuracy, of this voice. This was a collectors' item at RCA and it surely will be again, just as soon as it goes out of print—when and if. Better grab it, anyway.

Anything Goes. (Hi-fi on the Harpsichord). Bruce Prince-Joseph and His Group. **RCA Camden CAL 416**

I only mention this one because (a) the guy with the funny name, Prince-Joseph, happens to be one of the best Baroque-style organists around and has presided at numerous important concerts in Carnegie Hall and the like (he's the only man who can make Carnegie Hall's organ sound like Bach's); (b) he has an organ recording on the Hifi-record (Hifitape) label that goes through just about every professional organists' trick on a strictly non-Baroque church-style organ and (c) he plays—improvises, more or less—a species of modern jazz, as herewith. Multiple threat, like so many younger musicians, breaking down the old barriers. . . .

Cool (?), sophisticated stuff again, elaborating old favorites, including "Anything Goes" as well as "Thou Swell" and "Surrey with the Fringe on Top." Some organist! Betcha he could do a Giant Wurlitzer recording, if you wanted him to, or maybe the entire works of J. S. Bach.

Music for Frustrated Conductors. (Baton included). **RCA Victor LSC 2325 stereo**
Pops Stoppers. Boston Pops, Fiedler. **RCA Victor LM 2270**

RCA Victor stops at nothing when it comes to figuring ways of using the same old pieces and the same fine recordings over and over again. Old wine in new bottles! The Boston Pops in particular has practically run out of titles for its dozens and dozens of ever-fresh, ever-best-selling records, and this one must have won a prize in the RCA main office. Let's hope it doesn't stop the Pops—fat chance.

I won't even bother to list the Pops Stoppers items; you know what the Pops sounds like and you'll go for this, in brand-new hi-fi, if you go for the rest. (I do.) As for the Frustrated Conductors item, it must have been the outcome of an especially turgid repertory discussion. The idea is fine in theory but slightly dizzy in practice. It won't get you far on the way to being a conductor.

Of course RCA didn't know that I *am* a conductor, at least of choral music, and that I was just dying to try out a baton on my small choral group. I got two—one for stereo and one for mono—and the very next singing session we had, I practically poked out the eyes of my front row of singers with my new baton. Lovely white, plastic coated grip on one end—you won't drop it even in a Toscanini tantrum.

As for *you*, well, you can beat away to your heart's content as this record plays, but even with Deems Taylor's amiable and slightly vague helping footnotes, you won't get far. Sure, he tells you how to beat threes and twos and fours (with pictures) and writes a running comment on each piece; but if I know *you*, it'll take more than Deems Taylor to put you on the beat in these excerpts. Diabolically tough, several of them.

I expect you'll settle quickly for Deems' emergency beat, the "one . . . one . . . one" system, when things get complicated; but even this is going to be hard, for RCA and Mr. Taylor forget that most of us tend to

(*Continued on page 58*)

CHARLES A. ROBERTSON*

STEREOPHONIC

Bud Shank: Holiday In Brazil
World Pacific Stereo 1018
The Mastersounds: Ballads & Blues
World Pacific Stereo 1019

A hot summer evening is one time when West Coast jazz definitely deserves a place in the living room. Its cooling influence is most agreeable and relaxing under such circumstances. The two newest items in this label's current batch of six stereo releases contain these elements in varying degrees of intensity. Laurinda Almeida provides a sheaf of Brazilian themes for Bud Shank and they work them over together with considerable skill. The result is an intriguing concoction, a combination of jazz improvization and written passages of folk and classical descent. The most successful bit is *Mood Antigua*, on which Shank plays flute instead of alto sax and drummer Chuck Flores distributes the rhythm of tabla drums between two channels. The standards are Rodgers and Hart's *I Didn't Know What Time It Was*, and *Little Girl Blue*. The bassist is Gary Peacock, and Almeida's guitar is both unamplified and unechoed.

The Mastersounds move closer to the area occupied by the Modern Jazz Quartet in this outing, playing Milt Jackson's *Bluesology*, and John Lewis' *Fontessa*. The usual comparison between two groups of like instrumentation becomes even more inevitable. But Monk Montgomery, playing Fender electric bass, gives them things of their own to say on his originals *Little Stevie*, and *Monk's Ballad*. Pianist Richie Crabtree contributes *Heidi*. Vibist Buddy Montgomery usually is centered in stereo, as the other soloists move to the front in turn. Drummer Benny Barth stirs up a comfortable breeze on Gillespie's *The Champ*, and Miles Davis' *Solar*.

"The King and I" (World Pacific Stereo 1017) the first venture into the field of show tunes by the Mastersounds, is still one of their best. The Siamese feeling of the dances, the beauty of the ballads, and the gaiety of the production are all splendidly conveyed, and the recording is excellent.

"Annie Ross Sings a Song with Mulligan" (World Pacific Stereo 1020), our purely personal nomination as the most satisfying jazz vocal album in years, sounds even greater in stereo. It also confirms a conviction that of the two sessions required, the one attended by Art Farmer and Bill Crow turns out more cording. Crow's bass seems better placed than favorably, both musically and in the re- that played by Henry Grimes.

"Ellington Suite" (World Pacific Stereo 1016), a rewarding examination of eleven middle-period Ellington compositions, involves the original Chico Hamilton Quintet, plus Paul Horn. The arrangements by Carson Smith offer subtle and colorful ensemble work and allow ample solo space.

"The Sound of Big Band Jazz in Hi-Fi" (World Pacific Stereo 1015) a gathering from previously released albums, samples the large studio groups in the label's catalog. The stereo effect varies from track to track. Most are picked for a dancing beat, and the leaders are Gil Evans, Johnny Mandel Gerry Mulligan, Chet Baker, Bill Holman, Bud Shank, Art Pepper, Bill Perkins, and Cy Touff.

The Thelonious Monk Orchestra At Town Hall
Riverside RLP1138

This February Thelonious Monk made his entry into Town Hall in a concert divided between his regular quartet and a ten-piece orchestra. The portions preserved here consist of originals reworked by the composer, in collaboration with Hall Overton, for the larger group. Always a figure of controversy, Monk enters a new stage in his career to the familiar chorus of voices in dissent. From some published reactions, even the modern side jazz seems to have traditionalists who resent change. Be that as it may, an important consideration is that the step was taken before an audience in lieu of Monk's personal preference for a darkened studio. The entire program was too much to absorb in an evening, especially from the confines of a theatre seat, and a sense of strain could easily develop. The recording permits a more leisurely approach and clearly defined stereo reveals all the parts for lengthy persusal.

Of six tunes, the most extended is *Friday the 13th*, with a long and characteristic Monk piano passage. Among the soloists are Donald Byrd, Charlie Rouse, Phil Woods, Eddie Bert, and Pepper Adams.

Mundell Lowe: TV Action Jazz!
Camden CAS522

The second low-priced stereo production by Mundell Lowe and assembled All Stars brings the musical backgrounds of seven television whodunits into sharp focus. Besides giving a fresh voicing to "Peter Gunn" themes, the guitarist enlarges upon the less substantial motifs which serve to identify "Mike Hammer," "Perry Mason," "The Thin Man," and "Naked City." His most skillful feat of detection is tracking down jazz elements in the "77 Sunset Strip" score. That hackneyed opus, booted off by a Tony Scott chorus on baritone sax, receives its best performance yet. The octet's operatives find an open-and-shut case in "M Squad," played on TV by Count Basie's crew, and Eddie Costa wraps it up with an arresting piano interlude.

Costa is heard also on vibes and marimba, while Scott plays clarinet and an unnamed flutist, probably Herbie Mann, doubles on tenor sax. Variety is added to the instrumentation thereby, without impeding the free flow of ideas. Jimmy Cleveland, Donald Byrd, Don Payne and Ed Shaughnessy pursue their quarry on a straight jazz course, an ideal way to handle such material. That their fee fits most budgets is another inducement to employ their services.

Benny Golson And The Philadelphians
United Artists UAS5020

As the title indicates, all members of the quintet are former residents of Philadelphia united briefly under the banner of Benny Golson, a brilliant tenor saxist whose skill as composer and arranger makes him an acknowledged leader. Included is *Stablemates*, one of his first tunes to attract attention, along with two of more recent vintage which offer proof positive that his star is continuing to rise. They are the warm and eloquent *Blues On My Mind*, and *Thursday's Theme*. The presence of bassist Percy Heath prompts an arrangement of John Lewis' *Afternoon in Paris*. Pianist Ray Bryant contributes *Calgary*, in a setting by Gigi Gryce who also adds *You're Not The Kind*. The drummer, to be sure, is Philly Joe Jones

Golson can speak with the lingering tenderness of Coleman Hawkins or the brisk urgency of John Coltrane. He does both here and his perfect foil is trumpeter Less Morgan. Because his last appearance on this label, under Art Farmer, was credited some months ago as containing the "most" attributes of any LP of the year, not much is left to be said for this album. But it is at least as good, and considerably better in stereo.

Ellington Jazz Party In Stereo
Columbia CS8127
Duke Ellington: At His Very Best
RCA Victor LMP1715

Since the success of Ellington's Newport 1957 jazz festival album, someone at Columbia seems convinced that the applause between tracks sells the Duke. Although portions of his 1958 Newport concert were remade in a studio, crowd noises are retained via dubbing. Now, on the pretext of taking you to a jazz party, the same procedure encroaches on the close of each number and the beginning of some. The festival aura extends to the program, calling to mind *Hodge Podge*, the title of a tune Johnny Hodges recorded in 1938. He must have sensed the comparison; at least one of the saving graces is his alto-sax solo on *All of Me*.

Where stereo is concerned, the other is the nine-man percussion section added on two of the leader's new works, introduced last summer at Lewisohn Stadium. Finding the composer in a gay mood, they strike a happy medium between some of the serious contemporary writing in the field and the supercharged improvisations of Art Blakey. Two vibraphones, two xylophones, a glockenspiel, and a marimba occupy the center, with the full band on one side and tympani on the other. Stereo works less well on *Toot Suite*, where inner-groove distortion sets in during Paul Gonsalves' multichorus ride out.

Guests invited to participate musically are Dizzy Gillispie, Jimmy Jones, and Jimmy Rushing. But why Gillespie and no solo space for Clark Terry? Jones is pianist behind Rushing on *Hello Little Girl*, where the most exciting sound comes from the baritone sax of Harry Carney. And why has no one thought of bringing him together with the blues shouter before?

The reissue set from Victor lives up to its title, and ranges from a 1927 *Creole Love Call*, with Adelaide Hall and Bubber Miley, to a 1946 *Transblucency*, with vocalese from Kay Davis. Included are *Concerto for Cootie*, *Jack the Bear*, *Harlem Air Shaft*, and the original recording of *Black, Brown, and Beige*. No stereo, but the playing time totals more than fifty minutes.

Shearing On Stage **Capitol ST1187**
Don Shirley **Audio Fidelity AFSD5897**

A concert held at Claremont College in Southern California shows the George Shearing Quintet in rare form. The first live-performance from the group, it reflects the pianist's ability to entertain and deliver some respectable jazz at the same time. Several standards long identified with his ballad style catch fire in this reading, perhaps the best they have received. His friendly impression of Erroll Garner, imparted by *On The Street Where You Live*, is accurate and amusing. With Armando Peraza added on conga and bongo drums, he allows his cohorts to wander at will through *Nothing But De Best* and *Caravan*. On the latter, guitarist Jean Theilmans switches to harmonica, an instrument he maneuvers like no one else. The stereo is well staged, giving a full view of the unit while maintaining its fine ensemble sound. Comments from the

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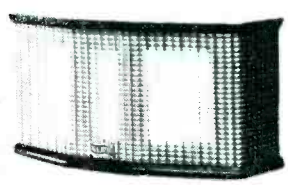

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leader introduce the numbers, and the large crowd is good mannered.

Don Shirley is another pianist who knows not to underestimate the intelligence of his audience. Shearing's listeners proved to be highly receptive of Randy Weston's *Little Niles*, a waltz undoubtedly unfamiliar to most, because they were meeting the pianist at his own level. In like manner, Shirley employs a very personal style to burnish undisclosed facets of *Satin Doll*, *Easy Living*, and *Dites Moi*. While his sound is equally subdued, he avoids some of the obvious trickery of Ahmad Jamal. Here the stereo effect is more intimate.

Eubie Blake: Wizard of Ragtime
20th-Fox 3003
Del Wood: Rags To Riches
RCA Victor LSP1633

When this recording was made, Eubie Blake was living in retirement in Brooklyn on his royalties and enjoying a ripe old age at seventy-five. Now he is back before the public, filling an engagement at a cafe with his partner Noble Sissle, and New Yorkers are paying to hear authentic ragtime for the first time in many years. Separated in 1927, the team is reunited here and Sissle, besides lending encouragement, sings *Ragtime Millionaire*, *My Gal Is A High Born Lady*, and *Good Morning Carrie*. Living up to his reputation, the pianist lays down an infectious beat and proves his feeling for the idiom is still strong. Accompanied by drummer Panama Francis, he revives *Mobile Rag*, *Maple Leaf*, and *Mississippi Rag*. Buster Bailey joins in occasionally and his clarinet is superb on *Sunflower Slow Drag*. This new label is undergoing growing pains and a promised stereo version is still in the works, but the monophonic seems adequate for most purposes.

Del Wood represents an area where ragtime was always lucrative. A protege of Chet Atkins, she adapts popular tunes to the genre and her original, *Whirl-A-Way*, might be from the pen of Zez Confrey. But her piano is ungimmicked and blends well with the guitar in stereo.

The Weavers: Travelling On
Vanguard VSD2022
Ralph Hunter Choir: The Wild Wild West
RCA Victor LSP1968

The Weavers journey far and wide on their current trip, from *Kumbaya*, a lovely African lullaby, to *Hopsha-Diri*, a vigorous Yugoslav dance. On some songs, Pete Seeger is replaced by Erik Darling, the newest member of the quartet who is credited with adding to its repertoire, *You Made Me A Pallet On The Floor*, which becomes a grateful letter of thanks in a revised version. Seeger joins Fred Hellerman on a story of *Greenland Whale Fisheries*, and is around for *Gotta Travel On*, a tune now enjoying hit parade status. Ronnie Gilbert has a touching solo on *House Of The Rising Sun*, and Lee Hays returns to native ground on *State of Arkansas*.

The closest they come to cowboys and the Wild West is *Mi Caballa*, a Chilean gaucho's tribute to his white horse. In defining on the liner what is meant by a "Weavers' song," they dismiss as not suitable one copied for nearly every western drama on television. It is *High Noon*, of course, and it might be pleasant to hear the Weavers upset this formula. Not much effort would be required on their part to elevate the medium, if given the chance.

The Ralph Hunter choir, in cataloging aspects of the territory with high spirits and rollicking humor, points the way in the right direction. Two soloists are exceptional and should be heard from again. They are Bob Harter, who makes a doleful plaint of *Rot Gut*, while Elmarie Wendel leads him to the light with *I'll Remember You In My Prayers*. Erik Darling reappears here as banjoist, joined by Tony Mottola, guitar, and Eddy Manson, harmonica. During the interludes, a third channel helps transport galloping horses or a thundering herd of cattle from speaker to speaker. The wide panorama of a square dance also unfolds, but such gimmicks are put aside when the full chorus breaks into song. Let's hope both recordings land on the turntables of a few television producers.

Les Baxter: Jungle Jazz **Capitol ST1184**
Markko Polo Adventurers: Orienta
RCA Victor LSP1919

Off for South America on his latest stereo exploration of exotic sounds, Les Baxter stops over at Caribbean ports on the way. His companion and featured soloist is Plas Johnson, the dauntless adventurer on tenor sax and alto flute who also made the "African Jazz" journey. This time a full complement of strings escorts them through the torrential downpour encountered in *Rain Forest*, around the rushing waters of *Amazon Falls*, and leads finally to the caroling of *One Thousand Cockatoos*. On the remainder, Johnson is backed by the usual reeds and brass, plus a percussion section which is augmented for the rhythms of *Carnival Meringue*, *Go Chango*, and *Voodoo Dreams*. Liner diagrams show how each group is seated to achieve optimum depth as well as breadth.

The Markko Polo Adventurers also set up in a Hollywood studio and follow close upon the footprints left by Baxter in his "Ports Of Call" album. Conducted by Gerald Fried, they cross the Pacific with a total of twenty-five percussion instruments to visit *Madame Sloe Gin's*, and *Girl Friend of a Whirling Dervish*. Here the thunder resounds on *Rain in Rangoon*, written for the group by Vernon Duke, while Leon Pober provides *Yokahama Ferryboat*, and *Runaway Richshaw*. In addition to arranging, Fried composed *Train to Ranchipur*, and revives Raymond Scott's *Mountain High, Valley Low*. There are stereo effects galore, many humorous and some more serious.

Mark Murphy: The Start Of Something
Capitol ST1177
Jack Smith: You Asked For It
Bel Canto SR1015

Two personable young Californians, backed by contrasting studio groups, convey considerable charm in making LP debuts. Mark Murphy worked out lightly swinging arrangements with Bill Holman whose tenor sax is spotlighted on one side, along with the trumpet-playing Candoli brothers, while conga drums fill out the rhythm section on the reverse. The singer is gifted with the sure sense of timing which permits him to appear to be an extra member of the band on *Just in Time*, *Lucky in Love*, and *Jersey Bounce*. But he also treats songs of sentiment in the same cavalier fashion, dealing quite brusquely with *Falling in Love With Love*, and *Cheek to Cheek*.

Jack Smith's album carries the same title as his television show and is dedicated to an audience which wrote in to help select the tunes. Russ Garcia casts his accompaniments along popular channels, both of which are occasionally filled to overflowing in stereo by a complement of strings and female chorus. *The Most Beautiful Girl in the World*, *Early Autumn*, and other romantic tunes show Smith at his best, but he does almost as well on *Cuanto La Gusta*, and *Have You Ever Been Lonely?* Perhaps the fortunes of recording will find him exchanging roles and arrangers with Murphy at a future session. Both voices occupy the center of the stereo stage.

A Party with Betty Comden and Adolph Green **Capitol SWA01197**
Pat Suzuki's Broadway '59
RCA Victor LSP1965

Seldom do all seven New York critics indulge in the unmitigated praise bestowed on this production last December when it opened at the Golden Theatre. Brought there by the Theatre Guild after a trial run at Greenwich Village's Cherry Lane, it affords audiences an intimate view of a joint career which has lasted more than fifteen years. As show business teams go, Betty Comden and Adolph Green might be called the Mr. and Mrs. Louis Prima of the intellectuals. The exuberance of the two men, at least, is such that it can be controlled only by women of ready wit and firm disposition. Both are fortunate in their partners and, as it is, they are likely to get out of hand once in awhile.

Recorded at an actual performance, the enthusiastic response to sketches written for "The Revuers" in the early 40's indicates that the Comden and Green brand of humor wears well. As part of their art is to stand in front of a backdrop and conjure up scenes from little more than words and music, less of the original effect is lost than in most transfers from Broadway to discs, especially when stereo seats you front row center. It is an album to bring out of the files for a reprise in years to come.

Pat Suzuki assembles hit tunes from seven of this season's musicals in one convenient package. A standup belter of songs, she includes three from her own "Flower Drum Song" and could do with less artificial echo. Despite the popularity of original cast performance, complete run-throughs eventually pall and the stylus is shifted to favorite bands, soon causing material damage to the grooves. No need for that here, and George Siravo conducts what sounds like a pit orchestra on a busman's holiday.

Stereophonic Demonstration And Sound Effects Record **Audio Fidelity ASFD5890**
This Is Stereo **RCA Camden SP3322**
What's New In Stereo?, Vol. 1
Capitol, May, 1959

Advances made in recording techniques during the past six months make many of the early stereo demonstration discs seem dated. Audio Fidelity wisely delayed its sound effects offering until a number of preliminary wrinkles were ironed out. It precedes the First Components Series, however, and all the musical excerpts are in the popular vein. The high point is a visit to the Army's Aberdeen Proving Ground in Maryland, where ricocheting bullets scream past the microphones and a 35-ton tank moves into action. Other stops are: a meeting of the Sports Car Club at Bridgehampton, L. I., the East 67th Street fire house in New York, the IRT subway station at Grand Central, and the Hell Driver's show. A power saw gnaws through a Douglas Fir tree and the crowd roars in Mexico City's Plaza de Toros.

The $1.98 price tags on the other two releases indicate the healthy determination of the large companies to make the public stereo-conscious. Robert Oakes Jordan Associates, Inc. helped prepare the RCA disc, a pleasing combination of sound effects and musical passages from Camden classical, popular, and jazz productions. As in the case of the Audio Fidelity production, a narrator explains the principles of stereo sound. When Ralph Camargo introduces the ascent of an ICBM, all early demonstrations pale by comparison. It is highly recommended to all dealers who are anxious to prove that stereo need not be an expensive proposition.

The Capitol promotion is a plain and simple bargain. For several years, the label has sent monthly samplers of popular releases to radio stations and other interested parties. To aid in introducing stereo, a similar compilation is being placed in the hands of dealers, starting with the May issue, for sale to all comers. Each promises to be a honey,—don't miss any.

Johnny Pineapple: Hawaii
Audio Fidelity AFSD5850
Webley Edwards: Hawaiian Strings
Capitol ST1152

A steel guitar is far from being our favorite instrument, but when freed from distortion and nestled among others of its ilk, as in both these fine stereo recordings, its appeal is undeniable. Johnny Pineapple leads his Islanders in the romantic style that assures their welcome as entertainers in top hotels across the country. A light mixture of melodies straight from his native Hawaii, leavened by popular themes from Broadway, comprise his program. *Beyond The Reef*, *Little Brown Gal*, and *Hawaiian War Chant* are included. Flute and mellow woodwinds fill out the sound when necessary, and the rhythms are meant for dancing.

Webley Edwards, for the third in his "Hawaii Calls" series, chooses a similar instrumentation and arrangements. In his first stereo attempt, he brings Al Kealoha Perry to the front and center, after spreading a vocal chorus across the background. On *Hawaiian Vamp*, his one original, he assembles the guitar key changes common to the hula, and summery breezes blow softly through both

albums. Surprisingly, none of the titles is duplicated, not even *Aloha Oe,* as Edwards concludes with an old Polynesian farewell song from Tahiti.

Ron Goodwin: Music In Orbit
Capitol ST10188
Esquivel: Exploring New Sounds In Stereo
RCA Victor LSP1978

Stereo space is utilized in opposite ways on these two entertaining examples of music in motion. Ron Goodwin, who leads nearly fifty musicians in EMI's London studios, examines the broader aspects in a dozen celestial sketches inspired by the quieter portions of Holst's *The Planets.* Contrary to the impression conveyed by the soaring rocket on the cover, there are few sensational noises inside. A melodious waltz is dedicated to Venus, instead, and the composer launches witty exchanges between sections on *Sally the Satellite.* Those earthbound mortals who enjoy light mood music on a high plane will be suitably transported.

Esquivel runs the gamut of instrumental sound, from ankle bells to theremin and back by way of jew's-harp and buzzimba, a singular animal which emits low, resonant tones when struck with mallets. The quixotic Mexican piano wizard may focus on the intimate tinkle of a harpsichord, an agile Latin-American percussion section, or the powerful blast of nine brasses. These last not only bounce wall to wall but from floor to ceiling as well. It all could turn out bottomside up, if his arrangements were less clever. Standouts in any language are Oscar Straus' *La Ronde* and *The Third Man Theme.* His own original joins Mexican rhythms and the *ondioline,* a French pedal-piano that is similar in sound to a high-pitched organ.

MONOPHONIC

Claude Hopkins: Music Of The Early Jazz Dances **20th Fox 3009**

The idea for this enlightening program originated in the survey of jazz dance given by Albert Minns and Leon James. The hit of the 1958 Newport Jazz Festival, their demonstration was repeated on television and is currently scheduled for other concerts. But where the dancers perform steps first made popular in the 20's and after, Claude Hopkins concludes his researches with *Original Black Bottom,* a Perry Bradford composition of 1919 which illustrates an early incidence of what is now generally referred to as shuffle rhythm. The pianist takes as his point of departure *The Alabama Walkaround,* written in 1891 to accompany the minstrel tableau which evolved into the cakewalk, and embarks on an engrossing resume of three decades of dance history.

Julia Steel sings those tunes with descriptive lyrics, offering *Rules and Regulations,* and giving instructions for *Scratchin' the Gravel, Walkin' the Dog,* and *Messin' Around.* Those written after the dances gained wide acceptance are apt to show the refining influence of Tin Pan Alley. Musicians sat behind potted palms and dancers reigned supreme in those days. Thus varied rhythmic patterns supply most of the interest, although the band includes Charlie Shavers, Red Allen, Tyree Glenn, and Vic Dickenson. They play tastefully even on such titles as *When I Do the Hoochy Coochy in the Sky,* and *Wiggle-Dee-Wow!* There is an amusing contrast between the primness of Buster Bailey's ragtime clarinet and the hotter style he adopts later. Valuable as the first investigation of this era since the series Tony Parenti made for Circle, it is the only one available on LP and the fact that Milt Hinton would hardly pluck a bass viol in the 1890's in no way impairs its authenticity.

Bob Scobey: The Scobey Story, Vols. 1 and 2 **Good Time Jazz L12032, L12033**

Some day these recordings will take their place in the archives as an important part of the San Francisco jazz revival. Among the most danceable sides ever made, they are still fresh and too much alive to stay on the shelf for long. The twenty-four selections trace Bob Scobey's career during the three years after he left Lu Watters in 1950, and

(*Continued on page 64*)

NEW PRODUCTS

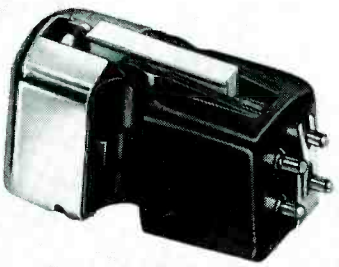
● **"Surround-Sound" Speaker System.** This system has an 8-in. driver mounted in the bottom of the cabinet and a matching 4-in. tweeter mounted in the top, distributing sound in a 360-degree pattern. In addition to providing realistic sound reproduction, the system also provides the answer to the problem of "what to do with the

cabinets"—they double as handsome end tables. With stereo, the listener benefits from the stereo directional effect without consciousness of speaker placement. Cabinets are made of heavy wood, laminated with Formica, and are available in walnut, mahogany or blond finish. Further information and literature are available from the manufacturer, ALPHA-sonic Manufacturing Company, 256 Fourth Ave., S.E., Osseo, Minn. **G-7**

● **H-K Stereo Amplifier.** Priced essentially for the budget-conscious user, this new Harman-Kardon amplifier incorporates many of the features normally found only in units which cost considerably more. Known as the Lute, Model A220, it is a 20-watt stereo amplifier with dual preamps and two 10-watt output channels all on a single chassis. It is supplied com-

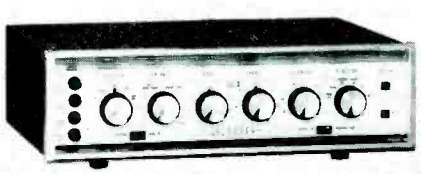
plete with cage without extra cost. At normal listening levels, the frequency response of the Lute is 20 to 20,000 cps. Four Type 7408 output tubes are employed to insure minimum distortion. Inputs are provided for both magnetic and ceramic cartridges. A highly effective full-range balance control will compensate for any speaker system, regardless of variations in efficiency. There are also separate ganged bass and treble controls, and a ganged loudness control. For full description of the Lute, write Harman-Kardon, Inc., 520 Main St., Westbury, N. Y. **G-8**

● **G-E Stereo Cartridges.** Major improvements in the essential areas of stereo performance—response, separation, compliance, and freedom from hum—have been achieved with the new VR-22 series of stereo cartridges recently announced by General Electric. The VR-22 series comprises the VR-225 with a 0.5-mil diamond stylus for professional turntable systems, and the VR-227 with a 0.7-mil diamond for record changers and other turntables. While both units are similar in appearance and basic design, the VR-225 is superior in some performance areas. The VR-225 has 20-to-20,000-cps frequency response within 3.0 db, up to 30-db channel separation, and recommended tracking force of 2 to 4 grams. The VR-227 has a frequency range of 20 to 17,000 cps within



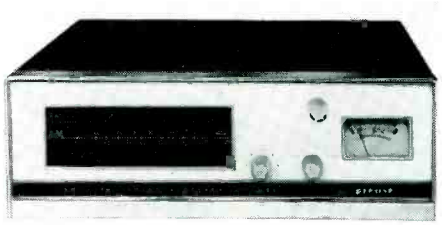
3.0 db, up to 30-db channel separation, and recommended tracking force of 5 to 7 grams. Replacement styli for the VR-22 series are not interchangeable with previous G-E stereo cartridges. In addition to the new series, G-E will continue to market its "Golden Classic" stereo cartridges, as well as the VR-11 monophonic models. General Electric, Specialty Electronic Components Department, West Genesee St., Auburn, N. Y. **G-9**

● **Sherwood Amplifier.** This latest Sherwood development, Model S-4400, is a 36-watt add-on basic amplifier and stereo preamp on a single chassis, for converting monophonic music systems to stereo. Matching all other Sherwood units in style, its 10-in. depth permits bookshelf mounting. To make a dual 36-watt stereo combination, the S-4400 can be used in conjunction with the Sherwood S-360, a small basic 36-watt amplifier. When used in this fashion, only the S-4400 need be accessible. The S-4400 offers the important control features essential to stereo operation. These include dual loudness control, stereo normal/reverse switch, and phase-



reversal switch. The four modes of operation—stereo, stereo-reverse, mono 1, mono 2, mono 1 and 2 (for use in operating a stereo pickup on a monophonic record with the vertical rumble and scratch components balanced out)—are selected by the function switch, which also operates a corresponding group of indicator lights. In addition the unit incorporates the controls found on all Sherwood amplifiers. Frequency response is 20 to 20,000 cps within ±1.5 db at full rated output, with 1.5 per cent intermodulation. Preamp filaments are d.c. powered. For complete technical specifications, write Sherwood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill. **G-10**

● **Precise AM FM Tuner.** A newly-developed dual-limiter circuit designed to improve selectivity is featured in the Perfecta, an AM-FM tuner recently added to the line of high-fidelity equipment manufactured by Precise Development Corp., Oceanside, N. Y. Also featured in the tuner is variable automatic frequency

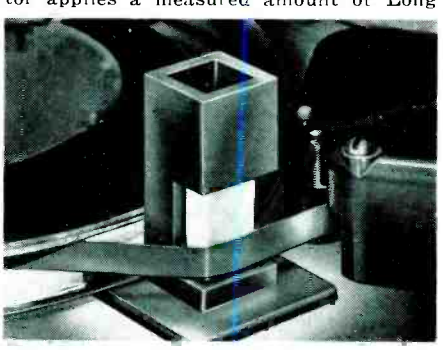


control. Coupled with the dual-limiter circuit, the a.f.c. affords unusual sensitivity, an ability to bring in even weak stations and "lock" them. An output meter assists in tuning by giving visual indication on both FM and AM. Other features include a cathode-follower output, Foster-Seely discriminator, flywheel tuning, ferriloop antenna, and 3-gang variable capacitor. A rich white-and-gold front panel harmonizes pleasingly with a handsome charcoal grey case. **G-11**

● **Koss Stereo Headset.** The SP-3 Stereophone headset is unique in that it reproduces the full frequency range of 30 to 15,000 cps by means of 3½-in. dynamic reproducers incorporated in each earphone. Specially constructed to overcome the constricted sound so often associated with headphone listening, it preserves the full dimensional effect of stereo. Since

the Stereophone headset has an impedance of 4 ohms, it can be connected directly across an amplifier output or speaker voice coil with no internal wiring changes. Adapters are available for 600- and 12,000-ohm impedance to enable the phones to be used for monitoring. Only one simple connection is necessary if the phones are to be used monophonically. Full descriptive information is available from Koss Incorporated, Electronic Manufacturing Division, 2227 N. 31st St., Milwaukee 8, Wis. **G-12**

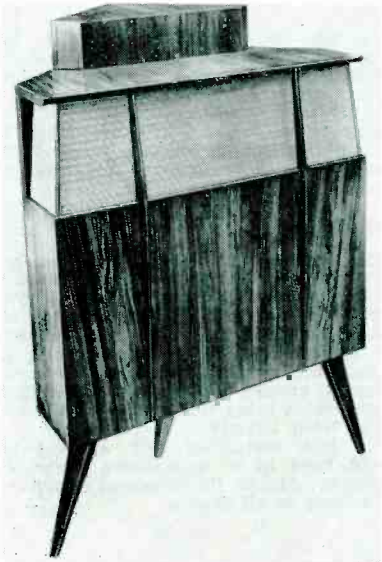
● **Tape Conditioner.** A convenient, compact attachment which applies a newly-developed tape conditioning fluid to tape in any player or recorder is now being marketed by the Electrical Chemical Specialty Company, St. Paul, Minn. Built to fit all tape machines, the Tower applicator applies a measured amount of Long



Life tape conditioning fluid to magnetic tape as it is run through the recorder. The conditioner removes dirt and other contaminants from the tape and reduces friction on heads and guides. The applicator is included as part of a new Master kit, containing Long-Life cleaner, lubricant and conditioner, packed in 2-ounce squeeze-feed plastic bottles. **G-13**

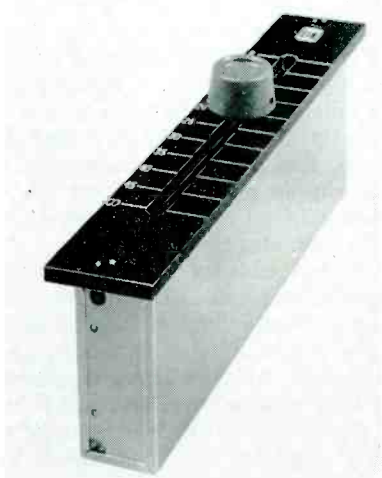
● **Lowther Speaker Systems.** Two new speaker systems, engineered by the Lowther Manufacturing Company of England, are now available to music lovers of this country. The Model TP-1, illustrated, is a corner enclosure utilizing dual horns. Middle and treble tones are dispersed uniformly by a reflective horn of unique design. In the bass range, the driver unit is efficiently coupled to the air by means of a folded horn utilizing the corner of the room as a prolongation of the horn structure. The PM3 driver system contained in the TP-1 is an unusual 8-in. twin-cone unit with a large magnetic structure which provides a gap flux of 22,000 gauss. Developed specifically for the TP-1 enclosure, the PM3 has a frequency range of

20 to 22,000 cps and will handle 25 watts of integrated program material. The other system introduced is the Acousta, a moderate-size system—conventional in appearance—which performs outstandingly.



Frequency range is 20 to 18,000 cps, gap flux is 17,500 gauss, and power rating is 25 watts. Complete descriptive material on both the TP-1 and the Acousta will be mailed upon request to Lowther Sales Company, 880 Bergen Ave., Jersey City, N. J. **G-14**

● **Straight-Line Mixer Control.** Intended for demanding professional application, the 1001-A mixer is exceptionally low in contact noise, is extremely smooth sliding, and incorporates a resistance element which can easily be replaced. Special controls may be made up with ganged elements for stereophonic mixing. Frequency response is within ± 0.5 db from 0 to 20,000



cps. Maximum input level is 1.0 watt, or 25 volts rms. Insertion loss is 6.0 db. Impedance is 600/600 ohms. Slider pressure is 20 grams, with friction-adjusting screw provided for adding more drag if desired. This is an excellent instrument for mixing signals from several sources, such as microphones and other low-level devices, with application in music scoring and re-recording systems. For full technical specifications write Electrodyne Corporation, 503 S. McClay St., Santa Ana, Calif. **G-15**

● **Test Record.** Performance of stereo and monophonic music systems, from stylus to speaker, may be tested in the home with the Audiotester test record. The stereo side includes metronome-balance, pickup-alignment, channel-separation, frequency-response, and turntable-rumble tests. Monophonic systems may be checked for stylus wear, frequency response, intermodulation, rumble, and tone-arm resonance. Further information on the Audiotester test record may be obtained by writing Audiotex Mfg. Co., Dept. FR, 3225 Exposition Place, Los Angeles 18, Calif. **G-16**

RECORDS

(*from page 51*)

do a jazz beat—double speed—when we're asked to "keep time" with any music. Just watch any handy foot tapper. At double speed you'll turn purple and gasp for air long before the music ends.

If you ask me, you'd better forget the whole thing and go buy the original discs from which these assorted excerpts were taken. Just listen; it's easier.

Steel Drums. Hifirecord R817 stereo

This umpteenth recording of the great steel drum phenomenon is a whangeroo, made on-the-spot in the best recording tradition with assorted ultra-native singers doing solos off-mike here and there, plus assorted shouts and exclamations in the background suggesting the proper crowd of local folk, clustered around. Good, and superhifi, my only question being WHO ARE THEY? What name? What Island?

I'm just wondering why a steel band should have to be anonymous, even as to geography. Maybe the musician's union has got around to oil drums. **Æ**

OSCILLATOR CIRCUITS

(*from page 26*)

tween emitter and ground and 75 ohms from emitter to negative supply were tried. Some improvement was evident, but the circuit was still too critical for comfort.

The next step was to use a positive supply. This would be good if a separate positive supply were available and can be used quite readily with the circuit at *Fig.* 10. But it was appreciated that such a positive supply might not always be available as a separate entity. Consequently another possibility was considered, that of using a portion of the main supply and bucking out the effective external resistance in the emitter of the gain stage.

This was achieved by making the collector resistance of the gain stage equal to both collector and emitter resistance of the phase-inversion stage. To avoid the emitter follower currents interfering, their resistors were returned to supply positive so that their current did not pass through the common resistor. This gave the additional feature of allowing the emitter followers to operate at a more realistic current value so as to achieve their full current amplification, which was particularly difficult in the case of the first one, when the emitter-to-ground voltage was only of the order of one or two volts.

By making the fluctuating component of current in the gain stage and the phase inverter equal, due to the fact that the voltage swing on both is the same, results in virtually zero swing at the negative end of the dropper resistor, which is the bottom end of the emitter coupling resistor of the phase inverter and the emitter itself of the gain stage. This point also becomes the

ground reference for the whole oscillator. This arrangement slightly improves the spread of curvature in the gain stage due to the existence of a small amount of positive feedback from the phase inverter to the gain stage.

Now the bias on the base of the gain stage starts (in the absence of oscillation) with about 2 volts negative, taken from the tapping on the emitter load of the phase inverter through the emitter follower to a resistance divider down to a point approximately 6 volts positive. This provides the base with a small negative bias, putting it in the region of maximum gain. When oscillation starts the phase-inverter current drops due to diode action, thereby reducing the negative voltage fed back through the emitter follower, so the gain stage tends to approach cutoff.

By adjusting the values correctly the bias which is fed through the 3300-ohm resistance from the intervening emitter follower just controls oscillation to a conveniently steady value and maintains a uniform waveform. This complete circuit was set up and tried with a bunch of resistors taken from stock. It was found to be reasonably independent of individual transistor inserted in the gain stage as regards output and waveform and also the most critical resistors could be varied over a reasonable tolerance range without running into distortion in one direction or failure to oscillate in the other. Æ

FM-BAND RECEPTION

(*from page 21*)

d.c. plate voltage to the first tube. Compress or expand L_1 to get maximum signal at the output. Then compress L_1 to reduce the output voltage by about 20 per cent. This completes the alignment. The correct adjustment of C_1 and L_1, which is necessary to get the lowest possible value of noise figure, can be made more rapidly with a noise generator, quite a rare item among most experimenters. Details on using a noise generator are given in chapter 14 of reference 2b. However, good results can be realized using the method outlined above. As *Fig.* 1 illustrates, the knob which controls C_2 is provided with a paper scale calibrated in megacycles (88–108) and glued to the panel.

Performance

The pre-amplifier has been in use at the author's home (north of Schenectady, N. Y., elevation 400 feet) now for over eight months and has been most helpful in increasing the enjoyment of FM listening. During this period of time 58 stations have been logged. Consistent reception of stations 150 to 200 miles away has been the reward for installing this little gem. Stations have been heard using the preamplifier that were literally buried in the noise otherwise. The greatest distance logged while using it was close to 300 miles. Almost any time, day or night, 20–30 stations can be tuned in that are of listenable quality. The antenna used is a six element Yagi, mounted about 25 feet above the ground. The tuner is one of outstanding reputation and of excellent design. The preamplifier has been used with several other dissimilar receivers with a variety of antenna systems, and located in diverse places. Not in one instance did the preamplifier fail to show either some or marked improvement. The improvement was most impressive when the preamplifier was used in conjunction with tuners of poor noise figure or marginal over-all gain.

Because of the lack of high selectivity preceding the first stage of the preamplifier, there may be some ghost signals of "birdies" from a local FM station. Should this be the case, a trap tuned to the local station and inserted in the transmission line from the antenna as close to the preamplifier as possible may help minimize this difficulty. Some receivers have no tuned circuit preceding the first r.f. amplifier stage (often the grounded-grid type) and a local FM or TV station may cause similar trouble. In this case best rejection of the ghosts may be accomplished by inserting the trap between the preamplifier and the tuner. This latter method of providing extra selectivity prior to the tuner may minimize ghosts due to too high a signal level being delivered to the FM set from the local station.

The author would like to thank Henry W. Griffin, Jr., for his help in the design and testing of the preamplifier. Æ

References

1. a) A. B. Bailey, *"TV and other receiving-type antennas."* J. F. Rider Publisher, Inc., New York, 1950.

b) J. D. Kraus, *"Antennas."* McGraw-Hill Book Co., Inc., New York, 1950.

c) S. Uda, and Y. Mushiake, *"Yagi-Ufa Antenna."* Sasaki Printing and Publishing Co., Ltd., Sendai, Japan. (In English)

2. a) A. Vander Ziel, *"Noise."* Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1956.

b) G. Valley, Jr., and H. Wallman, *"Vacuum Tube Amplifiers."* Vol. 18, Radiation Laboratory Series, McGraw-Hill Book Co., New York, 1948.

3. H. Wallman, A. B. Macnee, C. P. Gadsden, "Low noise amplifier." *Proc. I.R.E.*, Vol. 36, 1948, pp. 700–708.

ABOUT MUSIC

As The Expression Goes . . .

HAROLD LAWRENCE*

DURING THE REIGN of Louis Philippe, an amateur choral society founded by the Prince de la Moskowa gave some eccentric performances of the works of Palestrina. "It was their custom," wrote Saint-Saëns, "to sing the greater parts of these pieces *pianissimo* and with extreme slowness, so that in the long-held passages the singers had to be divided, some of them carrying on the sound when others had exhausted their breath." Although a few musicians grumbled at the absurd treatment, the mid-19th century public as a whole accepted it complacently. Palestrina, after all, had left nothing to guide future interpreters but the notes themselves; and the Prince, detained by no indications of pace, dynamics, and phrasing, gave free reign to his "imagination."

Had Palestrina been born half a century later, the Prince might not have dared to turn the Italian composer's music into a breathing marathon. But it was not until the middle of the 17th century that the expression mark became universally adopted. The verbal notations which musicians employed constituted a simple language: speed was indicated then as now by such terms as *adagio, allegro, vivace;* volume by *piano, forte,* etc. Italian won out over French and English as the language of "expression" due to the wide distribution of Italian madrigals in the early part of the century.

There was no reason for the Baroque composer to sprinkle his music with additional expression marks. Apart from the essentials of tempo and intensity, his music clearly dictated its own expressive course. Expression marks were therefore utilized only to avoid possible ambiguity. (Bach dispensed with them altogether in the *Well-Tempered Clavier.*) Even tempo markings were often omitted when the composer felt their inclusion superfluous. The modern interpreter need only follow J. C. Bach's sound advice in his book, *Essay on the True Art of Playing Keyboard Instruments,* to do the right thing by the Baroque repertoire: "The pace of a composition . . . is based on its general content as well as the fastest notes and passages contained in it. Due consideration of these factors will prevent an *allegro* from being rushed and an *adagio* from being dragged." Choice of tempo is also dictated by the place in which the work is performed—and this applies obviously to all forms and periods of music. To secure the utmost clarity, one must adjust the speed to the hall's acoustical properties. One of the reasons church performances are generally unsatisfactory is that the performer rarely takes into consideration the long reverberation period.

The vocabulary of "expression" grew along with the development of instrumental and orchestral music. Where, for example, a page of a keyboard work by Bach might contain such indications as *Allegro, piano* and *forte,* a page of Beethoven might be filled with the following markings: *Vivace ma non troppo, sempre legato, p dolce, Adagio espressivo,* and a liberal assortment of *pianos, fortes, crescendos* and *diminuendos.* Note the embellishment of certain basic designations: vivace *ma non troppo;* p *dolce;* adagio *espressivo.* In a letter written in 1817, Beethoven spoke of those "headings, inherited from times of musical barbarism, by which we describe the tempo of a movement. What, for example, can be more absurd than 'allegro' which, once and for all, means 'cheerful'? How far removed we often are from the meaning! How often a piece of music expresses the very opposite of its heading! . . . I have often thought of giving up those absurd words *allegro, andante, adagio, presto.*"

Beethoven never carried out his threat to abandon Italian terms, though he amplified the headings with such words as *appassionato, molto cantabile, espressivo,* and so on. The linguistic revolution he hoped for was brought about instead by the Romantic composers who, spurred on by nationalistic impulses, reverted to their native tongues. An outcome of this movement was greater freedom of vocabulary and more detailed indications.

In more recent times, one of the most colorful advocates of the "national" expression mark is Percy Grainger. Virtually all of Grainger's indications are written in a sort of open-air English that turns the standard Italian markings into vapid symbols. Here is a partial list of Grainger's expressions with their traditional counterparts:

Grainger	*Italian*
louden	crescendo
feelingly	espressivo
soften and slacken	dim. e rit.
louden lots / louden hugely	molto crescendo
don't soften	non dim.
slow off	rit.
slow off lots	molto rit.
shortish	mezzo staccato
quicken	accelerando

Not content to substitute his own expressions marks for the Italian, Grainger has also focused his attention on the names of instruments. In his orchestral scores, violins are "fiddles," violas "middle-fiddles," cellos "bass-fiddles," and percussion instruments of definite pitch "tuneful percussion."

There are only remote Italian translations for the following Grainger instructions: "With Healthy and somewhat fierce 'go' ", and "wrenched forte."

Few composers have displayed as much consideration for the lowly instrumentalist as did Grainger in his *Lincolnshire Posy.* At the bottom of one page he wrote, "The flügelhorn or soprano saxophone soloist may, if he likes, use his own expression marks, in place of those printed."

Along with the flowering of the Romantic Era came a certain verbal extravagance, which often confronts the performer with some rather interesting musical challenges. A case in point is Moussorgsky's *Pictures at an Exhibition.* One particular phrase is

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

marked *poco ritard con dolore*. As R. W. Wood pointed out in his article on expression (*Music & Letters*, Oct. 1930), "If the pianist duly regards the *poco ritard*, the *piano*, the <>, the *sf* and the slurs it is virtually impossible for him to do anything further . . . If *con dolore* (dolefully) results, well and good, if not, the performer is not to blame." Other examples mentioned by Mr. Wood include Holbrooke's "Moving exorably, grim, and prodded," Debussy's "this rhythm must have the sonic value of a sad and frozen landscape," Wagner's many *zarts* (tender), and Elgar's *nobilmentes* (nobly). "All they actually convey," concludes Mr. Wood, "is how the passage in question always sounds to the composer himself."

But is it that simple? According to this line of reasoning, of what possible value to the player is the unscientific *nobilmente?* Would the conductor approach the score any differently if it were not there? What specific ingredient does it call for? Logically speaking, it is a superfluous marking. Can we dismiss it however because it fails to concern itself with isolated points of tempo, dynamics, touch, phrasing, bowing, and other technical details? It is true, of course, that a sensitive performer will probably ferret out the expression inherent in a given musical work, with or without the "fringe markings. But what Mr. Wood calls the "loose-thinking" expression mark nevertheless serves a thoughtful and far from loose purpose. The appearance of a *zart* or a *nobilmente* at a certain point in the score, perhaps underlining a cello theme or accompanying a sudden shift in dynamic values, should alert the performer and suggest to him that the composer attaches a special meaning to the passage in question, one that could not be conveyed by the traditional marking. In plain words, the composer hopes to put the performer *in the mood*. No one blames the conductor who supplements his stick technique with a large repertoire of facial expressions, gestures, and even choreography of a sort, so long as the ultimate result is a great performance. Why then should not the composer employ unusual verbal means to obtain a deeper understanding of his intentions?

The inevitable outcome of the growth of the expression mark in the 19th century was its abuse, not only by composers, but by publishers of older music. Editions of Bach, Beethoven and Mozart appeared in print containing markings in such profusion that it was sometimes difficult to see the notes for the marks. Early 20th-century Erik Satie satirized the "over-expressive" score in his own music by filling his pages with such whimsical instructions as:

Ne tournez pas (Don't turn)
Grattez (Scratch)
Souriez (Smile)
Ne parlez pas (Don't speak)

Igor Stravinsky, whose own scores are models of clarity, has some cogent thoughts to offer on the subject of the expression mark: "No matter how scrupulously a piece of music may be notated, no matter how carefully it may be insured against every possible ambiguity through the indications of tempo, shading, phrasing, accentuation, and so on, it always contains hidden elements that defy definition, because verbal dialectic is powerless to define musical dialectic in its totality."

This, of course, is where the interpreter takes over; it is his task to respond to the directions *implied* in a musical work, using the expression mark merely as a valuable guidepost. Æ

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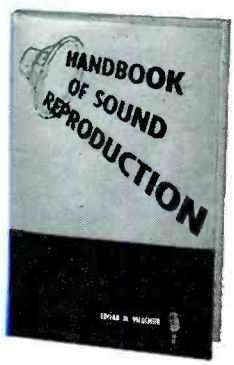

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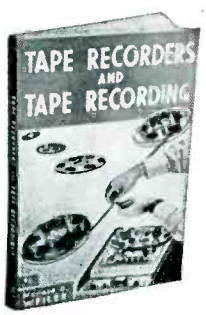

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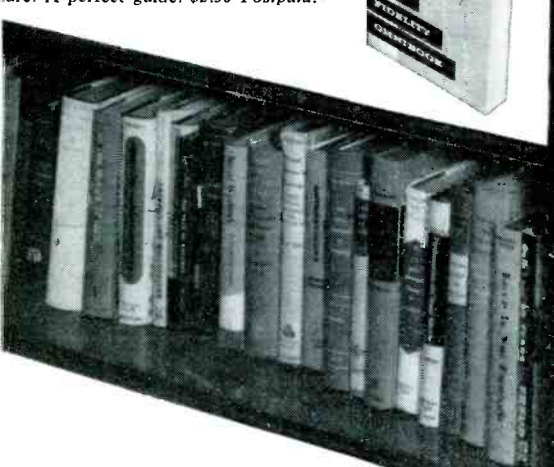

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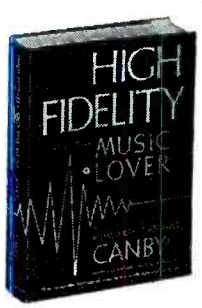

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LOUDSPEAKER DISTORTION

(*from page 28*)

tic power at 40 cps on one side of the baffle. The cone deflection required comes to 0.145 in. An 8-in. diameter cone radiating the same amount of power would require a cone travel four times as large, or 0.58 in. By considering the expression for the frequency-modulation distortion factor, we learn that this type of distortion is four times as high for the small speaker as it is for the larger one.

Minimizing the Distortion

The question arises now as to what can be done to reduce this type of distortion. Fortunately there are several relatively simple means to minimize the condition. The most effective is to employ a two- or three-way speaker system. Examination of the distortion factor equation shows that the distortion is a function of the modulated frequency. Therefore, instead of employing a single speaker to generate both 40 and 10,000 cps, it is advisable to employ two emitters and a cross-over network designed for, say, 250 cps. In this case, then, the highest modulated frequency would be 250 cps. instead of 10,000 cps, and the resulting distortion would be approximately 1/40 as large.

To gain some idea of the amount of distortion involved in the case of a single speaker emitting both 40 and 10,000 cps, simultaneously, consider a 16-in. speaker radiating 1 watt at both these frequencies. The cone amplitude at 40 cps, as shown on *Fig.* 1, comes to 0.289 in. The distortion factor, then, amounts to

$$D.\,F. = .033 \times .289 \times 10000$$
$$= 95 \text{ per cent.}$$

Figure 2 shows this graphically.

In the case of the two-way speaker system with the 250-cps cross-over, which radiates 40 and 250 cps simultaneously at 1 watt, the frequency modulation distortion will be only 1/40, or approximately 2.4 per cent.

Another means for still further lowering this type of distortion consists in using more than one large woofer. The reason for this, of course, is that the distortion is dependent on the travel required by the cone in emitting the low frequencies. This travel, for a given sound output, is in turn dependent on the cone diameter (actually the projected area of the cone, which is a function of the cone diameter).

Still another means of distortion minimization consists of employing a horn for the low-frequency speaker, because this device assists in reducing cone travel for a given acoustic output power requirement.

The writer has made many qualitative evaluations of this type of distortion. It should be noted that the distortion is not dependent on the amplitude of the modulated frequency, but on the amplitude of the modulating, or low, frequency. In the absence of other forms of distortion, frequency-modulation distortion appears in the form of a flutter, and is most easily recognized during the reproduction of sustained and strong low-frequency piano tones, while a high-frequency note, possibly from another instrument, is also being reproduced. As noted above, however, other forms of distortion, especially intermodulation distortion, should be at a minimum when such a listening test is made. Possibly the best way to conduct a test of this type is to make an A-B test, using a single speaker and a two-way speaker system during the reproduction of sustained music tones, switching quickly from one to the other system, so as to be able to hear the same signal from both types of emitters. *AE*

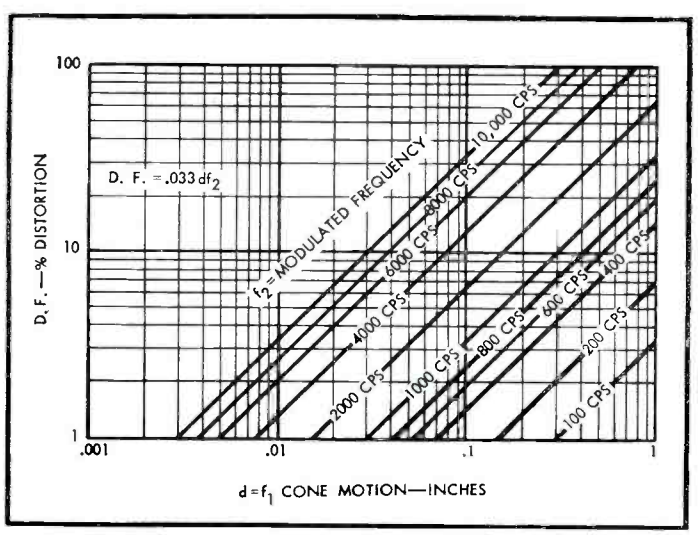

Fig. 2. Distortion factor for various amplitudes of f_1.

JAZZ

(*from page 55*)

are ideal companions at a mountain resort or the shore as an antidote for rock and roll. The first set, with clarinetists Albert Nicholas and Darnell Howard, is recommended as a starter. Hearing the leader's trumpet and Clancy Hayes sing *Sailing Down Chesapeake Bay*, if you can be counted among those not so favored before, should make the second irresistible. Good to begin with, the sound benefits from the remastering.

Steve Lacy: Reflections **New Jazz 8206**

Launched by Prestige to introduce newer artists and for reissues, this label is priced below the parent line. Quite a few changes have occurred in the record business since the advent of stereo and this is one of the indirect benefits passed on to the listener. The death of Sidney Bechet left only one jazz musician whose main instrument is the soprano sax. Its mastery is a perfect preparation for the work of Thelonious Monk, as both present difficulties insurmountable by anything less than a disciplined and unafraid spirit. In accepting the challenge, Steve Lacy plays seven of his pieces from the early 50's, only one of which was recorded before by anyone but the composer. Zoot Sims did *Bye-ya*, and the others have drawn no more than respect, despite the increased attention they are receiving since Monk's rise to favor.

In transferring the pianist's style to soprano sax, Lacy retains its important qualities and proves to have a deeper insight than some of the tenor men associated with it. By assuming many of Monk's thematic duties in the quartet, he clears the decks for his own pianist Mal Waldron, who is left with considerable freedom for individual comment. Buell Neidlinger, bass, and drummer Elvin Jones round out the group. A young man to watch, Lacy is to be congratulated for keeping the distinctive sound of the soprano sax alive in modern jazz. Æ

Carlos Montoya: Presents Porrina De Badajoz **RCA Victor LPM1878**

Los Macareno's: Flamenco! **Capitol T10146**

Two imports from Spain offer different approaches to the flamenco tradition. During his search for new talent last year, Carlos Montoya came upon one personality he believes to be outstanding in the field of *caute flamenco*. They met in Madrid for the intimate collaboration which occurs when a great guitarist improvises beside a singer who is also a master of the art. Porrina de Badajoz, a fellow gypsy from the company of Conchita Picquer, is gifted with a masculine voice that is flexible enough to encompass the dynamic range demanded of it. His heartfelt cries are intense and full of manly vigor, yet finely shaded. The recording is close and defines each detail.

Los Macarenos live and perform at Sacre Monte, in the hills and caves of Granada, but went to a Barcelona studio to present a group example of their fiery music. It comes complete with castanets, rhythmic healls, and spontaneous outbursts from the singers. Joining them all together are the continuing patterns set by the guitarists. Here a more distant recording accommodates the entire panorama. Æ

INTERFERENCE

(*from page 27*)

on the input cable, a physical position of the cable can usually be found which will eliminate pickup of the r.f. signal. Perhaps moving it away from power leads, or running it under a corner of the amplifier will remove the signal. In some cases an earth ground for the amplifier will remedy the disturbance.

One of the above suggestions, or a combination of them should prove effective in the reduction or removal of radio frequency interference. Æ

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RANK ACQUIRES WHARFEDALE. The **Rank Organisation, Ltd.,** London, England, has taken over **Wharfedale Wireless Works, Ltd.,** Bradford, Yorks. G. A. Briggs remains as managing director of the firm which manufactures and markets Wharfedale loudspeakers on a world-wide basis. Wharfedale speakers and systems will continue to be distributed in this country by **British Industries Corporation.**

MRIA ELECTS OFFICERS. Herbert L. Brown, vice-president of Ampex Audio, is the newly elected president of the **Magnetic Recording Industry Association.** Other officers newly chosen are: vice-president, Ken Bishop, general manager of Bell Sound Systems, Inc.; treasurer, Charles Murphy, president of Michigan Magnetics, Inc.; treasurer, Herman Kornbrodt, sales manager of Audio Devices, Inc. Elected to serve as members of the board of directors are: Hugh Daly, general manager of Magnecord, Inc.; Victor A. Miller, president of V-M Corporation; Russ Malloy, vice-president of Bel Canto Magnetic Tapes; J. Herbert Orr, president of ORRadio Industries, Inc.; Irving Rossman, president of Pentron Corporation, and Harry Sussman, president of Telectro Corporation.

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