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Joseph Giovanelli

Send questions to:
Joseph Giovanelli
3420 Newkirk Ave.
Brooklyn 3, N. Y.
Include stamp-d. self-addressed envelope.

Leaky Oil-Filled Capacitor
Q. Is a small hole needed in the case of an oil capacitor? I had an oil leak in one of mine and found what looked like a drilled hole. D. M. Anglin, Seattle, Washington.

Yes. There should not be a hole in an oil-filled capacitor otherwise the oil will leak out and the capacitor will change in value. Discard the unit.

VU Meter to Balance Speakers
Q. I have been trying to find a VU meter that will work with the 8-ohm output of my Williamson amplifier. I tried one that was supposed to work with any circuit but I could not get a reading while the speakers were playing. I want to balance my stereo setup. How are the meters connected—in series with the speakers or in parallel? Would it be an a.c. or d.c. reading? Will it be possible to get a meter which will work with my amplifier? D. M. Anglin, Seattle, Washington.

A. The VU meter is connected in parallel with the speakers. You are not getting deflection of the meter because the loudness level is too low; there is insufficient voltage developed across the meter to drive the pointer upscale.

Most meters have an impedance of 600 ohms. If yours does the solution is simple. Use a transformer to raise the 8-ohm impedance to 600 ohms. A line-to-voicecoil transformer will do the job. You may need to attenuate the signal to the meter when loud passages occur. Use a 600-ohm pad.

The speaker voltage is a.c. so that the VU meter is reading an a.c. voltage. Audio voltages are always a.c. Sometimes this a.c. is superimposed upon a d.c. voltage. An example of such a superposition is given in our December 1962 column.

Recording from a 70-Volt Line
Q. Do I need a transformer to feed a signal from a 70-volt speaker distribution system to the input of a tape recorder? I wish to record from a number of different locations. Atein E. House, Ames, Iowa.

A. You do not need a transformer in order to record from a 70-volt distribution system. You do need a potentiometer of high enough value so that it will not take appreciable power from the line. Its power rating should be sufficiently high to prevent burnout at the power level employed.

The signal input of the tape recorder is connected to the arm of the potentiometer and the signal ground to the ground side of the line. The line is connected across the potentiometer. The potentiometer serves as a coarse attenuator. It should be preset and left that way. Recording level is adjusted at the tape recorder in the usual manner.

This arrangement is recommended only when the line has one side grounded to the 70-volt line amplifier. In other words, the system should be used only with an unbalanced line.

If the line is balanced, a transformer is necessary. The voltage is high enough so that the transformer type is not critical. The secondary has to be wired for an unbalanced line. Use a quality transformer to avoid serious degradation of the program material.

If the voltage level of the tape amplifier is high, you will need an attenuator. This attenuator can be the potentiometer arrangement we have already described.

Theory of Internal Impedance Measurement
Q. In a previous letter I asked how I could find the impedance of a cathode follower output on my tape recorder. You told me to hook a VTM to the output while sending a 1000-cps tone through the preamp. Then you said to connect a variable resistor across the output and adjust it until the VTM reading drops 6-dB below what it was when no resistor was present. By measuring the value of this adjustable resistor I would find the output impedance.

I am curious as to why impedance can be determined in this way. I know 6-dB would be 1/2 the original power output. How does the variable resistor affect this? Can you explain? Robert C. Knoaia, APO, San Francisco, California.

A. The reason that a 6-db below the no-load voltage gives the output impedance of the preamplifier is that the tape preamplifier has resistance. For this discussion, let us assume that the output impedance of a cathode follower acts like a pure resistance. Therefore some of the signal is lost across the internal resistance of the cathode follower. When the output of the tape recorder is not loaded, and a VTM is placed across the output terminals of the unit, it is the same as saying that no signal is being taken from the cathode follower. (The impedance of the VTM is so high, compared to the impedance of the cathode follower, that the power taken by it is virtually unmeasurable.) When the output of the cathode follower is gradually loaded by decreasing the value of the variable resistor, the signal is taken from the unit. Some of this signal is lost across the internal resistance of the cathode follower. There will be a time when the signal voltage will drop to half of its original value, or 6-db below the no load voltage, and is equally divided between the internal resistance and the external load. The current in each resistance is the same by Kirchoff's Law, thus the voltage across each resistor is equal when the values of the resistances are equal. This (Continued on page 4)
We at Garrard congratulate Shure on the development of this new floating cartridge assembly... only available in a shell designed for this cartridge and the Garrard automatic turntables. Supplied by Shure... premounted, ready to plug in and play.
Music... soft and caressing... vibrantly alive... inspiring. The pure sound of Grommes stereo recreates each mood... with fidelity and presence of infinite superiority. Prices are sensible... quality unsurpassed.

Model 101M FM multiplex-stereo tuner. Magic bar tuning with exclusive Stereo Sentry to indicate stereo broadcasts. $139.95
Model 102M FM and AM multiplex tuner with all features of above $159.95
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BOOK REVIEW

MUSIC, ACOUSTICS, AND ARCHITECTURE
Author: Leo L. Beranek
Published: Sept. 1962; 596 pages; John Wiley and Sons; $17.50. Available through the Audio Library.

This latest book by Leo Beranek is a very important book. It is important for several reasons. First of all we have here one of the first systematic and relatively scientific approaches to the definition of what a good, very good, and excellent musical-performance hall is. Secondly, and we suppose out of necessity, he has reduced the definition to a numerical rating scale so that acousticians can design halls more precisely than heretofore. Thirdly, he has given us an example of how his rating scale works. Of course the example is Philharmonic Hall in the Lincoln Center for the Performing Arts. Finally he postulates a new way to calculate the audience and seat absorption in large halls which may bring the uncertainty of projected reverberation times back to the realm of accuracy.

What is a Good Musical Performance Hall?

By far the largest portion of this book is devoted to defining the subjective and objective parameters which add up to quality in concert halls and opera houses. This is done in several ways: First the terms commonly used to describe judgment of a musical performance are defined. This step is so obviously necessary that we are surprised that it wasn't done before. With such a standard vocabulary it is possible to communicate effectively in an area which has been rather difficult to pin down. But of course it is a lot to expect musicians to adopt a new language. Dr. Beranek goes further: he says: "I am not proposing that musicians change their ways". He then indicates that it is enough that we now can understand what they mean. Eighteen terms were defined, certainly sufficient for a musician or anyone else to describe his reactions to a concert hall or opera house.

Dr. Beranek next interviewed 23 of the most famous conductors and musicians in the world and 21 well-known critics. From them he gathered opinions as to the best halls in the world and detailed comments about them. He was thus able to correlate this information into significant judgments about the best and least liked halls. These judgments are of singular value when linked with the measurements Dr. Beranek and his associates made of 51 of the most famous and liked halls in the world. (Figure 1 is an example of the type of presentation.) In our opinion just the compiling of valid statistics about all these important halls is a great step forward and makes the book worthwhile. From this mass of information it was now possible to explode some of the long persisting myths which surround music halls, but more important it was possible (Continued on page 63)

Figure 1.

Audioclinic
(from page 2)

Internal resistance can be said to be the impedance of the preamplifier at the frequency used to make the measurements—1000 cps in this instance. For this reason, when the voltage has dropped to half the no load value, the internal resistance is equal to the external resistance. Now, by measuring the load resistance, we have automatically read the internal resistance, or impedance, of the unit under test.

Actually, there will be some error here due to the negative feedback. As the load increases the voltage tends to drop off thereby decreasing the feedback signal. Reduction of feedback causes the gain of the device under test to increase. This, in turn, will cause an increase in the output voltage. For most applications the results will probably be close enough.

If you had any difficulty in picturing the action of the load resistor, think of the circuit as a series circuit. One end of the internal resistance of the cathode follower (one output terminal) is connected to one end of the external resistance. The other end of the external resistance is connected to the other end of the internal resistance of the cathode follower (the other output terminal).

Think of the combination of the two resistors as a voltage divider. When the two resistors are equal in value, the voltage divider action will be such that half the voltage will be developed across each resistance making up the divider.

Audio • January, 1963
What compact can do everything a console recorder can?

The Ampex PR-10 gives you all the features, all the performance of a console recorder. Even remote control. And it’s all wrapped up in a suitcase-sized package. That means you can take a complete recording studio out into the field, into the school, the church, industry—anywhere you need it. The PR-10 features positive push-button controls; record-safe switch; and separate erase, record and playback heads. And there’s room for an optional 4-track stereo or additional playback head. There’s also a new electro-dynamic clutch system to give you fast, gentle starts and lower braking tension. If you want to monitor on-the-spot, the PR-10 has A-B switches, VU meters, phone jacks, output circuits. Moreover, electrical alignment controls are accessible through the front panel. You get all this plus a new Ampex "FourStar" one-year warranty. For data write the only company with recorders, tape & memory devices for every application: Ampex Corp., 934 Charter St., Redwood City, Calif. Worldwide sales, service.
SPACE BREAKTHROUGH!

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100 Audio Control Components in a space 28" x 30"

The new Fairchild Integra/Series, a group of miniature audio control components (13/4" narrow) is the first and only space breakthrough in recording, broadcasting and speech reinforcement systems coupled with higher quality performance. The Fairchild Integra/Series, brought about through the use of the most recent advances in solid state design, allows you to build the most complex console entirely within the reach of your fingertips. Now you can have an individual no-distortion compressor, an automatic attenuator (AUTO-TEN*), a 50 db high output, low distortion transistorized pre-amplifier, a new attenuator (LUMITEN*) guaranteed noiseless, and a flexible program equalizer for every channel. All Fairchild Integra/Series components complement each other yet each component can be bought separately and worked as an independent unit with all existing conventional equipment. Included in the Fairchild Integra/Series:

*Trade Mark

Model 663 - A no distortion compressor
Model 661 - An automatic attenuator (AUTO-TEN)
Model 662 - A 50 db high output, low distortion transistorized preamplifier
Model 668 - A new type attenuator—the LUMITEN, guaranteed noiseless
Model 664 - A flexible program equalizer

Only with the FAIRCHILD INTEGRA/SERIES can you make a sound investment in the future.

Send for data on the complete FAIRCHILD INTEGRA/SERIES SYSTEM.

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See advertisements on pages 69, 70, 74 for additional data on Fairchild Integra/Series Components

LETTERS

Vertical Tracking Angle

SIR: According to your statement the occasion for the so-called "consternation" was highlighted "a year and a half ago," when FM stereophony became a reality. This would make it around June 1961. By this date the means of obtaining a summation of the two channels of information from a stereophonic disc was well known because the disc standard covering this specification had been widely publicized to the recording industry.

R.I.A.A. Bulletin E9
I.E.C. Publication 981
B.S.I. British Standard 1928: 1961
E.I.A. Standard RS221-A

While some failures to adhere to these well established standards have caused a few red faces, there was certainly no consternation. The fact that a summation obtained from all stereophonic recordings does not always result in the most desirable monophonic sound was also known and understood, and this fact was clearly noted in the N.S.B.C. report to E.C.C.

I suggest that it would be more fitting to have devoted more editorial space to Mr. Madsen's brilliant work and less to drawing erroneous conclusions based on incomplete consideration of all the existing facts. A more positive approach of exposing some of the effective results that standardization groups have achieved for the easy exchange of goods both domestically and abroad would be highly appropriate toward enlightening many readers concerning what goes on in EIA, EEC, ISO, RTAA, ASA, SMPTE, NAB, CCIR, MHIA, IEEE, and others. Do you know?

E. H. Usccra
Capitol Records, Inc.
Hollywood and Vine
Hollywood 28, Calif.

SIR: I was certainly pleased to read your editorial support to the standardization of the vertical tracking angle in stereo records. I am slightly disappointed, however, that it took you so long to recognize the problem, and put your weight and prestige behind a corrective movement. Many engineers, including myself, recognized the vertical tracking angle problem four to five ago, and suggested standardization.

REIN NARMA, Chief Engineer
Ampex Corp., Audio Div.
1020 Fifer Road
Sunnyvale, Calif.

SIR: In this paper Mr. Madsen calls attention to the importance of standardizing and controlling the tilt angle in recording and the vertical tracking angle in playback. On the basis of work in our laboratory, we can endorse Mr. Madsen's conclusions. However, it is unfortunate that in listing the vertical tracking angles measured for various pickups, the author did not include model designations of the pickups. Our observations indicate that different models marketed by the same manufacturer may differ considerably in vertical angle. It also appears that some of the pickups tested by Mr. Madsen were older models not now in production. While we find that the vertical angles of currently available pickups of various manufacturers cover roughly the same range of angles as those listed in the article, in fairness to the manufacturers, your readers should understand that the listed values of angle do not necessarily apply to current models of the manufacturers as listed.

J. G. Woodward
J. E. Halter
RCA Laboratories
Princeton, New Jersey

Belt Slippage

SIR: Mr. Subber is correct in that, if I chose to discuss the matter at all, I should have pointed out that with a belt of finite thickness the effective pulley diameter is greater than the actual diameter. I didn't, out of ignorance.

While he does not directly deny the relevance of belt slippage to speed, the implication of irrelevance seems clear. This is not correct. With the motor in perfect sync, the platen speed (in the AR turntable as well as in all others tested here) will vary

(Continued on page 71)
What professional recording tape now offers a new standard of performance? AMPEX 600.

Ampex engineers are never content with present standards. They are always trying to improve what sometimes seems un-improvable. Now they have been at work on the Ampex 600 Series Professional Recording Tape. And they've improved it so much we felt we should call it the new Ampex 600. This 600 Series now offers better high frequency response characteristics. And because an exclusive Ferro-Sheen process makes the tape smooth, the first play and the one-hundredth have the same response characteristics curve. It gives you the kind of reliable performance you expect from Ampex recording equipment. Try this improved 600 Series and see. It's made in the same rigidly controlled clean-room atmosphere as precision computer and instrumentation tapes. Write the only company with tape, recorders for every application: Ampex Corp., 934 Charter St., Redwood City, Calif. Worldwide sales, service.
Gus Farney: Giant Pipes

Gus Farney, former Broa Tape WSTC 1423

During the first month of this decade, War- ner Bros. released the initial offering in a series of organ recordings that should take care of our needs until the 1970's. The series, featuring the veteran theater organist Gus Farney, now numbers three recordings and all of them are available on four-track tape. It doesn't take a mind reader to figure out why the engineering staff at Warners urged the front office to waste no time in getting these releases out on tape. Anyone familiar with the sound on the master tapes would have been reluctant to sacrifice even a small amount of the luxuriant bass due to the exigencies of the disc recording format. Without the walls of stereo groove to worry about, this tape album will have a good user-parting in regions that one seldom hears from on a run-of-the-mill tape. Nothing is lacking in the response of the church and boisterous sound, and Gus Farney turns his attention to the aper- tures with that special voice of the range in the Thirties, "Forty- Ninth Street," "Foot- light Parade" and "Gold Diggers of 1933" are numbered among the sources of the recent tape movie rolls that tune with beguiling ease from the group of keyboards under the command of Gus Farney.

Music by Cesana: The Sound of Rome

RCA Victor LSP 2600

When RCA opened its lavish new recording studios in Rome last March, the occasion received more than passing notice in magazines devoted to the recording industry. To insure maximum news coverage of the formal inauguration of RCA's Italian recording center, Decca, a planeload of American editors was whisked to Rome for a tour of the studios before the studio, not an editor) said to be the largest in the world. Preliminary reports on the ultra-modern equipment installed at RCA Italians could only hint at the nature of the audio work that would be forthcoming from this lavish layout. "The Sound of Rome," a collection of origi- nal compositions by arranger-conductor Cesana, is the first recording I've heard from the studio and it bodes very well for the future. This disc has everything recently at- tained in RCA's domestic studios along with a luxurious feeling of freedom in the acoustics that is a distinct rarity in recordings made over here. Some of the favorite haunts of Vic- tor's engineers stationed in New York offer almost as much freedom. We may tend to identify ourselves by the nature of their resonance characteristics. The Italian studio used by Cesana's sixty-piece orchestra has no sound characteristic of its own. When the recording room is filled with sound from nearby studio walls, the listener is free to hear the music without the typical studio effect. This recording is all the more fluent examples of the advantages gained when the sound is allowed to go its own way in an enormous room with the mikes placed close enough to permit lower-than-average level settings. Under these cir- cumstances, for distortion-free recording get a toe hold. The effect is very rich and pleasing to the ear because the 60 musicians get a chance to be heard without favor being shown to a few. The sound vibrates on the bland and soothing side with little in their musical content to describe the specific landmarks of Rome mentioned in their titles.

Scottish Soldiers

London Tape LPM 70057

You'll want to tell the rest of the clan about this one. London Records now has the answer for tape fans hankering to acquire the stirring music of the Highlanders. The typical theater stereo series of organ recordings has been pleasing the advantages recording music have over the typical studio, this tape is a result of the almost magical world. Of all the tunes in "Mr. President," on a wide variety of subject matter, this song most closely typifies the hues of Berlin magic in the wedding of melody to a high level in sound that follows only Men betrays the first truly gutsy moments of animation heard so far in the record. They Love Me online offers Nanette Fabray the opportunity to unleash the comedy talent that first brought her to the attention of a nationwide TV audi- ence than to depiction of an actual person in charge of housekeeping at the White House. London for the version here, Miss Fabray is introduced quite early in the proceedings. Whenever a good song comes along, she is generally chosen as a fitting song for it across. No sooner does the show get underway, Miss Fabray dives in with her line, "The White House with a mellow song (Let's Go Back to the Waltz) Just as the bull being held there is more of a characteristic thing in the Twenties," and scenes dealing with the private life of Presi- dent Stephen Decatur Henderson. (Berlin's White House occupant) to start the first scene of song hit proportions when Nanette Fabray is asked if she is "The President's "Be- loved lassie." Of course. The younger roles in "Mr. President" are filled with more than average skill and talent. Anita Gillette gets her break so far as the First Daughter of the land. Miss Gillette uses the news on the Main Stem while still an understudy. She replaced Anna Maria Alberghetti for ten days in the part of the President's daughter. Miss Gillette's successor engagement in Ray Holger's show, "All American," has paved the way for the favorable impression she has made here as the President's daughter. Jack Haskell, in his first Broadway appearance, easily walks off with top honors in the vocal department. Haskell's experience gained during the year spent on the Carrie Hall and Miss Fabray shows. As a Secret Service man in love with the President's daughter (democracy always has a chance in a Berlin show), Haskell is effective in romantic-interest songs that full just show up cold hit material. Despite the long list of song supplied by the composer, only a few will be remembered when this Berlin show leaves the stage. Haskell is helped to return to the "private life" of other broad- stage productions.

Norman Luboff: Choral Spectacular

RCA Victor LSP 2522

Only a major label could have risked the extra expense involved in this pop recording. Everything for the completed recording costs are somewhat cheaper in England, the budget made available to Norman Luboff in his latest recording was on a scale usually reserved for important classical works re- quiring a full chorus and symphony orchestra. The term of the idea for this album first be- gan to wiggle when producer Charles Gerhardt auditioned the recent stereo recording of Bee- thoven's Ninth (Choral) Symphony made for WLS by the Chicago Symphony under Fritz Reiner. His suggestion was that Luboff and orchestra placed at the service of standard pop material. Gerhardt's suggestion then called to deliver the arrangements of Norman Luboff was received with favor by the front office recording department and in London's famous Walthamstow Town Hall. Some of the better recordings have been turned out in the last year or two by several American labels. A symphony or- chestra would have had a bale bale re- cent of the presidential tribulations that re- cent occupant of the White House have been called upon to maintain their popularity. The libretto is careful to avoid reference to the better singer, Robert Ryan gives the character's anonymity by sounding far younger than either Truman or Eisenhower yet older than Kennedy. Nanette Fabray's First Lady is a carefree invention devoted more to the entertainment of an audi-
"Over-all, I would rate the XP-4A as one of the best, most truly musical reproducers available today."

—JULIAN D. HIRSCH *

*Noted equipment reviewer, in a lab report published in the December, 1962, HiFi/Stereo Review. Writes Mr. Hirsch: "Inside...the XP-4A is quite unlike any of the other speakers it resembles externally...proved to be an unusually wide-range, smooth system...the response was virtually flat from 5,000 cps to beyond the limits of audibility...Tone-burst tests showed very good transient response...In listening tests, the XP-4A...was almost neutral in character, very smooth and natural-sounding...had an especially fine and satisfying presence...a healthy amount of undistorted output in the 30-to-40-cps range...The XP-4A is priced at $199.50."

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NEW VELOCITONE MARK II

why it's the finest stereo cartridge
you can use with your record changer

It isn't as if the new Mark II won't work wonders with your transcription turntable and arm. That it would. But, matching a cartridge to a record changer is the far more challenging problem. It's a tougher nut to crack.

Here are some of the problems. You can select one of those ultra-high-compliance magnetic cartridges that track at a gram or two. Now what?

Says Joe Marshall, noted authority in the January, 1962, issue of High Fidelity: "An attempt to reduce needle pressure with an arm not designed for low needle pressure will usually result in high distortion due to loading the needle with the mass and friction of the arm."

And in the April 7, 1962, issue of Opera News, Conrad Osborne observes: "The thing to be sure of when seeking a new cartridge is that the compliance... suits the characteristics of your tonearm. A cartridge with extremely high compliance will not necessarily turn in better performance with arms on changers, or with manual turntable arms requiring fairly heavy stylus pressure..."

Now let's take a look at the Velocitone Mark II. Compliance: 0.001 x 10^-3 cm/dyne, designed to track at from 2 to 4 grams. Perfect! Also because it is a ceramic transducer, you can play it with an unshielded motor—in an intense magnetic field—without a trace of magnetically induced hum. Fine! But, how about frequency response, output, channel separation? How does it perform?

The usable response of the Mark II extends from 20 to 20,000 cycles—±1 db to 17,000. And it has better than 30db channel separation. What's more, it is supplied with plug-in, matched equalizers so that it functions as a constant velocity transducer, and can be fed directly into the 'magnetic' phone inputs of any stereo preamp. Universal terminal plug eliminates soldering to arm leads. Its output is in the order of 11mv per channel. You can operate your amplifier with lower gain settings and with less power, resulting in improved signal-to-noise ratio, lower distortion. What more could you ask?

The Velocitone Mark II is priced at $22.25 with two 0.7-mil diamond stylus; $19.25, diamond/sapphire; $14.75, dual sapphire. Ask your hi-fi dealer to show you and demonstrate the new Velocitone Mark II.

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SONOTONE CORPORATION

10 AUDIO • JANUARY, 1963

Stop the World—I Want to Get Off
(Original Broadway Cast)

London Tape LAN 85001

Robbed of its pantomime and tricks in stag- ing this new show from England is so light- weight in its recorded version, it may be blown off the globe before the world has a chance to stop. It's difficult to see how this production can succeed in attracting many record or tape buyers. The qualities of this new-style musical that first won the attention of the London producer David Merrick when he attended the tryout at Nottingham, England, are the very things that fail to register when the show is transferred to the recorded me- dium. Unlike the average stage production that booms a varied cast of performers, the beauty of this show is carried by two persons, Brissicher Anthony Newley is the star, director, co-author, co-composer and co-lyricist of "Stop the World." Sharing the songs in this album with Mr. Newley is Anna Quayle. Between them, they trace from birth to death the life of a clown character known as Littlechap. The story begins in England but soon switches to Russia, Germany and America. Anthony "Littlechap" Newley, and co-author Leslie Bri- sicker wrote a lot of mileage out of one tune that is sung throughout the show by Miss Quayle. Changing the lyrics each time, they use it to poke fun at the customs and attitudes of peo- ple in all four countries. Mr. Newley delivers some of his songs in the self-styled style that Rex Harrison first made memorable in "My Fair Lady." The humor in "Stop the World." although attempting to sound serious, succeeds only in verifying the contention of the authors that the show was written in only four weeks.

A Leroy Anderson Concert

M-G-M SE 4075

To all outward appearances, this is merely another release in MGM's 21 Channel Sound that has been making the rounds in recent months. What first aroused my curiosity was the fact that the cover of the jacket does not carry the name of the composer, but lists some of those performances of a Leroy Anderson mi- xed-sound performance of the Deutsche Grammophon Company of Hamburg. In recent months, MGM has been distributing in this country the classical recording of this famous European firm but this release is the first of his own. What has that MGM had per- signed to a German partner to adopt an Ameri- can recording gimmick for pops records. I must say that the Deutsche Grammophon does have a stunning good job with a technique that must have been a puzzling one at first glance. The highs are higher than ever, and the sound is far superior to those found on domestically produced MGM discs in this particular series. Only part of the reason is traceable to the 30-inch-per-
During rehearsals members of the San Diego Symphony Orchestra pause now and then to listen to a taped recording of the passage they have just played.

AR-3 loudspeakers were chosen for the stereo playback system because of their lifelike reproduction of orchestral timbres. Any pseudo-hi-fi coloration here would defeat the purpose of monitoring. AR-3's and other AR speaker models are often used professionally, but they are designed primarily for the home. Prices range from $89 for an unfinished AR-2 to $203-$225 (depending on finish) for an AR-3. A five-year guarantee on all models covers any repair costs, including freight.

A catalog and list of AR dealers in your area will be sent on request. We will also send a brief description and order form for two books on high fidelity published by AR.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge 41, Massachusetts
CULTURE FOR FREE

There's no question about it, we have found the means, these last years, to broadcast a really amazing variety of good things on radio, primarily via FM. (AM is, oddly, the secondary outlet. Some of the FM material spills over in various AM FM broadcasts, such as my own WNYC broadcast in New York.) Broadcasting in this country is a curious thing, of course; the air waves belong to the people and yet that which goes out upon them must, somehow, pay for itself. Somebody must fork over, to meet the not-insconsiderable bills.

It is so much simpler in Europe. Over there, the people not only own the air waves but pay for them too. The government operates virtually all radio service. The government pays for the broadcasting equipment in toto — and — very importantly — the government also pays, to greater or lesser degree, for the material it broadcasts. Such down-to-earth money raisers as taxes provide the funds. There's a tax, over here, on cars and gasoline, to pay for roads. There's a tax, over there, on radio broadcasts.

Over here, we have a strange idea that culture doesn't pay. We are, of course, entirely right. It does not, in business terms, mean real culture — not spectacular shows, big-name events, first-nights-with-the-President, which pay off in prestige but, in cash. Nobody has yet to my knowledge made Mr. Beethoven pay for himself "live" — that is, strictly in terms of musical performance.

Doesn't our FM culture system get its steam? Well, there's storecast-multiplex, of course, one ingenious way to promote culture and prestige on a station and yet come in for the expenses of broadcasting. But this is merely a final technical "miracle." What goes out on the air?

Remember that there is an obligation on the part of our stations to promote the public good to some degree, in exchange for the public's air. That much-abused concept still manages to exert its influence in various ways. The government exerts varying pressure, of course, depending on the current climate at the top levels. But the indirect results of this concept itself are more important — every station wants to seem culturally vital, if it is, and indeed, must show it. And so, among other public services, a certain amount of sheer, non-paying Culture gets onto the air for sheer prestige, even though it comes out in the red, and is probably expected to. Not at all business-like of course. "It's best that can be done" is what to make this culture the sort which attracts listeners and thus — just maybe — brings a sponsor or two to cushion the financial shock. Big names and big events. Not dead names like Beethoven, but living celebrities — from Pablo Casals to, maybe, Jack Benny. In addition, it means big-name outlookers, if possible. It never hurts to have Jackie or Rocky or Minnie and Ike on hand for a cultural do! Given all this, a broadcast can pay for itself and add prestige too. But not via our modest FM operations, unless as a mere hand-me-down, from the AM or TV audio lines.

And yet our FM abounds in culture. So does radio in Europe. The sounds you hear on Radio Paris or Radio Genève aren't very different from those available via local FM. The reasoning is, however, quite different from that which brings culture to the European stations. Culture comes to the stations for free.

Paying The Overhead

Our system works well and ingeniously. The station's operating costs are paid for indirectly. It gets a sponsor for a program whose cost is all and so pays the overhead; or it gets cash out of its storecast operation; or it receives grants from outside philanthropic sources; or has its own built-in sources; or is musically superb. This last includes many universities and even more, religious organizations all over our land. In fact, much of our audible FM culture is backed by assorted church funds, providing the basic operating upkeep essential to broadcasting. Like the universities, the churches can make the excellent use of a radio voice — but not a one of them can keep talking 8 or 16 or 24 hours a day. So they reserve what hours they need and turn on the almighty assembled culture for the rest of the time. That's a lot. It is a worthy system and brings us much wonderment. Again, the actual programs are rarely paid for. There aren't any funds, or not enough. The setup doesn't survive it, and for good reason. It doesn't need to.

And there is also the latest wrinkle and craziest — in view of its success — the listener-supported radio station. Its programs, individually quite often out of the ordinary, command the respect of an increasingly devoted audience. They find on this type of station things they can't hear elsewhere and, suddenly, they realize how much could be done in radio and isn't. Even when it's half-baked; at least there are new ideas, new attempts. But we must note, once more, that the setup isn't essentially different from those already described. Programs come from many of the same free sources — more of them, in new areas. The basic broadcast facility is again paid for, the programs are not.

Nevertheless, listener's radio, the basic facility supported at least in part by the voluntary donations of the audience is in "business" on the West coast and, in a related venture, has survived surprisingly long in hard-boiled New York, via the WBAI outlet.

There is still one more built-in source of operating funds for broadcasting, closest to my own experience, the city-owned station, or the state broadcasting network. Our WNYC facilities in New York are provided by the city. Out in Wisconsin there's a whole slate of interconnected, state-owned FM stations. In these cases we have the same basic structure, like church-owned or university-owned stations — the operating cost paid for by the owners, who use a proportion of the time for their own purposes and turn the rest over to culture via the familiar media of FM or AM. The difference, here, is that this radio is publicly owned, by government. It doesn't make much difference, actually. The situation is the same as elsewhere. In New York we hear the Mayor whenever he wants to talk to his people, and we get a spate of school activities, reports of public officials, plus endless "commercials" about not crossing against the red light, and so on. Also much in the way of diet, and market news, out of city departments. Takes a good deal of the station's useful time. And in emergencies, of course, the station goes over 100 per cent to the city. (The UN gets split, significantly, between AM and FM. AM gets the continuous UN programs, FM gets "live" programs.) Even so, as always in our FM broadcasting, the air-day includes many hours of recorded music, educational and government broadcasts. But this "homegrown" culture, basically linked to the institutions of local control, is really the only type of FM operation already described. (In fact, WNYC was the fountainhead operation of the NAB's FM "network" and has used BBC and similar material for many years.)

By government stations in our country goes further than most others in acquiring free programs because of its unique position. WNYC has long broadcast "live" concerts of many sorts, and many other stations would be turned aside. I wish I could say the idea bore notable fruit. Some "live" broadcasts are better but most are just plain terrible. All of them tend merely to prove what we all know, that "live" broadcasts are inferior to those from recordings. "Live" music is fast losing ground to tape, edited or unedited, and to the omnipresent recording . . . but that is another subject.

Program Sources

What are these free sources of programed culture? First, of course — records. The world's finest music and drama, a major source of most stations, it doesn't cost much. Mostly, it costs nothing at all.

And then we have the record companies who are happy to provide their culture free, since in their own quite different area the free broadcasting tends to promote each other's sales of recordings, as well as to build prestige for the labels. As we all know, major record companies even go so far as to sponsor programs of their own records, complete with commercials, culture galore. Needless to say, this happy bonanza is sheer closer to FM broadcasting. It is a steady flow of high quality coming in, month after month, large portions of which can be reused time and again over others. With this we have a not surprisingly widespread on the air.

Cultural broadcasting could well exist on this formula alone, but there are other "natural" sources of free material. Second is the "information service" tape, a program provided by some government agency, a common exchange and delivery service. Here, we benefit indirectly — but very positively — from those distant taxes on radios that people pay in other lands; we get (for a song) the best of the foreign production in every imaginable area. Phew! Imagine this! You have on tap the extra resources of giant government-operated radio serv-
A great tape recorder made greater:
1. New professional studio recording hysteresis-synchronous capstan motor: 24 stator slots for ultra-smooth drive, ultra-quiet and vibrationless professional bearing system.
2. Two new take-up and rewind reel motors, both extra-powered for effortless operation.
3. New core-out steel capstan flywheel with all the mass concentrated at the rim for improved flutter filtering.
4. New optimally designed capstan drive belt brings wow down to negligibility.
5. New relay provides instantaneous extra power to the take-up reel motor at start to minimize tape bounce. Provides near-perfect stop-and-go operation and eliminates any risk of tape spillage when starting with a nearly full take-up reel.
6. New automatic end-of-tape stop switch cuts off take-up reel motor power. Also permits professional editing techniques, whereby tape being edited out runs off the machine while you are listening to it.
7. Playback preamps remain 'on' during stop-standby mode to permit cueing.
8. Recording level adjustment during stop-standby.
9. Shock-absorbent helical spring tape lifter practically eliminate tape bounce at start of fast winding.

And All These Well-known RP-100 Features:
Separate stereo 1/4 track record and playback heads permitting off-the-tape monitor and true sound-on-sound recording; separate transistor stereo record and stereo playback amplifiers—meeting true high fidelity standards, monaural recording on 4 tracks; digital turns counter; electrodynamic braking (no mechanical brakes to wear out or loosen); all-electric push-button transport control (separate solenoids actuate pinch-roller and tape lifter); unequalled electronic control facilities such as mixing mic and line controls, two recording level meters, sound-on-sound recording selected on panel, playback mode selector, etc. Modular plug-in construction.

Wow and flutter: under 0.15% RMS at 7½ IPS; under 0.3% RMS at 3½ IPS. Timing Accuracy: ±0.15% (=3 seconds in 30 minutes). Frequency Response: 10 to 15,000 cps at 7½ IPS, 55db signal-to-noise ratio = 20db 30-10,000 cps at 3½ IPS, 50db signal-to-noise ratio. Line Inputs Sensitivity: 100mv, Mike Inputs Sensitivity: 50mv.
It's what you don't hear that counts!

That's why you buy a turntable. For silence. Silence of operation. Rondine 2 delivers both the sound and the silence you want: Menus 57 db silence even at full amplification! That's what you want in a turntable, what you're sure of getting with Rondine 2. Combine it with the Auto-Poise Tonearm and you have the world's only true turntable with fully automatic operation. For complete catalog, write Dept. AU-1, Rek-O-Kut, 38-19 108th St., Corona 68, New York.

R Stereotable only $9.95
R 320 with 320 Tonearm $15.95
R 320 A (illustrated with Auto-Poise Tonearm) $16.95
R Base (oiled walnut finish) $14.95

That's only one of the reasons why the B-12H is the standard of the broadcasting industry! Another reason? A custom-built hysteresis synchronous motor (the very one that drives the renowned B-16H) which assures you of all the torque you need for fast starts and perfect cueing. Other reasons? Write for complete information today.

So rugged you could play it "25 hours a day"

TURNTABLE B-12H

Specifications:

NOISE LEVEL: 57db below average recording level.
WOW & FLUTTER: 0.12%.
Starting: From standing start to operating speed at 78 rpm, .14 turn at 331/3 & 45 rpm, .14 turn
B-12H 12" Stereotable $149.95 net
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That's why the B-12H is the standard of the broadcasting industry!

ices and specialized information services the world around—the BBC, the French Broadcasting Service, the Dutch, Austrian, Belgian—and in lesse degree many others more remote and more exotic. Even our neighbor Canada, which has a remarkable dual broadcast system, part government, part private (same with railroads), sends us down some fine material every so often. The U. S. itself comes up with quite a bit too, though our principal interest is, of course, to send our culture to other people, rather than to ourselves. (An odd idea, that, but I'll let it pass.)

Third, there are the burgeoning new sources of so-called educational material emanating from all sorts of academic and artistic organizations within our own country. I am not here to the precise operations of the numerous and semi-interlocking enterprises of this sort—notably the NAEH—but the principle is quite clear: the talent comes for free, mainly from educational institutions or from cultural outfits like, say, the Boston Symphony. The cost of the talent itself is in the last analysis provided by these institutions. Otherwise the proofs and the teachers we hear on the air would long since have begun to starve.

Thus, from Boston's famed WGBH, via a local FM station near me at Amherst, Mass., I heard an hour-long tape featuring my old music professor at Harvard, G. Wallace Woodworth, analyzing the Beethoven "Emperor" Concerto at length, complete with taped illustrations. Amherst got it from Boston, of course. And Boston got it right from Harvard. Terrific! But I'll bet dollars to doughnuts that "Woody" didn't make any princely sum out of his hard work. He gets paid by Harvard, mainly, and can afford extras of this sort both as a constructive pleasure to himself (as is clearly the case—you could hear it in his voice) and as an item of excellent personal prestige. Programs of this sort become more frequent every day, under the many tricky systems of dissemination we are now setting up for FM radio.

Thus, wherever we look, we find the proof of the same. Before FM, we had precious little of all this culture on the air. Not feasible. Not commercial in a large enough way. Now we have it every where and indeed this is a blessing to those who find it worthwhile to listen. Increasing numbers of us do. But in all our various arrangements we subscribe to the same theory, that the station facilities must be paid for, but the programming itself must be free. Mostly, anyhow.

Cultural Commentators

That includes commentators on cultural subjects, non-jockey-style. (Disc jockeys get paid.) There are many of them, these non-paid performers, and most are happy at the rich new audiences open to their material and their personalities. These indirect fringe benefits are supposed to be adequate compensation and, in many areas, they surely are. Especially in the high-density urban regions with vast numbers of listeners. But as for direct compensation, the system simply does not allow for it. Talent—whether live, via tapes, records, or TV (as in the new educational stations) is for free. You make your living elsewhere.

And so I must end on a somewhat wistful personal note that may indicate to you how very much involved I have been in this whole argument. This autumn, I began my nineteenth consecutive year of weekly half-hour broadcasts, my sixteenth on our New York City station. Within a couple (Continued on page 18)
NEW PRODUCTS!

High-performance in a modern design of sense

40W Stereo Tuner-Amplifier SM-Q300B

Here is a new amplifier further improved in appearance and performance over SM-Q300, which is widely recognized as the best seller of the year. The newly designed front panel is deluxe in appearance because of the use of a gold-colored fretted material. The frame and the knobs are arranged in perfect harmony with the panel. The output is as high as 40W. The power supply circuit is a voltage-doubling rectifying system using silicon diodes. The main amplifier is provided with a phase reversing circuit originated by PIONEER engineers to obtain highly stable and distortion-free output.

The tuner is a FM/AM/SW all-wave system with very high sensitivity and selectivity. For FM a multiplex adaptor can also be used. In addition to the use of PIONEER's unique mode-blend control and the 4-gang volume control for cutting down residual noise, the amplifier is provided with rumble, scratch and whistle filters. It is, in fact, a highly versatile stereo amplifier since it is provided with terminals, such as for tape recorder and center channel, for broadening the scope of its application.

Specifications
Vacuum Tubes: 19 tubes 6 diodes; Tuning Range: MW 535-1605Kc, SW 3.8-12Mc, FM 80-108Mc; Input and Gain: MAG. PU 3.4mV, XTAL. PU 38mV, AUX. 160mV, MIC. 4mV. Equalizer: NF type, RIAA curve; Frequency Response: 20 cps - 50kc; Maximum Output: 20W x 2; Output Terminal: 4, 8, 16 ohm for speaker (each channel), extra output for center channel amp. and for simultaneous tape recording; Dimensions: 18 1/4 (W) x 14 (D) x 5 1/2 (H) inches

Handy Stereo Amplifier

14W Stereo Tuner-Amplifier SM-Q141

Our new stereo amplifier SM-Q141, designed and manufactured with an eye to easy operation, is now available at a low cost.

Specifications
Vacuum Tubes: 15 tubes 3 diodes; Tuning Range: MW 535-1605Kc, SW 3.8-12Mc, FM 80-108Mc; Input and Gain: MAG. PU 2.8mV, XTAL. PU 28mV, AUX. 500mV; Equalizer: NF type, RIAA curve; Frequency Response: 40 cps -100kc; Maximum Output: 7W x 2; Output Terminal: 4, 8, 16 ohm for speaker (each channel) and extra output for center channel amp. and for simultaneous tape recording; Dimensions: 16 1/4 (W) x 13 1/2 (D) x 5 1/2 (H) inches

PIONEER ELECTRONIC CORPORATION

5 Otowacho 6-chome, Bunkyo-ku, Tokyo, Japan

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EDITOR'S REVIEW

ONE YEAR LATER

It hardly seems possible but we now begin our second year as Editor. Where did 1962 go to? We enjoyed it very much, thank you.

Looking forward into 1963 we can think of several things we would like to see in Audio:

1. More articles on recording techniques.
2. Increased comment from readers on what you would especially like to read about in 1963.
3. A definition of high fidelity compiled from what readers think it is (see next section).
4. A construction article on a high-powered transistor amplifier that doesn't require special transistors and is relatively economical.
5. Photographs of home installations which demonstrate a variety of different ways to install systems.
6. A column devoted to audio clubs (or tape clubs).
7. Product profiles on bourbon (it has nothing to do with audio but we like it).
8. A construction article on a high-quality tape preamp.

We really do not expect all of these thoughts to materialize but with your help we hope to see most. Anyhow we have already started on No. 7 as of New Year's Eve.

HIGH FIDELITY DEFINITION—AN OPPORTUNITY

Last month we urged all readers to write to the Commissioner of the Federal Trade Commission (Hon. Paul Rand Dixon) asking him not to accept the definition of high fidelity being proposed by the Electronic Industries Association. If you haven't written yet, do it now!!

The opportunity we have now is to convince the FTC that an acceptable definition must aim towards the highest and not the lowest. We can't quarrel with an attempt by an industry association to raise the standards in its industry, but not at the expense of the high fidelity components industry.

But that is not the whole of our opportunity. We quote below a portion of the letter we received from the FTC in reply to our letter of protest:

While no proposal as to a definition of "High Fidelity" has as yet been received, it is my understanding that the Electronic Industries Association expects to submit such a proposal for our consideration in the near future. We would welcome similar suggestions from other groups or individual members thereof. Before any definition or standard is adopted, it would be our purpose to afford all interested persons an opportunity to present their views in the matter.

From this we see that we have the opportunity, and obligation, to supply a definition acceptable to quality-minded people. Therefore we propose that readers who are competent to speak in this area put their definition on paper and send it to us. We will assemble all the points, add the thoughts of as many professionals as we can collar, and send it on to the FTC. We would suggest that existing audio clubs and associations now meet and, as a group, commit their definition to paper.

A few people have asked us, after reading the first definition, why we bother to do battle with such giants as comprise the EIA, especially since the definition is supposed to apply to packaged sets only. Truly, we are not intending to point our lance at the giants of American industry—we make a rather sorry-looking Don Quixote. We just felt that we wanted a better definition than the one arrived at. We want a definition which truly attempts to define this area which is of great importance to us. In the words of the chairman of the group which arrived at the definition: "so many engineering and technical aspects could not be covered that we had to come up with minimum standards." (From Home Furnishings Daily, Friday, Nov. 30, 1962.) To us it seems tragic to be compatible with a "minimum standards" definition when the word we are trying to define aims at maximum standards. No, we are not Don Quixote, but that doesn't mean we will calmly accept an attempt to degrade standards.

Now what about the contention that the present definition only applies to packaged sets? Frankly we fail to see how one could distinguish between "packaged" sets and really good sets from this definition. Besides are there really no good packaged sets? In effect, whether they intend it or not, they have defined every piece of equipment which hopes to be called high fidelity.

Oh, well, we promise to keep you informed. You, in turn, should write to the FTC asking them not to accept the EIA definition, and also write to us what you think the definition should be.

VERTICAL TRACKING ANGLE

In our November 1962 editorial we mentioned the problem highlighted by E. R. Madsen's article on vertical tracking angle. Several readers wrote to tell us that they recognized the existence of this problem (see Letters) but that we were wrong about the amount of "consternation" caused by the discovery that most stereo records were not suitable for FM-stereo broadcasts (the FCC actually made note of this in their order authorizing FM stereo broadcasts). Also, we were informed, this information was known for a long time, 1957, according to one reader, and why do we raise the question now?

Perhaps we do deserve to be criticized for taking issue at such a late date, but somehow we define late as being after the scene was truly patent for many years while the "proper" organizations followed their normal course of action, but here it is many years with no tangible result in the offing. The truth also is that companies which make record cutters are not yet seriously considering changing the cutting angle of their machines to conform to the 15-deg. "standard" (we called several and asked). The truth is that early tape manufacturers are also not seriously considering changing. Are we really late?

As to whether there was "consternation," we will concede that many people viewed the distortion emanating from the early FM-stereo broadcasts with less than "alarmed dismay," but those on the receiving end were more likely to be "consterned." Anyhow we all agree that standardization should be effected soon.

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AUDIO • JANUARY, 1963

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Throughout the entire world... more people listen to stereo records reproduced by the STANTON Stereo Fluxvalve than any other magnetic pickup!

*More* stereo records are quality controlled and reviewed by professionals using STANTON Stereo Fluxvalves.

*More* high quality phonograph consoles use STANTON Stereo Fluxvalves than any other magnetic pickup.

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And now... new dimensions for stereo from the world's most experienced manufacturer of magnetic pickups -

**STANTON 481**

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Model 481AA STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with ultra-lightweight tone arms capable of tracking within the range from 1/4 to 3 grams. Supplied with the D405AA V-GUARD diamond stylus assembly.

**AUDIOPHILE NET PRICE** $49.50

Model 481A STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with manual tone arms, recommended tracking force is from 2 to 5 grams. Supplied with the D4007A V-GUARD diamond stylus assembly.

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**STANTON 400**

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*The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.*
Only Sherwood could combine the two most wanted components to bring you the new S-8000 II FM Multiplex Stereo Receiver.

The advanced design, highly sensitive and selective stereo FM tuner is essentially the same as that employed in the pace-setting S-2100 Sherwood tuner (below). Stereo music power circuitry is similar to Sherwood's high-rated S-5500 II stereo amplifier (at right).

These extra quality features are standard with the Sherwood S-8000 II.
- Instant FM stereo broadcast identification — Sherwood's new Stereo Indicator Light.
- Novar Output Tubes — have higher voltage ratings, more dependable.
- Noise suppressing FM circuitry 3 Mc. Gated-Beam Limiter and Balanced Ratio Detector — 2.4 db. capture effect.
- Flywheel tuning — for faster, smoother dial tuning.
- Elimination of "rushing" sound when tuning — FM Interchannel Hush.
- Dial spread — communications-type, 20%-longer professional scales.

64 Watts Superb Music Power

Price of the S-8000 II with attractive Walnut Leatherette Case $317.00 (Fair-Trade). Without case $309.50. Full-year warranty.

If you prefer a receiver which also includes AM reception and has even greater music power (80 watts), Sherwood now offers the new S-7700. Price with case $377.00. Without case $369.50. Full-year warranty.

S-8000 II Specifications
- FM Sensitivity: 1.8 µv. for — 30 db. noise and distortion (IHFM).
- FM Selectivity: 200 kc. @ — 3 db. FM Detector: 1.0 Mc. peak to peak
- FM Distortion: ½% @ 100% mod. Power output: each channel 32 watts music power or 30 watts continuous @ 1½% IM distortion.
- Stereo low-noise phono or tape head play-back preamps. Tubes: 21 plus 2 silicon rectifiers, 9 diodes. Size: 15¼ x 4 x 14 in. deep.

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Stereo Receivers • Tuners • Amplifiers • Multiplex Adapters • Stereo Indicator Lights • High Fidelity Speaker Systems • Contemporary Cabinetry

www.americanradiohistory.com
FM-Stereo Reception

JACK BEEVER

Receiving FM-stereo broadcasts may require sophisticated techniques on the part of the city dweller because of the multiple paths the signal takes to reach his antenna and the wide angle his antenna must cover.

**FM Reception Reminds One of the Old Nursery Jingle—When She's Good, She's Very Good, but When She's Bad, She's 'Arrid!** Such a statement obviously calls for clarification.

FM reception has a threshold, a level of signal strength, above which the signal produces sound essentially free of "sferics," the background hiss which is the composite of all electrical interference occurring over a large part of the world. This noise is heard in AM tuners as a continuous part of the background of the programming. Below this threshold level, FM is worse than AM.

The threshold level is dependent in part on the excellence of the tuner. However, tuner design cannot overcome the limiting factor of noise developed in the circuits of the tuner itself; the thermal noise level. Thermal noise is created by the molecules and electrons "bouncing around" in the tubes, transistors, or conductors of the input (antenna) circuits of the tuner. This problem inspired the use of masers for reception. In order to reduce the thermal noise level, maser circuit components are operated at cryogenic temperatures; temperatures down near absolute zero. These low temperatures reduce the banging around of the atoms of the conductors, hence the thermal noise.

The thermal noise level in practical FM tuners limits useful reception to signals having strengths of about 1.8 microvolts (millionths of a volt!) across the antenna terminals. In general, the best tuners will handle signals down to this level, producing "quieting" or elimination of most of the hiss. Less elaborate tuners need more signal to produce the same quieting, as much as ten times more signal in some types.

If you've read this far, you may have come to the correct conclusion that to get good FM, you need good signals from the FM transmitter. You're right, and if we're to do a good job in this article, we'll have to tell you how to get good signals, but first we'd better knock out a lot of the mythology about VHF radiation, which is engineeringese for signals in a band of frequencies which include FM transmissions. We'll include these electromagnetic radiation travels in straight lines, they travel enormous distances over the earth's surface.

FM stations, on the other hand, are on frequencies between 88 and 108 megacycles. At these frequencies, the signals penetrate the upper levels of atmosphere, and except for freak conditions, do not bounce back to earth. For this reason, FM reception at 100 miles is freakish, depending on unusual conditions such as having the receiving antenna on a high mountain, or freak atmospheric conditions. At these frequencies, it is much easier to beam a signal at the moon and receive the bounce than it is to try to broadcast to a point 500 miles away on the surface of the earth.

"I hate to put up an antenna on my house. I should be able to get just as good results in the attic since it would only be a few feet lower down than an outside antenna." An antenna in the attic will do better than the same antenna on the first floor, but it will not do as good a job as one outside. The roof absorbs and weakens the signals, although usually less than the house walls, which contain pipes, wires, heating ducts, and such which tend to absorb the radiation.

"I get good monophonic FM with an indoor antenna from a station 25 miles away, then I should get good multiplex stereo." Not necessarily true. In the first place, when the station "goes stereo" you have less power in each channel of stereo, so the station is weaker. Secondly, the multiplex stereo transmission is prone to interference by multipath signals—the same thing which produces ghosts on TV—and multipath is much, much worse indoors than out.

**Fig. 1. S-shaped antenna is used for omnidirectional reception.**

**Fig. 2. The turnstile antenna is also omnidirectional.**

**Fig. 3. 6-element FM yagi.**

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**Mythology**

"Radio signals go right through house walls." They do, as long as those walls aren't metallic or insulated with metallic foil. Even then, they'll get in through the holes left by windows and doors, but they are weakened in any case, and they are weakened more if the wall is of dense materials. Brick is worse than wood and metal is much worse than brick.

"I can pick up Ft. Wayne, Indiana on AM in New York City, therefore, I should be able to pick up FM stations as far away. They're both radio, aren't they?" They're both radio, true, but the AM stations are on frequencies between 0.5 and 1.7 megacycles, roughly, and have very long wavelengths. These signals often travel around the earth by being trapped between the stratosphere and the ground. They bounce up and down between these two boundaries; thus even though they obey the law that electricity...
Having painted this horrible picture of the FM reception problems, what can we do about it? We'll make one blanket statement: nothing, but nothing, can replace a good outside antenna and the farther away from the station, the more it is needed. But this is about the only blanket statement that can be made, because circumstances can make it necessary to use a high-gain fringe-area antenna when you're almost in sight of the station you want, and they can make you wind up pointing the antenna away from the station.

Basically, listeners can be divided into three groups according to normal antenna requirements: local, up to 15 miles from the transmitter; medium range, 15 to 40 miles from the transmitter; and fringe, 40 to 70 miles. Beyond this it is super-fringe and extremely elaborate setups are required for good results.

All the classifications listed above can be further divided into multidirectional reception and uni-directional reception, which affects the choice of antennas just as much as range. With the foregoing groundwork, we can get down to cases, using examples as the best way of making a point.

Local, Multi-Directional Reception

Let us take a hypothetical resident of Queens, one of the boroughs of New York City. This listener will have FM stations to his north, west, and south-west, within 20 miles.

Assume also that he lives in a single frame dwelling and that he is not within a mile of a large apartment or other building (I know it's almost impossible, but just imagine, please.) He does not wish to get distant stations, but he does want good stereo FM on his locals.

His problem calls for an antenna which will pick up signals equally well within an angle of about 135 degrees (from north to southwest.) The only kind of antenna which will pick up equally well over this great an angle is an omni-directional antenna; one which receives equally well from all directions in the horizontal plane. Figures 1 and 2 illustrate two types of antennas having this ability, a "bent" dipole (the "S-shaped" antenna) and a "turnstile" (the two crossed rods). Of these antennas, the turnstile is more effective because it will provide more signal. These antennas are low gain; the turnstile, for example will deliver, from any direction, about one half the signal power a single dipole delivers in its best direction. The rods of the turnstile are half-wave dipoles, and the simple half-wave dipole is the reference against which all other antennas are compared. In technical terms, the turnstile will have a "gain" of minus 3 db. This sacrifice in power is made to gain omnidirectionality. Since only local stations are wanted, this loss of power in the signal will not be significant; the signals should be well above the noise threshold.

Local, Multi-Directional Reception, with Multipath Distortion

If we now take our resident of Queens, but put him in an area where he has a number of large buildings or bridges in his vicinity, he is troubled by the fact that the large buildings will act as reflectors to the FM signals coming to his antenna. He will thus receive radiation direct from the transmitter and also via reflections from the buildings or bridges. This is the same mechanism which causes ghosts on TV pictures. In stereo FM, it causes distortion of the sound, and sometimes loss of channel separation. The effect is due to the fact that the "ghost" signal is coming over a longer path than the direct signal and may arrive so that it "bucks out" part of the direct signal.

If we're going to solve a problem like this, we need some kind of handle on which to hang an attack. The only handle we have is that the direct signal and the reflected signal come from different directions; they are exactly alike in all other respects.

This, then, calls for an antenna which has "blinders," such as we used to see on horses. We can't exactly duplicate the horse blinders in an antenna, but it is true that the higher the antenna gain the narrower the forward "lobe," which is a way of saying that the antenna is directional, as is the blinded horse.

To use such an antenna, it is aimed at the station, or at the strongest of the signals, which may mean that the antenna is aimed at a nearby building. This is particularly true when the direct path from transmitter to receiving antenna is blocked by a building or other obstruction. In practice, the antenna is turned for best results while listening to the stereo broadcast. This process is called "antenna orientation."

Antennas filling this need are generally of the yagi type, illustrated in Fig. 3. The rule for yagis is the higher the gain, the narrower the forward lobe and hence the ability to reject multipath signals.

But our hypothetical Queens resident has stations coming in over an arc of 135 degrees. If he aims his antenna at one station, he will probably make his other stations worse, since the antenna's high forward gain will discriminate against stations out of its "line of fire."

This same problem was faced and solved many years ago for TV reception by an antenna rotator, a small gadget on the mast which turns the antenna by means of a control placed convenient to the tuner. With this device, the FM listener tunes in the desired station, then turns the antenna until the reception clears up. All rotators have indicators at the control cabinet which show the antenna direction, and these can be recorded, once found, for quick return to the best position for a given station.

Medium Range Reception, Stations in One Direction

Listeners falling in this category are usually located in smaller communities, and their major problem is enough signal to the tuner. They generally have much less trouble than the resident of a "canyon" city like New York, since multipath problems are much less prevalent.

The usual installation is a yagi, either high or medium gain (and the only reason for the medium gain job is economy). A rotator is not needed, since the range allows the antenna to be orientated to a compromise position where all stations come in satisfactorily. This listener is probably in the most enviable position for stereo.

(Continued on page 70)
The function of an amplifier is to provide an output signal that is an exact, but amplified, replica of the input signal. While this may seem simple, it has been an elusive goal for the audio designer. Now with the development of solid-state circuitry, the unattainable may be in sight.

E veryone is aware of the publicized advantages of semiconductors—cooler operation, compactness, lighter weight, lower voltages, and so on. However, the ability of semiconductors to reproduce audio input signals more faithfully than tube has not been as well publicized. To the discriminating music lover, the primary consideration is the quality of sound, not the size or weight. If he were not interested in faithful reproduction of music, he probably would not have invested in components in the first place.

Two of the less-publicized advantages of semiconductors over vacuum tubes are their quick action and their low impedance. Music is full of instantaneous pulses and transients. The transistor can capture this while a vacuum tube with its slower action cannot.

The lower impedance of a transistor makes it possible to direct-couple it and thus avoid the use of audio transformers. Since audio transformers have some limitations, it is a tremendous advantage to be able to omit them.

Amplifier Limitations

The finest vacuum-tube amplifiers have made the problems of non-linear distortion reasonably academic. Harmonic and intermodulation distortions have been reduced to the vanishing points. Flat frequency response from 20 to 20,000 cps at full rated output is also common in the best tube amplifiers (although this is seldom accomplished when both channels are operating simultaneously at full output). A solid-state amplifier must certainly be able to provide equivalent performance to be considered of top quality.

Unfortunately, the transistor amplifiers hitherto available were generally not able to duplicate the performance of the best vacuum-tube amplifiers in these important criteria. Much of the problem can be attributed to the use of germanium output transistors which are hard put to produce power at high frequencies. As a result, most present solid-state amplifiers have gradually reduced power capabilities at frequencies over 8000 cps and are virtually useless above 15,000 cps. To those desiring high fidelity performance, an amplifier that cannot provide satisfactory output to at least 20,000 cps is not a high fidelity amplifier.

Another limitation of many transistor amplifiers using direct coupled outputs (no output transformers) is the limitation in power at normal speaker impedances. Most solid-state amplifiers using germanium output transistors have maximum output near four ohms. At higher impedances, the power drops so drastically that with a 16-ohm load, as little as one third of the rated power is available. Unfortunately, almost every quality loudspeaker system in use today is rated by its manufacturer at 8 or 16 ohms. The one quality American-produced loudspeaker system rated nominally at 4 ohms actually measures considerably higher than 4 ohms at frequencies below 8000 cps—where the power requirements become more critical. Publishing power ratings based on 4-ohm output is misleading. Equally misleading is the use of so-called "music-wave" power rather than the standard rms or steady-state values. Granted, the music power will probably be higher than the steady-state value in an amplifier with poor power-supply regulation, and this higher number looks good in ads. However, the entire concept of music power is buried in so much controversy and confusion that its use in the rating of a quality amplifier is questionable.

Another factor in power measurements is the phenomenon of the one-channel measurement. Stereo amplifiers are, of course, intended to be operated
stereophonically, meaning that both channels will be in use simultaneously. What possible benefit is it to the consumer to read specifications based on measuring only one channel at a time? Again, the answer is that the measurements come out better that way.

Take, for example, amplifier X, advertised at 300 watts. This means 150 watts per channel. Closer inspection shows that the 150 watts is actually music wave, delivered at 4 ohms, with only one channel operating (yet there is no hesitancy in adding together the two one-channel measurements to obtain the 300 watts). In the fine print you notice that the amplifier, at 16 ohms, with both channels operating simultaneously, may produce only 20 watts steady state per channel. Then as the last straw, the power measurements were made at 1000 cps. If the amplifier were tested at 20,000 cps, it might deliver only 2 watts (if it uses germanium outputs). What is the correct rating for this amplifier?

**Figure 1** illustrates a perfect square wave. At one instant, the applied signal is zero, the next instant it is at maximum, where it stays for a specified period. Then the signal is turned off and instantaneously returns to zero. With a perfect square wave, the time required to go from zero to maximum is zero microseconds, and the decay time of a perfect square wave is also zero microseconds. When the signal is applied and reaches maximum, it should stop instantly and remain constant without overshoot, ringing, ripple, and slope. In Fig. 2 we see an imperfect square wave. How does one design a power amplifier to reproduce square waves perfectly? The first requirement is extended frequency response. Many designers of tube amplifiers have long claimed that an amplifier that can reproduce from 20 to 20,000 cps is more than satisfactory for music reproduction because the ear cannot hear beyond this range. There is no argument with this statement. The argument is with the one determining the frequency response. Inevitably, this has been done by feeding in sine waves. However, as previously indicated, music patterns seldom resemble pure sine waves. If we accept a square wave as providing a closer approximation of musical patterns, then by rights an amplifier should be able to reproduce square waves from 20 to 20,000 cps. A Fourier analysis shows that an amplifier must be able to reproduce sine waves to 200,000 cps to reproduce a 20,000 cps square wave properly with good rise time. In order to reproduce a 20-cps square wave with minimum phase shift, the amplifier should be able to reproduce sine waves down to below one megacycle.

These square waves must be reproduced with no overshoot, ringing, or ripple, as the time needed for these undesirable characteristics to be damped out far exceeds the rise time itself. Some overshoot, ringing, and ripple is present in the square waves of all vacuum-tube amplifiers having fast rise times, due to the limitations of the tubes themselves and of the output transformers. The limitations do not apply to silicon output transistors in a circuit without any audio transformers (neither driver nor output). While most germanium output transistors are limited at high frequencies, it is possible to obtain high-power silicon transistors with a beta cutoff above one megacycle. Using such devices in a transformerless circuit produces square-wave output patterns virtually indistinguishable from the inputs. In Fig. 3, (A) and (B) show the 10,000- and 20,000-cps square-wave patterns from the output of the Acoustech I (top pattern) compared to the inputs (bottom pattern). This phenomenal square-wave response is not attained at the sacrifice of the 1000-eps

**Design Criteria**

In establishing design criteria for a solid-state power amplifier, all these subtleties are extremely important. The criteria set for the Acoustech I described herein were as follows:

1. All measurements shall be made with both channels operating simultaneously at the rated output.

2. Steady-state (rms), not music-wave power, shall be used.

3. The rated power and distortion specifications shall be the results of measurements made between 8 and 16 ohms, and from 20 to 20,000 cps. The maximum output of the Acoustech I shall be developed into a load somewhere between 8 and 16 ohms.

4. Harmonic distortion shall not exceed 0.05 per cent with both channels operating simultaneously, at 8 or 16 ohms, 20 to 20,000 cps.

5. Intermodulation distortion shall not exceed 0.05 per cent, using frequencies of 60 and 6000 cps mixed 4:1. Because of the aforementioned high-frequency problems with germanium output transistors, some transistor amplifier manufacturers have found it desirable to measure IM with mixed tones of 60 and 3000, or 50 and 5000 cps. Tube amplifiers have been generally measured with mixed tones of 60 and 6000 or 60 and 7000 cps.

**Transient Response**

The maximum allowable distortion of the Acoustech I (0.95 per cent) has been achieved by several fine vacuum-tube amplifiers, but never by transistor amplifiers. Why, then, is a transistor amplifier reputed to sound better than tube units? The answer is that good sound does not depend on low harmonic and intermodulation distortion alone. An analogy can be made in the field of medicine. When millions died of diphtheria, tuberculosis, and smallpox, barely considered were heart disease and cancer. Once the former were brought under control, however, the seriousness of the latter became quite evident.

The whole field of transient response has only recently become prominent in audio despite the fact that over 15 years ago its importance was recognized by some authorities. To the casual music listener, a transient is considered the sudden creation of a tone, such as that by a piano, drums, or cymbals. However, almost all music is involved with transients. People are so inured to sine-wave measurements that they overlook the fact that music seldom resembles sine waves. Helmholtz demonstrated years ago that the sounds produced by a violin bow pulled across a string are actually a series of tiny little transients blended together. A similar explanation has been made for the sounds of brass instruments, where the air column is activated by a rapid series of motions from the lips. The problems of piano reproduction have beenlegend and can mostly be blamed on poor transient response.

It is in the field of transients that the solid-state amplifier is able to make a unique contribution to the art of sound reproduction. In explaining how this contribution is accomplished, let us first examine the concept of the square wave—the most popular method of evaluating transients.
Another advantage of direct-coupled solid-state circuitry is its lower internal impedance as viewed from the speaker. This provides a very high damping factor, which in the case of the Acoustech I is over 50 : 1. Speaker manufacturers are not unanimous in the importance of high damping. At one time, some even recommended low damping, although these have recently changed their designs and now recommend high damping as well. The question is—how high can one go before further improvement in sound is no longer detected? In listening tests with almost every well-known speaker system, it appears that damping in excess of 50 : 1 is valuable. The tightness of the bass response and lack of boom indicates that this is another important advantage that can be derived from solid-state amplifiers. Perhaps it explains why transistor amplifiers sound different—and in the opinion of many experts, better—than tube amplifiers.

Designing the Amplifier

In planning the Acoustech I, the first and most basic decision was to use silicon output transistors. The extended high-frequency range, the ability to operate at much higher temperatures with no ill effects, and the greater reliability all combine to make the use of silicon outputs essential in the design of a quality power amplifier. Indeed, the advantages of silicon are so pronounced that it was decided to use them wherever possible. As a result, 24 of the 25 solid-state devices in the Acoustech I are silicon.

If the advantages of silicon outputs are so pronounced, why have they not found greater application in consumer products? The reason is simple—money! It is possible to pay more for one silicon power transistor than for a complete vacuum-tube amplifier. Unfortunately, top quality does not come cheap.

Once the decision to use silicon was made, a fringe benefit arose. The circuit itself could be basically simple since complicated circuitry would not be needed to compensate for shortcomings of the output transistors. The simplicity of this circuit means that it is easy to build, easy to service, and easy to maintain in top operating condition since there is so little to go wrong. Silicon transistors, computer-grade electrolytics, and oversized power supply are used so conservatively that no degradation of the original performance is likely for many years. Since the unit operates so cool, thermal stresses are minimized.

The Circuit

The schematic of one channel of the amplifier is shown in Fig. 4. The output from the preamplifier is fed directly into a high-voltage germanium PNP operated as a grounded-collector stage. This stage provides slightly less than unity gain, for its principal function is to raise the input impedance. The average preamp has an output impedance between 500 and 15,000 ohms. The output coupling capacitors of most preamps will roll off the low frequencies if fed into an impedance less than ten times the output impedance of the preamp. The input stage (T1) of the power amplifier provides the useful function of
raising this input impedance to 150 k ohms.

The signal next goes to $T_x$, a silicon NPN transistor with a high voltage rating. This stage acts as a high-gain amplifier. The main negative feedback loop of the amplifier is connected to the base of this transistor. The 22-pf capacitor between collector and base provides some local feedback. This serves as a neutralizing network to stabilize the high frequencies. The two series diodes ($D_1$ and $D_2$) between $T_x$ and $T_y$ comprise a temperature-compensating network in conjunction with $D_1$ at the collector side of $T_x$. It has the effect of varying the bias with a rise in temperature. Under normal ambient conditions and with music signals, this network is unnecessary. However, if the amplifier is being utilized for high-power steady-state measurements, as in industrial or laboratory applications, it is useful.

The signal from the collector of $T_x$ goes to the base of $T_y$ which acts as a phase splitter and driver for half the output stage. $T_y$ is a high-power PNP germanium transistor, but this is not the reason it is used here. It was selected because of its exceptionally wide frequency response (its internal cutoff is above 15 megacycles) which makes this germanium comparable in performance (and cost) to many silicons. To compensate for the unbalanced driver stage, a simple bootstrap network provides a little positive feedback from the dividing network between the collector and base of $T_y$, through a capacitor into the output stage. $T_y$ is a high-voltage medium-gain NPN silicon transistor which is a driver for $T_z$ and $T_s$ outputs. $T_z$, its complementary PNP unit, drives $T_3$ and $T_4$. The outputs are biased at slightly above Class B (AB1).

The particular silicon power transistors used in the amplifier (ST7175) were designed and tested according to Acoustech's exact specifications by Transistor Electronic Corporation of Wakefield, Massachusetts, one of the largest manufacturers of semiconductor devices. The ST7175's have a beta cutoff above one megacycle, and excellent high-frequency response at high power and temperature. A high breakdown voltage and low saturation resistance are other important characteristics. A problem that does exist with silicon power transistors is their somewhat limited current-carrying capability. This is especially important with 4- and 8-ohm loads, when the current rises appreciably. By using the outputs in push-pull parallel, this problem is minimized, and with an effective reduction in saturation resistance, the over-all performance is markedly improved.

The amplifier is fully stable with any load or with no load. The use of silicones means that a very simple stabilization network consisting of an 18-ohm resistor in series with a 0.1-μF capacitor is sufficient to prevent a rising impedance at high frequencies.

Power Supply
The design of the power supply required more than routine thought to meet the basic requirement of providing rated performance from 20 to 20,000 eps, into 8- to 16-ohm loads, with both channels operating at full power simultaneously. As a result, the power transformer used is far above what is needed for music listening. Under the worst possible laboratory, steady-state operating conditions, the transformer is designed so that there will be less than 40° C. internal temperature rise. Under music conditions, the temperature rise will be barely detectable. A standard full-wave bridge with four silicon diodes feeds into a 1000-μF, 150-volt electrolytic for initial filtering. Figure 5 is a schematic of the power supply. From this point, the voltage is split and goes to a separate diode and 1000-μF electrolytic for each channel. In essence, each channel has its own filter network, allowing a considerable amount of independent action between channels. A heavy bass transient on one channel will have little effect on the other channel. A separate B+ fuse for each channel is located between the diode and the electrolytic, protecting against shorts across the speaker terminals or lengthy severe overloads. If one of the fast acting fuses blows, a light flashes on the front panel.

(Continued on page 60)

Fig. 6. Top view of the Acoustech I with the protective cage removed.
+0 \( -\frac{1}{4} \) db from 1 to 1,000,000 cps. That’s the bandwidth of the new Harman-Kardon Citation A—the world’s first professional Solid State (transistorized) Stereo Control Center. It is totally new in concept, design and performance. When you hear it, you will share the experience of its creators—the experience of genuine breakthrough and discovery; the experience of hearing music as you’ve never heard it before. Citation A represents a towering achievement for Stewart Hegeman and the Citation Engineering Group. It will change all of your ideas about the reproduction of sound. Visit your Citation dealer now for an exciting premiere demonstration.

For more complete technical information on Citation A write to the Citation Division, Dept. A-1, Harman-Kardon, Inc., Plainview, N.Y.
Alignment and Adjustment of
FM-Stereo Tuners and Adapters

C. G. McProud

Equipped with suitable test-signal generator, VTVM, audio oscillator, and scope, anyone should be able to align multiplex circuits with ease. The MX generator described can serve as a model for the advanced constructor.

Each new development in electronic circuitry brings with it a completely new set of problems relating to its maintenance. Time was when we thought that a short-wave set reaching up to 30 megacycles was a pretty daring enterprise—now practically anyone can tune in, by simply turning a switch, a fairly sophisticated piece of equipment working up to around 216 megacycles—the ordinary TV set.

Hi-fi equipment used to present quite a problem to the average serviceman (still does, too, to judge from some of the comments we hear), but after some twelve years of having hi-fi, this condition is fast growing better.

Now, of course, FM-stereo is here, and from the secrecy surrounding the servicing of the equipment, it would appear that it is entirely unsurmountable. To date, we do not recall having seen any information about how to align the FM-stereo circuitry in any service notes for tuners. Nor, for that matter, have there been any such instructions with tuner or adapter kits.

It may be, of course, that the necessary equipment has not been readily available. For a time there was only one multiplex generator available, then there were two, then three, and we have heard rumors of a fourth. The first such unit was quite expensive, and it was not likely the individual would buy a $1000 unit to align a $100 tuner. But if audio servicemen are going to remain in business and continue their claims to being complete service centers for hi-fi equipment, they will have to provide themselves with some sort of multiplex test equipment.

For ordinary service use, the device does not have to be especially complicated, nor does it demand the use of a scope capable of providing a bandwidth up to 5 megacycles. Such bandwidth may be necessary for the development laboratory, but not for the audio serviceman.

Multiplex Circuitry

Stereo multiplex circuits—either in the adapter or in the test generator—do not represent anything essentially new in electronic circuitry. Basically they consist of oscillators, frequency doublers, phase-shift networks, cathode followers, and so on. The only unusual parts of stereo multiplex equipment are the modulator and demodulator circuits. And it is only the special requirements of signal separation that make these circuits different from other modulator circuits.

Since these elements are the fundamental parts of the multiplex equipment, any attempt to understand such circuitry requires a basic knowledge of diode gates and their operation.

Figure 1 shows a typical demodulator gate used in multiplex adapters and tuners, and now the most popular type of circuit. Most of the original circuits employed a conventional AM detector which demodulated the subcarrier, and the resulting output was then matrixed with the sum signal from the main carrier to provide the required L and R signals.

The same result can be obtained much more simply by use of the time-division method which samples the signal 38,000 times per second in each polarity and feeds all the samples of the positive side of the signal to one channel and all from the negative side to the other channel. What is needed, then, in the tuner or adapter is a SPDT switch which can function at a 38,000-cycle rate—not a likely mechanical device. Most circuits resort to diode gates to perform the required switching.

Referring to Fig. 1 again, the composite multiplex signal is fed to the center tap of the secondary winding of the 38-ke transformer, while the primary is excited from the plate circuit of the 38-ke oscillator or doubler. The amplitude of the switching voltage should be approximately ten times that of the composite signal in order to keep the separation of the two channels at a reasonable level. In any modulator circuit, the fixed or "carrier" signal must be greater in amplitude than the signal with which it is being modulated if the composite output is to vary in direct proportion to the modulating signal. This also applies to the modulation if the recovered signal is to be a faithful replica of the original modulating voltage.

In Fig. 1, it will be noted that a capacitor is provided in the circuit from the signal source so as to eliminate any d.c. voltage from the preceding circuits which would disturb the functioning of the diodes. In operation, the two ends of the 38-ke transformer will have equal and opposite carrier voltages. When the positive swing of the carrier appears at the junction of diodes D1 and D2, diodes D3 and D4 are conducting and diodes D1 and D2 are cut off. Thus the signal voltage applied to the center of the transformer secondary will be fed through the "on" diodes to the filter circuit in the "A" channel. Similarly, when the positive swing of the carrier voltage appears at the junction of diodes D4 and D2, diodes D3 and D1 are conducting and diodes D1

Fig. 1. Schematic of diode-gate circuit used in typical FM stereo tuner or adapter.
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6. **Complete anti-vibration system**
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7. **High-fidelity arm**
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8. **Lifetime warranty**
   - The Empire Troubadour comes with a lifetime warranty, reducing your concerns about equipment failure and providing peace of mind.

These features, among others, contribute to the Empire Troubadour’s reputation as the “World’s Most Perfect Record Playback System.”
and $D_2$ are cut off, thus feeding the signal to the filter circuit in the "B" channel. Since the composite signal consists of information from the "A" and "B" channels appearing alternately in 38-ke samples, this results in feeding the "A"-channel information only into the "A" channel and the "B" information only into the "B" channel.

The purpose of the filters is to provide the necessary de-emphasis and to suppress the 38-ke switching signal and its harmonics as much as possible. Since the normal de-emphasis network in a tuner would result in attenuation of the 38-ke subcarrier and the modulating sidebands which represent the difference signal by about 26 db, it is obvious that the multiplex demodulator circuit should be fed directly from the discriminator or ratio detector, and thus ahead of the de-emphasis circuit. However, the de-emphasis must be provided somewhere in the audio circuit, and since there are two channels, it follows that there must be two de-emphasis networks, one in each.

Once the basic principles of the diode gate are understood thoroughly, it is easy to follow the operation of the circuit for a generator designed to provide the necessary signals for service on the multiplex portions of FM-stereo tuners or on separate adapters.

**Generator Requirements**

A stereo test-signal generator must provide a composite signal consisting of several separate frequencies having specific phase and amplitude relationships, together with suitable means for combining these signals in the proper manner. First, the generator must provide 19,000 eps at a high accuracy of frequency. According to F.C.C. regulations, an FM-stereo transmitter must hold the 19-ke within ±3 eps, and such accuracy is desirable in a test generator. This demands the use of a crystal-controlled oscillator. Second, the generator should provide one or more frequencies in the audio range to serve as the "program" which must be reproduced at the output of the adapter circuit under test. Third, the generator must be able to switch the test signals of the two channels on and off alternately at the rate of 38,000 eps, with a controllable phase relationship to the 19-ke pilot. Fourth, the harmonics of the 38-ke switching frequency must be filtered out. Additionally it may be advantageous to be able to apply the composite signal as modulation of an r.f. carrier in the FM band so as to permit feeding the composite signal into the antenna input of the tuner so as to observe the effect of i.f. and discriminator (or ratio detector) bandwidth upon the recovered signal. It may also be advantageous to have several modulating frequencies which may be switched to either right or left channels as desired. Neither of these requirements is necessary, however, for service work. Thus it is possible to construct a generator which will give a suitable signal without making it a complex and expensive unit.

Such an instrument is the Karg Model MX-1G stereo multiplex generator, which is available in kit form or factory-wired. In addition, the advanced experimenter should be able to follow such a circuit as this and construct his own generator.

**Generator Description**

The Karg test generator, shown in Fig. 2, is comparatively simple, and can readily serve as a guide to the enterprising experimenter who wishes to build his own equipment. It is available as a kit, or as a factory-wired unit. The over-all schematic, Fig. 4, shows the 19-ke crystal oscillator comprising a 6A8QA. The output of the second section feeds a transformer with a center-tapped secondary which in turn feeds a phase-shifting network used to adjust the relative phase between the pilot and the switching rate in the composite signal. In addition, this secondary feeds the grid of the 6A8Q pentode section as the doubler, the two diodes providing positive pulses from both half-cycles of the 19-ke signal and thereby driving the oscillator at a 38-ke rate, and it, in turn, keys the diode bridges at the same rate and feeds the left and right channels alternately to the output.

These diode bridges differ from the simple ones of Fig. 1 because in a test generator it is necessary to keep the switching frequency out of the composite signal. In the receiver the 38- and 76-ke components can be filtered out because the only frequencies of interest in the output are those up to 15,000 eps. In the composite output of a generator, however, the 38-ke and its harmonics must be passed in order to carry all of the necessary information, yet there should not be any 38-ke sine wave signal. While this may sound ambiguous, it must be understood that the tiny samples of alternate right and left signals are at the rate of 38 kc, there is still no pure 38 kc in the composite. Since it is not possible to filter out the switching frequency, it must be balanced out in the switching circuits, Figure 3 shows the diode bridges rearranged. When terminal A of the transformer is positive, diodes $D_1$, $D_2$,
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Fig. 4. Over-all schematic of Karg MX-1G multiplex signal generator.
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Fig. 5. 'Scope patterns obtained at output of MX test generator. At two-channel modulation, L = R, with pilot; (B) L = -R mod-ration, with pilot, and gain increased to show crossings; correct zero phase shift pilot-carrier relation is shown by the "points" opposite each other; (C) Same as (A), except without pilot; (D) Same as (A), but with phase relation about 30 deg. 

The filter waveform in Fig. 5 is of the composite type. In practice, R 37 actually consists of a fixed resistor and a variable one permitting a range of adjustment from 15,000 to 30,000 ohms. Also, in practice, R 36 is in two sections, each of 500K ohms and connected between the two diode bridges where the 38-kc is injected, as shown in Fig. 3. The composite output is fed to a cathode follower, and thence through a filter to the output. The filter is designed to eliminate the second and third harmonics of the switching frequency.

The audio signal frequency, approximately 1000 cps, is furnished by V 45. This is a phase-shift oscillator with the output taken from the center-tapped secondary of a transformer so that the right and left signals fed to the bridges may be in either or out of phase, depending on the position of the switch S 3. The third position of the switch permits feeding only one of the channels—right or left—being selected by a slide switch. Another slide switch permits the use of an external source of audio signal when desired. Two other slide switches control the pilot signal and a.c. power to the generator.

Adjustment is quite simple. With the pilot signal on and internal audio on, the output control is set to furnish a composite output of 2 volts; then with modulation off, the pilot amplitude is adjusted to provide an output of 0.2 volts. The pilot is then turned off and the carrier-balance potentiometer adjusted for minimum output signal, which should be around 50 to 55 db below the 2-volt composite signal. Then with the output fed to a 'scope, and modulation set for L = R, the pilot phase control is adjusted to give the type of signal shown in C of Fig. 5 in which the differences between the alternate peaks of the composite signal are the same at top and bottom parts of the pattern. Increasing the amplitude of the signal and concentrating on the axis crossing gives a pattern like (B), which shows clearly the correct phase adjustment when the points are opposite each other. (C) is the same as (A) except for different audio modulation and absence of pilot; (D) shows incorrect phase adjustment.

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Circuit Alignment

The actual operation of alignment of the multiplex circuit of an adapter or tuner is extremely simple, once the generator is available. Although there are minor variations in multiplex circuits, all of them contain essentially the same elements, and even without specific instructions, no trouble should be encountered. Most circuits have a 67-kc SCA filter; all have a 19-kc filter to separate the pilot carrier from the remainder of the signal; all have 38-kc circuits—either oscillator or doubler; and some have a separation control.

The first step is to adjust the 67-kc filter. This requires a source of this frequency, usually from a wide-range audio oscillator. With this signal fed into the multiplex circuit and a VTVM on the output of either channel, adjust the filter for minimum output. If the 67-kc circuit is not identified on the chassis but you have the schematic, you will be able to recognize it by the value of the components. Filters of this type usually consist of an adjustable-core coil with a small capacitor across or in series with it—the capacitor value usually between 50 and 150 pf.

After the SCA filter is adjusted for minimum output, apply a 19-kc signal to the input of the adapter circuit. For preliminary 19- and 38-kc adjustments, assuming the entire unit is completely out of alignment, it is suggested that a 'scope be connected to some point in the adapter where 38-kc is present. With the oscillator type of circuit, this point can be found by probing with the 'scope lead with no signal fed into the adapter. If the circuit uses a doubler, however, no signal will be present unless some 19-kc pilot is fed to the input, so some should be injected. Once the 38-kc point is found and the 'scope connected, adjust all remaining circuits in the adapter for maximum output at 38 kc. While making

(Continued on page 61)
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PART THREE OF A SERIES

CALCULATIONS

In this Section all calculations necessary to achieve the required performance specifications shall be described in detail. If the reader prefers to use a different stereo cartridge or different transistors, or if he wants to select gain and impedance values different from those described the same calculations may be applied using the appropriate new values.

Selection of Operating Points and D.C. Stabilization

The selection of the operating point of a transistor audio-frequency amplifier stage is of great influence upon the useful collector-voltage swing, distortion, and noise level. Any uncontrolled change in the operating point has to be avoided since it directly influences the performance characteristics of the stage. Once a suitable operating point has been selected, it has to be stabilized to be essentially independent of transistor parameter tolerances (especially of variations in current transfer ratio), temperature, and supply-voltage variations.

The influence of the different parameter variations upon the operating point shall not be discussed here, nor is it intended to present a complete theory of transistor-stage operating-point stabilization. Rather elaborate calculations and extensive tests have shown that under normal conditions excellent stability can be achieved by observing two simple rules of thumb.

One of the most effective and convenient methods to achieve d.c. stabilization in a common-emitter stage is the insertion of a resistor in the emitter lead, as shown in Fig. 12. The resulting negative d.c. series feedback stabilizes the operating point of the stage against changes in transistor parameters, temperature, and supply voltage. It is obvious that for optimum stability, $R_v$ should be made as large as possible. However, supply voltage is lost in $R_v$, and a very high value requires an impractically high supply voltage. Normally, a compromise has to be made between stability requirements and supply voltage facilities. It has been found if

![Fig. 12 Simplified circuit of a common emitter stage with series feedback.](image)

that very good stability can be obtained $V_{BE} = V_{CB}$ and $|V_{CB}| < 0.5 |V_{CC}|$.

As indicated in Fig. 12, the bias problem must still be decided. For good stability of the stage it will be necessary to apply a highly stable voltage, $V_{BE}$ or current, bias $I_B$, to the base electrode of the transistor. In addition to this, stability can be improved considerably by the use of a degenerative d.e. feedback loop around one or more stages of the amplifier.

In our special case all three amplifier stages are operated in common-emitter connection, they are directly coupled for optimum low-frequency response and good d.e. stability. Operating point stability of the individual stages is achieved by emitter resistors, and a d.e. negative-feedback loop around the first two stages insures high over-all d.e. stability. Different methods of bias stabilization have been employed in the individual stages: stage one uses constant-current bias via the d.e. feedback path from the emitter of the second stage, stages two and three are operated with constant-voltage bias from the collectors of the respective preceding stages. The d.e. circuit of the three-stage amplifier which will now be developed in detail is shown in Fig. 13.

Since there is no universal standard concerning the use of reference arrows as yet, the system used in the following calculations shall be explained briefly. In principle, any desired system of reference arrows may be used, the results of the calculations will be the same in any case.

All reference arrows will be applied according to the sign convention used in four-terminal network theory. Current reference arrows will be counted positive for currents flowing into the network, and voltage reference arrows will be counted positive for voltages referred to the common or ground terminal. Actual d.e. currents are counted positive in the direction of conventional current flow, and d.e. voltages are counted positive from positive to negative terminals.

When this system is applied to PNP-transistor circuit analysis, a number of values become negative. To void misunderstandings, a negative sign is always added to the symbol and not to the

![Fig. 13 D-C circuit of the three-stage amplifier.](image)
figure, for example, \(-I_c = 3\) mA, and not \(I_c = -3\) mA.  
In the following calculations the subscripts \(B, E,\) and \(C\) refer to the respective transistor electrodes. The subscripts \(I, II,\) and \(III\) refer to the individual amplifier stages, they will be omitted in places where a confusion with other values is not possible.  
Since direct coupling is employed, the base current of each stage affects the preceding stage. The amplifier will therefore be designed starting with the last stage. 

**Stage Three—RCA 2N109.**  
Maximum ratings: \(-V_{GB} = 12\) v max, \(-I_c = 35\) mA max, \(P_C = 150\) mw max at \(t_{em} = 25^\circ\)C.  
The output stage of the equalizer has to feature an output resistance, \(R_o\), of 600 ohms. It has to be capable of delivering an undistorted output voltage of 775 mv into an external load resistance, of 600 ohms, corresponding to an output power of 1 mw.  
Because of the low load resistance, this stage has to be designed like a large-signal stage, its set of characteristic curves has to be used for operating point selection. As shown in Fig. 14, stage three is operated in class A. The operating point, \(O\), has been placed into the most linear region of the collector characteristic, which results in very low distortion. Even with heavy overloading, the regions of collector leakage current and saturation voltage are not reached.  
The selected operating point is given by \(-I_c = 8.0\) mA and \(-V_{GB} = 8.0\) v, the supply voltage has been set at \(-V_{GB} = 25\) v.  
The output resistance of a common-emitter stage is composed of its collector resistor shunted by the output resistance of the transistor amplifier, which generally is in the order of several times 10,000 ohms and may, therefore, be neglected. Thus the required output resistance of 600 ohms can be achieved with sufficient accuracy by using a collector resistor, \(R_o\), of 620 ohms \(\pm 5\) per cent. The collector voltage then is \(-V_c = -V_{GB} + R_o I_c = 25 - 4.96 \approx 20.0\) v and the emitter voltage \(-V_E = V_c + V_{BE} = 20.0 - 8.0 = 12.0\) v. According to the transistor characteristics (see Fig. 14) the base current is \(-I_B = 8\) mA, the emitter current then is \(I_E = -I_c - I_B = 8.08\) mA and the required resistor  
\[ R_o = \frac{V_c}{I_c} = 12.0 \approx 1480 \text{ ohms}. \]

The base-to-emitter voltage as determined from the characteristics is \(-V_{BB} = 0.2\) v, the required bias voltage at the base of stage three will be \(-V_B = -V_E - V_{BB} = 12.2\) v. The collector dissipation of stage three is \(P_c = I_c V_c = 8.0 \times 8.0 = 64\) mw, and its total power consumption \(P_{DC} = I_c V_C = 8.0 \times 25.0 = 200\) mw.  

**Stage Two—RCA 2N175.**  
Maximum ratings: \(\beta = 65 - V_{GB} = 10\) v max, \(-I_c = 2.0\) mA max, \(P_c = 4\) mw max at \(t_{em} = 25^\circ\)C.  
The undistorted output voltage of stage two required to drive stage three has to be almost \(v_{ssl} \approx v_{ssl} = 775\) mv, since the voltage gain of stage three is only slightly above unity. However, to achieve maximum voltage gain the collector resistor of stage two will be made as large as possible, its external load resistance—the input resistance of stage three—is of the order of several times 10,000 ohms, too. The resulting load line in the collector characteristics, therefore, has a very gentle slope and the stage may be operated at rather low collector current, which, in turn, requires a large collector resistor. Thus, the selection of the operating point is not too critical. The chosen values are \(-I_c = 1\) ma, \(-V_{GB} = 4.8\) v, and \(-V_{CC} = 21.0\) v.  
Since it provides the required bias for stage three, the collector voltage has to be \(-V_{CI} = -V_{E II} = 12.2\) v.  

The d.c. resistance of the audio-frequency feedback network (as calculated later) is \(R_l = 51,700\) ohms. Since the feedback network is connected to the current divider in the emitter lead of stage one near ground potential \((R_E)\) is much smaller than \(R_l\), it may be assumed that the entire voltage \(V_{E II}\) is dropped across \(R_l\) only.  
The current in the collector resistor of stage two consists of  
\[ I_c = I_c II + I_c III \]
\[ I_c II = \frac{-V_{C II}}{R_l} = \frac{-12.2}{51.7} = -0.236\] mA.  
\((-R_E\) is much smaller than \(R_l)\)  
\[ I_c III = 0.236 + 1.0 + 0.08 = 1.316\] mA; the required collector resistor is  
\[ R_c = \frac{-V_{C III}}{I_c III} = \frac{-12.2}{1.316} = 9.316 \approx 3600 \text{ ohms}. \]

This current consists of the base current, \(-I_B\), of stage one and the current, \(I_c\), flowing through \(R_3\), which is \(I_c = I_c II + I_c III\).  
With \(-I_B = 0.0077\) mA (as determined in the next paragraph, we get \(I_c = 1.0 - 0.0077 = 1.007\) mA and therefore  
\[ R_c III = \frac{-V_{C III}}{I_c} = \frac{-12.2}{1.007} = 12.1 \approx 7340\] ohms.  

According to the base characteristics of the 2N175 the base-emitter voltage for the selected operating point is \(-V_{BE} = 0.1\) v, the required base voltage thus being \(-V_B = V_{BB} = 7.5\) v.  
Stage two has a collector dissipation of \(P_C = I_c V_C = 1.0 \times 4.5 = 4.5\) mw, and a power consumption \(P_{DC} = I_c V_C = 1.316 \times 21.0 = 27.1\) mw.  

**Stage One—RCA 2N175.** To achieve the desired high signal-to-noise ratio the first stage has to be designed for low noise. Since it has to handle only very small signals, the selection of its operating point is not limited by considerations concerning collector voltage swing and distortion. From the noise characteristics of the RCA 2N175 (Fig. 2) the optimum operating-point values have been chosen: \(-I_c = 0.5\) ma and \(-V_{GB} = 4.5\) v; the selected supply voltage is \(-V_{CC} = 19.0\) v.  
The collector voltage being \(-V_{CI} = -V_{E II} = 7.5\) v we get  
\[ R_c = \frac{-V_{CC} + V_C}{I_c} = \frac{-22.5 - 4.5}{0.5 - 0.015} = 22,300 \text{ ohms}. \]

(Continued on page 59)
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Microphone Techniques

Q. Can you supply any information on microphone techniques for recording orchestras and voice groups? We have a two-channel tape recorder, mixer, and several excellent microphones, and are interested in developing the correct mixing, and microphone placement techniques.

A. To the best of my knowledge, the professional recording engineer depends more upon electronic equipment and formulas, and his selection and placement of microphones varies with the engineer and with the recording site.

Converting to Stereo Record

Q. I have a tape recorder (mono record, stereo playback) which I would like to convert to stereo record. I am aware that it would be a great deal more convenient, and quite possibly less expensive, to just forget this and buy a stereo record model. My idea is this. The preamps and oscillator are put up as printed circuit units and can be purchased. The machine is equipped with a stereo record-playback head. Could I not add the necessary extra electronics, using the printed circuit units and such extra switches, and so on as would be required to activate the second half of the head and employ it for stereo recording? I have a fair understanding of elementary electronics and have undertaken quite a few construction projects successfully.

A. You have quite a difficult problem ahead of you. First, you have the problem of analyzing the present switching arrangement and converting it so that a recording signal may be fed to the bottom section as well as to the top section of the record-playback head. Second, you have the same problem with respect to feeding bias current to the lower section of the erase head. Third, there is the question whether the oscillator can turn out enough current to do double duty. Fourth, you will have to adjust bias and erase currents to their correct values. Fifth, you will have to add a second record-level indicator and calibrate it properly. Sixth, there is the question whether the present power supply can handle two recording channels at once; more power is employed in recording than in playback because of the oscillator and record-level indicator.

Replacing "Eye" Tube with VU meter

Q. I am enclosing a schematic diagram of the electronic section of my tape recorder. It came with a GE magic eye record-level indicator. I took this out and installed a VU meter. There are 4.5 volts of a.c. signal available at normal recording level, which seems efficient to drive the meter. Also, there is an isolating stage of amplification between the meter and the recording signal. Have I installed the meter correctly or should there be a separate cathode follower to drive it? Also, how should I connect the meter to read recording bias?

A. A VU meter should be driven by a low-impedance source, whereas in your case you are driving it from a high-impedance one. Therefore you should use a cathode follower to drive the meter. While 4.5 volts is much more than the 1.23 volts required to drive a VU meter (through a 3600-ohm series resistor), your present connection doesn't supply sufficient current to the meter.

To enable you to read recording bias, you can insert a variable resistor between the ground lead of the record head and ground, then connect the input of the cathode follower to the output of this resistor through a switch. Assuming that bias current is of the proper value, adjust the variable resistor until the meter reads 0 VU. Thereafter, should bias depart from the correct value, the meter would read higher or lower than 0 VU. The value of the variable resistor depends upon the amount of bias current flowing through the head. Assume that the head is a high-impedance one (usually the case in home machines) drawing 0.8 mA of bias current as the optimum amount. A VU meter requires 1.23 volts to read 0 VU when driven by a source through a 3600-ohm resistor, so that Ohm's Law we calculate that the variable resistor should have a value of 1538 ohms. However, the signal coming out of a cathode follower is only about 9/10 of the input signal. Dividing 1538 by 9/10, the value of the variable resistor becomes 1708 ohms. Therefore a variable resistor with a maximum value of about 2000 to 3000 ohms appears suitable. The resistance of 1708 ohms introduced between the record head and ground should have negligible effect upon bias current and therefore upon performance. The circuit impedances associated with a high-impedance head will probably total about 40,000 or 50,000 ohms, so that 1708 ohms is slight in comparison. However, if you are a purist, you may want to touch up the value of bias current to allow for the added impedance of 1708 ohms.

A Click-Filtering Tape Recorder

Q. I have owned a tape recorder for more than two years. I am particularly interested in recording pipe organs and have recorded many recitals using Electro-Voice 664 miles plus interference filters. Without exception, each time I record pipe organ music I also record clicks that are in tempo with the music, caused by the making and breaking of relays at the organ console. Recently a friend of mine bought a tape recorder (another make). I have borrowed it to record two organ recitals and this time there were no recorded clicks, although I used the same microphones, filters, and such. The manufacturer of my own tape recorder has offered no explanation in his reply to my letter describing the problem.

A. Perhaps one or a combination of the following measures may help reduce the clicks, which may be electrical impulses through the a.c. line or as magnetic impulses through the air: 1. Place a 600-volt capacitor across the a.c. line going into the tape recorder, or between each side of the line and chassis; 2. place a capacitor across the a.c. line going into the organ console between each side of the line and chassis; 3. place a 100-ohm resistor in series between the microphone input jack and the grid of the first stage tube. Place a 10-pf capacitor between this grid and ground.

Recording Level Adjustment

Q. I own a tape recorder and would like to ask a question regarding the adjustment procedure. 1. A standard-frequency tape of 250 cps is used to adjust the playback level. Should I connect a VTFM to the preamp output and adjust the playback until the VTFM reads plus 4 db, at which time the VU meter should read 0 db. I would like to know what the plus 4 db refers to. 2. The instructions state that the sensitivity of the VTFM should be adjusted since the test signals are recorded at minus 10 db. What does minus 10 db refer to? 3. The instructions state that the input level should be connected to the line input and set for 800 cps with the input level at minus 10 db. What does minus 10 db refer to? 4. How should I adjust the calibration of the VU meter? A. 1. It is standard practice to put a 3600-ohm resistor in series with a VU meter, thereby enabling the meter to operate properly. But this produces about 4-db reduction in the signal reaching the meter. Therefore it is required to increase the signal 4 db to make up the loss. 0 VU corresponds to 1 milliwatt in a 600-ohm line, which translates into 0.774 A. A signal 4-db higher corresponds to 1.23 volts. Accordingly, the "playback-level adjustment" apparently should be turned until you get a reading of 0.VU on the meter and 1.23 volts on a VTFM connected to the output of the tape recorder, as you are playing the test tape. The 250-cps notes should be one that is recorded at a level corresponding to 0 VU in playback. 2. The test signals are 10 db below the recording level that produces a reading of 0 VU on the meter when the latter is employed as a record-level indicator (not as an indicator of playback level), which is to a level 10 db below that which produces a recording indication of 0 VU. 3. I assume that you refer here to adjustment of the VU meter as a record-level indicator. Feed a signal between 250 and 400 cps into the tape recorder. Adjust the recording level until you obtain 40 cents harmonic distortion in playback, as measured by a harmonic distortion meter. Reduce the input signal about 6 db to allow for the mechanical lag of the record-level indicator. Check the meter so that it reads 0 VU on the basis of the reduced input signal. If the 250-cps note in the test tape represents maximum recording level (producing 3 per cent harmonic distortion),
all-transistorized

New Sony Stereocorder 777

The most advanced achievement in recorder engineering to date, the superb new remote-controlled professional Stereocorder 777 series features the exclusive and patented Sony Electro Bi-Lateral 2 & 4 track playback Head, a revolutionary innovation that permits the playback of 2 track and 4 track stereophonic or monophonic tape without track width compromise—through the same head!

Included in an array of outstanding features are individual erase/record/playback heads, professional 3” VU meters, automatic shut-off, automatic tape lifters, an all-solenoid, feather-touch operated mechanism, electrical speed change, monitoring of either source or tape, sound on sound facilities, and an all-transistorized military plug-in type circuitry for simple maintenance. The three motors consist of one hysteresis synchronous drive motor and two hi-torque spooling motors.

Unquestionably the finest professional value on the market today, the 777 is available in two models, the S-2 (records 2 track stereo) and the S-4 (records 4 track stereo). Both models can reproduce 2 and 4 track tapes.* And, the Stereocorder 777 models will integrate into any existing component system. $595 complete with portable case and remote control unit.

*Through the exclusive Sony Electro Bi-Lateral 2 and 4 track playback head.

Sony has also developed a complete portable all-transistorized 20 watt speaker/amplifier combination, featuring separate volume, treble and bass controls, mounted in a carrying case that matches the Stereocorder 777. $175 each.

Also available is the MX-777, a six channel all-transistorized stereo/monophonic mixer that contains six matching transformers for balanced microphone inputs and recorder outputs, individual level controls and channel selector switches, Cannon XL type receptacles, a switch to permit bridging of center staging solo mike. $175 complete with matching carrying case.

The first/complet/portable/all-transistorized/high fidelity/professional recording & playback system: $1120 complete.

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For additional literature and name of nearest franchised dealer write Superscope, Inc., Dept. 7, Sun Valley, California.

"In New York, visit the Sony Fifth Avenue Salon, 585 Fifth Avenue."
LEAK "STEREO 60" POWER AMPLIFIER

An additional convenience feature is the use of only one set of speaker terminals for each channel, the impedance being changed by moving a plug on top of the output transformer. Also the power transformer can be set for use with 110-volt, 117-volt, and 124-volt lines also by moving a plug to the appropriate set of holes.

The surprising thing about this amplifier is its unusually attractive appearance when viewed from the underside; here is where the professional touch is revealed. A glance at Fig. 1 reveals the rugged terminal board and neat cabling which go into a piece of equipment meant to last for a long period of time. Of course a glance at the sizeable transformers and high-quality components tell the same story. For some reason or other the topside is finished in a gold- or redish color—perhaps to match the hand-some appearance. It does look rather nice at that.

Fig. 1. Leak Stereo 60 power amplifier showing top and under-chassis views. Note military-board construction.

Fig. 2. Frequency response of Leak Stereo 60 at rated power output.

Circuit Description

The circuit of the Stereo 60 is unusually straightforward, each channel consisting of:

1. A triode amplifier stage consisting of half a 12AX7.
3. A push-pull ultra-linear output stage containing a pair of EL34's. Perhaps the strangest part of the circuit is that the tube in the output stage are completely independent of each other (separate cathode resistors) with no balancing provisions. They claim it is not necessary. On the other hand every other quality amplifier we know of provides a balancing arrangement and we tended to agree with them.

A negative feedback loop runs from the 16-ohm tap of the output transformer secondary to the cathode of the input tube. Clearly this is as conventional a circuit as one could imagine in this age of sophistication, but it is a well-proven conventional circuit. In addition, the components used are of such high quality, and the circuit put together with such care, that the amplifier performs as though the circuit were the most sophisticated.

Performance

It is axiomatic nowadays that the testing of an amplifier used for music reproduction requires two parts: measuring and listening. There are those people who insist that measurements alone can reveal the quality of an amplifier and we tend to agree with them. However we still like to be convinced by listening.

On the measurements scene we should be aware that there are two ways of amplifier design: the widest-bandwidth possible school which attempts to make amplifiers with excellent response from d.c. to a megacycle; and the limited low-frequency response school which limits the response below 20 cps. There are several technical arguments for the latter school, but the most dramatic is the effect produced when the rumble of the turntable is amplified—or the resonant frequency of the arm (many modern arms exhibit a resonant frequency below 10 cps).

We present this background to indicate some reason for the low-frequency power response of the Stereo 60 as indicated in Fig. 3. Note here that the maximum power obtainable at 20 cps, before clipping, was 20 watts (continuous sine wave). This roll-off is deliberate and not indicative of poor performance. The same figure also shows that the amplifier produces well above the rated output, without clipping, throughout most of the frequency range up to 20,000 cps. Also note the frequency response as shown in Fig. 2. Here we see response which is only 12 db down at 100,000 cps with excellent wavefrom. (As standard practice we monitor wavefrom.)

Perhaps the most impressive aspect of measured performance is the low distortion exhibited by this amplifier: Harmonic distortion is 0.3 per cent at 30 watts and 0.2 per cent at 1 watt; intermodulation is a maximum of 0.5 per cent at 44 watts. Test with a square wave indicated excellent transient response.

The Stereo 60 showed excellent stability with a 0.2-uf capacitor across the output. Also it delivered just a fraction less power than indicated in Fig. 3 with both channels loaded, thus attesting to the sturdiness of the power supply. We did note that one channel required only 1.4 volts to deliver 30 watts at 7000 cps while the other channel required 2.5 volts. On the other hand the less sensitive channel could deliver more power, possibly the feedback loop of
JBL produces precision loudspeaker systems which are acknowledged to be the finest in all respects by critics, scientists, musicians, engineers, and composers throughout the world. JBL systems are the reference standard for excellence in studios, laboratories, and the listening rooms of audio connoisseurs. They range in size and complexity from the magnificent JBL Ranger-Paragon to the ultra-compact new Trimline 54. Each is the finest of its kind; one is certain to fit your needs exactly.

The most popular of the more elaborate JBL systems is the highly versatile Apollo. This is a Linear-Efficiency system of moderate dimensions but life-scale reproduction.

The new JBL Model C53 is a shelf-size, ducted port acoustical enclosure two-feet wide, one-foot deep, designed for use with any one of three different JBL Linear-Efficiency speaker systems.

The JBL Ranger-Paragon is an integrated stereo system with two matched, three-way speaker systems. The radial panel distributes true stereo to every position in the listening area.

The sensational new Trimline 54 reproduces full, fundamental bass in less than a cubic foot of space by employing a passive low frequency radiator.

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this channel was not properly set. (One of the output tubes in this channel became defective during the testing and we replaced both tubes.)

Hum and noise was 82 db below rated output at 1000 cpa in one channel, and 78 db down in the other. Actually the Leak Stereo 60 is one of the quietest amplifiers we have heard in some time; with gain at the maximum position, and our ear up against the speaker, we could not hear even the slightest noise.

In listening tests, the Leak Stereo 60 proved that measurements can reveal the quality of an amplifier: It reproduces music musically. The sound quality could be characterized as tight and clean; a precise and controlled bottom end and sharp well-defined highs. Musically modern.

The Leak Stereo 60 is an unusually rugged stereo amplifier obviously intended to last and last under the most arduous use. It is of professional quality in construction and performance and merits the attention of those audiophiles seeking top quality.

Please note that the 30-watt per channel rating of this amplifier is an extremely conservative rating; it could easily be upgraded to 55 or 40 watts by the standards commonly used in this country. But of course the British are so modest.

**NEAT VS-1000D STEREO CARTRIDGE**

The Neat VS-1000D is a moving-coil cartridge with an easily replaceable stylus. That statement alone makes it one of the most unusual cartridge entries in a long time. Normally the construction of a moving-coil cartridge prevents the cartridge from being replaced easily; usually they have to go back to the factory. In the case of the VS-1000D one merely lifts the styli assembly up and out.

The secret of this unusual facility is the unique coil construction which is shown in Fig. 5. In this close-up head-on we can see that the coil is attached to the yoke on which the styli bar rests. Thus, when the styli bar moves, the yoke moves the coils which are in the field of the magnets.

One of the problems experienced by moving-coil cartridges has been the difficulty of preventing dust and dirt from entering the space between the magnet and the coils without restricting styli movement. Commonly, a diaphragm of some elastic material is placed over the entire coil-magnet area and the styli-tip would be the only moving element peeking through. With this arrangement the diaphragm is in intimate contact with the styli bar. Unfortunately, it has been very difficult to find a diaphragm material which did not cause strange behavior as it aged (we understand that this problem has been solved, but we have not yet tested the finished product).

The Neat method, however, avoids this problem completely. When the styli bar assembly is in position, the magnet-coil assembly is completely sealed off by the plastic case. The only opening is the one for the yoke, which is quite small.

**Performance**

The Neat VS-1000D has an unusually smooth and flat frequency response, perhaps a characteristic of moving-coil designs because the cartridges which are closest to it in this area are also moving-coil designs. Figure 6 shows the frequency response and the crosstalk performance. We especially noted that both channels were some 5 db different throughout most of the range, although this makes little difference in listening.

The one major caution we noted in relation to this cartridge is its strong magnetic field which makes it generally unsuitable for use with a magnetic turntable unless it is very well shielded. We would estimate that a space of over ½ in. is needed between the cartridge and the table. On the other hand the VS-1000D is not very sensitive to induced hum.

We noted a tendency to pick up lint and dust in sufficient quantity to cause clogging. Naturally, as dutiful and cautious audiophiles, we clean records and stylus frequently, don’t we?

Now that we have dispensed with the small details we will get to the important aspect of the Neat VS-1000D: How does it sound when reproducing music? One of the best.

It is truly hard to describe, but in our opinion this cartridge reproduces music as well as we have ever heard from a record. We did compare it with other excellent units and it compared well. Its handling of transients and ability to track at high velocities also compared well, and probably are significant factors in its excellent performance. (We used the new CBS STR-111 test record for the square-wave test and the Fandriksen 101 for the high-velocity tracking test.) We found the Neat able to track well at ½ grams, even with records that had heavily cut areas, although the tests were conducted at 3 grams (Neat rated value.) The output was 4.2 mv at 5 cm/sec.

In sum, the Neat VS-1000D is a very fine music reproducer, certainly in the top rank of cartridges we have listened to. It is well worth investigation by any audiophiles who is in need of a cartridge.

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**Figures and Diagrams**

- Fig. 1. Maximum power response of Leak Stereo 60 (before clipping).
- Fig. 2. Frequency response of Neat VS-1000D.
- Fig. 3. Frequency response of Neat VS-1000D.
- Fig. 4. Neat VS-1000D moving-coil stereo cartridge.
- Fig. 5. Front view of Neat VS-1000D with top portion of cartridge removed. Yoke is top center.

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*Audio* • January, 1963
No, Music-Lover—take heart. Live music is here to stay. But when recorded music can be so perfectly played back that even experts can't tell the difference from a live performance, this is big news for those who love music, live or otherwise. For three years now, thousands of discriminating listeners have attended concerts of the Fine Arts Quartet, sponsored jointly by the manufacturers of Dynakit amplifiers and AR speakers. Performances were so arranged that the audiences were alternately listening to live and recorded portions, without prior announcement as to which was which. These are typical comments of recognized experts:

C. G. McProud, editor of Audio reported: "We must admit that we couldn't tell when it was live and when it wasn't." The Herald Tribune referred to "awesome fidelity." Record reviewer E. T. Canby wrote: "My eyes told me one thing, my ears another." Ralph Freas, audio editor of High Fidelity, wrote: "Few could separate the live from the recorded portions."

When reproduction and reality cannot be separated, the reproducing equipment has achieved the top-most practical level of quality. And when that equipment is so moderately priced as Dyna Mark III amplifiers and PAS-2 pre-amplifiers, the obvious conclusion is that you can spend more money but you can't get higher quality. Anybody can build a Dynakit, including you, Music-Lover. And you can be confident that it will work well with performance indistinguishable from the original source of sound.

All Dynakits are designed with top performance as the primary objective. In any power range, mono or stereo, the established excellence of Dynakits is assured. If Dynakit's superior engineering, high quality parts and functional layout give you such fine performance that you can't tell the difference, why pay the difference?

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**ADOW**  *JANUARY, 1963*
NEAT GA-17 STEREO TONEARM

The Neat GA-17 is a 12-in. tonearm intended for use with stereo cartridges and features plug-in heads and audio cable, static and dynamic balance adjustments, isolation of the arm from the counterweight by means of damping rings, arm tubing stuffed with foamed plastic to reduce arm resonance, and the ability to handle any stereo cartridge with either 3- or 4-wire connections and varying in weight from 10 to 20 grams. In addition, a built-in mechanical constrainer lifts the arm off the record at the end of play. Actually it would be more accurate to say that it springs it off the record since the mechanism uses a spring pushing up beneath the arm just forward of the pivots. To reset the spring, the arm is carried back to the rest position by hand and pushed down. It is then ready to jump up at the end of the next record.

The first thing one notices about this tonearm is its very chromeey appearance. We must admit that we are not of the chrome-liking school, but it is very well done so that it looks quite opulent. Also they haven't scrimped on performance in order to provide the chrome. In fact, at second glance one is impressed by amount of fine workmanship that has gone into this product—and ingenuity too. Unquestionably, the Neat people have solved some

arm problems in a highly original manner. For example note the cross-section of the counterweight shown in Fig. 8; here we see a solution to the dynamic balancing problem which is perhaps the simplest we have seen yet. All they did was broach (It could be drilled) one side of the counterweight enough so that one side is heavier than the other. Now one can rotate the heavier side to balance the arm dynamically without changing the static balance. It eliminates the need for an outrigger. It works too.

Figure 9 shows the configuration of the pivots in a cross-section view. (Please note that the arm is not constructed exactly as shown, but essentially.) Here we can see the excellent mechanical structure as embodied by two rows of ball bearings for the horizontal pivot (10 balls in each race) and the use of sapphires in the vertical pivots. Damping (rubber) pads are placed behind the vertical pivots to isolate the arm from mechanical feedback. Also note the use of foamed plastic inside the arm tube to damp the natural resonance of the arm.

The plug-in head is made of molded plastic with threaded-metal inserts for the cartridge-mounting screws. The contacts at the rear of the head butt against spring-metal fingers to make a very positive electrical connection. The head is locked in position by a very satisfactory scheme which is hard to describe.

The GA-17 is finished by drilling a 1/16 in. hole for the main mount and a ¼ in. hole for the arm stand. After the arm is balanced, stylus force is applied to the needle as a screw on top of the pivot housing. This allows for adjusting the stylus force to any reasonable value; and it is extremely well constructed. Look for yourself.

Fig. 8. Cross-section of counterweight.

Fig. 9. Cross-section of arm pivots

ACOUSTIC RESEARCH NEEDLE-FORCE GAUGE

In November, in our New Products section, we described a new product from Acoustic Research intended to serve the owner of a quality turntable and arm—a gauge for measuring needle force (that's the term AR uses, we commonly use the term stylus force—they both mean the same thing). Immediately after the report appeared we were questioned as to the accuracy of the gauge; its price and method of operation make it rather attractive.

The AR needle-force gauge is an equal arm balance, to the best of our recollection it is the only one of its type used for this application; most stylus-force gauges use springs. Of course uniqueness is not in itself significant; we are more interested in whether the gauge is accurate. We can state that this gauge is accurate, well within the limits required of it.

Fig. 7. Neat GA-17 stereo tonearm.

Fig. 10. AR needle force gauge.

Before pursuing that topic further, we will describe what the gauge consists of. The "arm" section of the balance is made of clear plastic and the over-all length is a little over 4-in. Of course the ends of this section are dropped lower than the rest to form a counterbalance. The purpose of this is to make it easier to move the arm. In the center of each pan area there is an engraved cross, the center of the cross being the resting place for the stylus tip. On the underside, there is an engraved V-shaped line midway between the centerpoints of the crosses. The sharp-edged inverted-V stand fits into this line. The stand is also made of clear plastic, as are the supplied weights. There are four weights supplied with the balance 2 grams, 1 gram, ½ gram, and ¼ gram. Obviously, the maximum force this gauge will set is 3½ grams, and the minimum ¼ gram with the weights supplied. The instructions point out that if one should desire to set forces above 3½ grams that a penny is a fairly accurate substitute. We might add that it would be safer to use a newly-minted penny.

In order to obtain accuracy with an equal-arm balance there are three basic conditions which must be met: 1. The arms must be equal within a very close tolerance; 2. the pivot friction must be very low; and 3. the weights must be accurate.

When we measured the length of each arm we found one to be 0.11 inch and the other by 0.14 inch. This adds 0.03 gram when using the 2-gram weight—obviously an insignificant amount.

Considering the second condition, we had no way of measuring the amount of friction but we do know that a smooth, hard plastic such as this has quite satisfactory friction. The V-shaped sections of the both the stand and the arms are a very small radius; very close to the knife-edge classification.

The accuracy of the plastic weights was remarkably good; we found the worst one to be within 2 per cent of its stated value (the 2-gram weight was just a shade less than 0.04 grams light). Actually, knowing that one arm was slightly long (0.05 grams worth) and all the weights were on the light side (from 2 per cent down), we were able to get very accurate readings by using the weights on the long arm. But even with the worst situation, the weight on the short side, the over-all accuracy using the 2-gram weight was within 3½ per cent error.

Thus, using the best situation, we were able to set stylus force at ¾ gram within 1 per cent as checked by our much more expensive gauge. We should point out that the weights were checked on a laboratory balance.

In our estimation, the AR needle-force gauge is a simple but accurate device which is more than adequate for the audiophiles. And it is certainly inexpensive. Nota, however, that it is not available at your local dealer—it is only available directly from AR.

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AUDIO JANUARY, 1963

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Aren't these the qualities you look for in a fine record player?

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ably...in...the...opening...of...a...long...series...of...compressed...air...vales...That...is...precisely...what...it...is,...of,...course...But...the...beauty...of...the...organ,...ordinarily,...is...that...it...doesn't...sound...that...way

Nevertheless, after I'd caught my breath, I enjoyed this recording. It is always possible to find interesting works of a strong mind and a positive personality, no matter how eccentric. There's something about a certain musical spirit and musical musicality somewhere in a performance that is significantly different from another. In the Beechammer, if an accurate impression of their musical impression is to be conveyed. It is this which RCA has so skillfully done here. The triangle, right balance, is a factor. - 20th...trike, not a loud triangle! Thus when the full orchestra's plays with the triangle, the relative balance is correct and natural. So with all the other instruments each according to its kind. Naturally, the full dynamic spectrum is some-
what compressed, to fit the recorded medium. But the relationships between the musical parts of the orchestra are faithfully, remark-
tably, kept constant. A stunning job...in...stereo, too.

I recommend the recording immediately to anyone...musical listeners, as well as to school teachers.

ARTS OF FUGUES

Bach/Glen Gould The Art of the Fugue
Organ at All Saints', Toronto.

Columbia MS 6338 stereo

Bach, transcr. Samuel Baron: Art of the Fugue
Concert Disc CS 23 stereo

As I was saying...the "Art of the Fugue" was not composed "for" any particular me-
dium, and thus is necessarily heard in trans-
cription. Transcriptions of myriad sorts exist, and here is a new and interesting one, for four strings and five woods, made, obviously, to fit these two groups working in concert. What better impetus?

This is a splendid way to hear the music. (We can assume that the rest of the work will appear on a later disc)...Being in a sense timeless and peculiarly abstract, Bach's great work is more musically adaptable to media that are not of his own day—clarinet, French horn, in this version, for example—where in more specific media they would be highly out of place. (Bach used horns, but not in the manner proposed here). To be sure, certain more fundamental elements of Bach style that stem straight from his compositional technique must be observed, or should be—consistent instrumentation within each piece, without sudden changes of color, for instance. Many an arrangement has violently flouted this principle; not here.

These playing are not particularized by Baroque-minded, but they are all solidly musical and masterly affairs. I usually apply to later music. There is mildly anachronistic styling here, some of the fugues played more

like Mozart or Beethoven than Bach, with ex-
presive shaping and a few rather old fashi-
ioned ritards. The only mannerism I really found occasionally annoying is an old Stokouski trick of years back—the sudden loud cre-
scendo at cadence figures (musical para-
meters, so to speak). That's both old-fashioned and too modern, if you can stokowskian and technically "modern" in respect to Bach him-
self.

Generally speaking, the vital stuff of the music is both transparently clear and full of life in these playings—the increasing complexity and tension, as the work slowly evolves, is made evident in terms of excite-
ment, where many a misguided "pure" per-
formance merely plods along interminably in the name of non-interference. I'll be looking forward to the second half.

A Bach Recital (Capriccio on the Departur
of his Believe; Brother, Toronto, Adagio and Fugues in D mi., Four Duets; Adagio in G) Rosalyn Tureck, piano.

Decca DL 710061 stereo

Bach should be played on the harpsichord or the organ—so say the purists. The super-
purists, like myself, say it differently. Given a real musician, a pianist who understands Bach's music in its own right, who can "trans-
late" the essential meaning into the newer medium—then the piano is just fine

It is just fine here, as it was under the fingers of Myra Hess and Harold Samuel of an earlier generation in a modern piano musical playing of Bach anywhere, on harpsi-
chord or piano. In many encouraging re-
pects Miss Tureck has done what few pianists bother to do: studied the music in its original context outside of the piano literature. Orna-
ments, for instance. She plays them incorrectly. I am sure every harpsichordist of vision will respect each note she plays. And would-be Bach players on the home piano had better try her too.

CHRONICLES AND DOCUMENTS

Chronicle of Music. The Age of Roman-

Decca DCM 3205 mono

Chronicle of Music. The Age of Transition from Baroque to Classic (Series D: No. 1.). Concerts Royaux Nos. 3, 4, N. Y. Chamber Soloists.

Decca DCM 3203 mono

Decca lost the Deutsche Grammophon "Beethoven" series along with the smaller Decca label last year. (Now issued through MGM) The newly launched "Chronicle" is purely a replacement, even—as above—to the title format, dividing music history into Ages. ("Research Periods") the "Archive" people call them.) Each Age-group now has one rec-
ord, as per the first Chronicle release.

The Chronicle, of course, is simply a collecting-together of past releases in the Decca catalogue, plus new recordings as and when available. Many of the first batch have been seen before. How much of a recording
A TRIPLE PLAY MIRACLE! THE MOST AMAZING STEREO RECORD EVER MADE!

- POP + JAZZ = SWING, Orchestration and conducted by Benny Golson—Taking Pop music on the left, Jazz music on the right and using regular stereo controls, you create infinitely variable blends of both or play separate pop or jazz concerts. Contains the entertainment value of 3 conventional LP records. Includes: Whispering, Autumn Leaves, Lover Come Back. QuickSilver.

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- PARIS Jo Basile, Accordian & Orch. with Massed Strings—Lovish orchestral treatment of beautiful numbers: I Wish You Love, The Night They Invented Champagne, Melodie d'Amour, Greensleeves. AFLP 1955 AFSL 5935


- STRINGS FOR A SPACE AGE, Bobby Christian & Orch.—Big, orchestral performance of beautiful, melodious favorites and Bobby Christian's original Space Suite. Includes: Midnight Sun, Out Of This World, Blue Star, Autumn In New York. AFLP 1959 AFSL 5999

- MANOLOINO ITALIANO, Dick Die—La Spagnola, Santa Lucia, Vieni Sul Mar, Lo Siciliano. AFLP 1923 AFSL 5923

- Fabulous Eddie Osborn at the BALWDWIN ORGAN—Hey Look Me Over, Moon River, Ferdinand The Bull, Some Day You'll Want Me To Want You. AFLP 1968 AFSL 5968


- JOHNNY PUDELO & his Harmonica Gong, Vol. 1—Shak A Rhythm It Had To Be You (Medley), Pep O' My Heart, Peasant Vendor. AFLP 1830 AFSL 5810

- LIMBO PARTY, Southern Tropical Steel Band—Cachito, Papa, Pachanga, Limbo. AFLP 1967. AFSL 5967

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- DUDES AT CARNEGIE HALL—Muskat Rambler, Mack The Knife, 26 Trombones, Tin Roof Blues, AFLP 1955 AFSL 5913

- SATCHMO PLAYS KING OLIVER—St. James Infirmary, Frankie & Johnny, Jolly Red Blues, Panama. AFLP 1930 AFSL 5920

- LIONEL, LIONEL HAMPTON—Just One Of Those Things, Lazy Thoughts, Cabaret Of Broadway. AFLP 1849 AFSL 5849

- HAMP'S BIG BAND, Lionel Hampton—Flying Home, Boogie Woogie, Airmail Special, Night Train. AFLP 1943 AFSL 5913

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MUSIC OF THE MIDDLE EAST

- EL DEBEKE, Naif Ayby & Orch. (New Records) Brestashli (You Desire It), Mawal (Solo), Rouh, Rouh (Go, Go), Sama Yo Tamili (Beautiful Brunette).

AFLP 1980. AFSL 5880

- PORT SAID, Mohammed El Bakkar & Orch.—Port Said, Sauda Sauda (Dark Eyes), Haun Mehbe (Sway Here), Al Jazaria (Dance Of Algiers). AFLP 1833 AFSL 5853

AUDIO FIDELITY RECORDS

770 Eleventh Avenue, New York 19, N. Y.
The booklet is full of comment, some of it of the expected dedicatory sort, a good deal of it more interesting than that. Also fine pictures.

Better music to see whether Columbia will issue the musical works separately before you plunge into this album on purely musical grounds.

**BEETHOVEN**

**Beethoven: Complete Violin Sonatas.**

Aaron Rosand, vl., Eileen Fissler, pf.

*Vols I, II.*

*Vox Boxes SVBX 17, 18 (2 each) stereo*

Here Vox has picked out a first-rate team, if a youthful and somewhat brush pair of collaborators. Interestingly, so to the piano which leads in buoyancy and enthusiasm—Miss Fissler, hailed by Vox as the coming American woman pianist, is precisely that; her enthusiasm is instantly communicated, her energy is boundless and, best of all, her musicianship is flawless. Aaron Rosand, however, takes only a slightly less forward role, exactly as the music demands, and the workmanship of his playing is clearly attuned to that of the pianist. These sonatas have been well studied. Only a slight tendency to hurried playing in the faster passages mars his superb violin approach.

These two young people bring out first of all, the extraordianary musical energy of Beethoven's work, notably in the earlier sonatas, often played in a more "Mozartian" manner than here. Good—the music is there. You will unavoidably sense a certain youthful impatience, an un-mellowness; but that must await the years—it can come in no other way.

**Beethoven: Piano Sonatas "Tempo, Pastoral," "Les Adieux"**

*Op. 31, No. 2; Op. 28; Op. 81a.* Andor Foldes.

*Deutsche Grammophon 136 002 stereo*

Piano Recital Andor Foldes

*Deutsche Grammophon 138 784 stereo*

The Foldes Rethoven series is surely as fine as any on records to date, granting that every artist has his own individuality. Foldes is neither monumental nor grandiose; his Beethoven does not strike you in the noble manner of some of the greats—from Schnabel to Berkmann. It is more straightforward—but no less impressive for its power, its superb shapeliness of detail and extraordinarily careful calculation of effect. Not a thing escapes the Foldes observation; every trick Beethoven used, every possible shade of harmony of expression, is grasped and neatly set forth, but without ornamentation or extra dramatics. There was a time when Foldes seemed to be a "sleeper," a hard driving keyboard man. Now his understanding of this music has mellowed that harshness to perfection. Perhaps he does not rise to romantic heights of ecstasy. But then, he is not that sort of pianist.

If you prefer a standard survey-type recital disc, try the other one listed here. It has Beethoven, Brahms—three Be—plus Falla, Debussy, Liszt, and Poulenc. The Beethoven disc is more heartier.


*Deutsche Grammophon 138 643 stereo*

Quick add this one as well. Last summer in Switzerland I heard Andor Foldes play this Opus 101 on an elderly rented upright with one key that didn't work—it was even better then than here, or so it seemed to me as I watched a helicopter hover over the top of a Bavarian mountain. With Foldes, it is the first movement that sizzles. An excellent record for young pianists; they always seem surprised on beat-up pianos! This one sounds good on a good piano, too.

**Beethoven: The Late Quartets.**


*Columbia M55 677 (5) stereo*

Again the Budapest records Beethoven—over the years this group has covered the same high ground numerous times, as technological improvements have dictated. Here they record in stereo.

The inevitable question from the aficionados is—how do these compare musically.
with earlier Budapest? The answer is simple: there is no real change; no sacrifice, no compromise in drive, no diminution of force, no relaxing of the disciplined concepts so beautifully worked out over the many years. But, on the other hand, there is a decided looseness, a liveness, notably in the first violin, who has the top notes just as he should, but just because there is no compromise, notably in the rapid tempi, the first violin has a bit of a "faking it" to come out right. It really is not inconsistent with Beethoven, still, to the superb sense over-all concept of Beethoven's works. The music is more genuinely revealing performances in respect to intensity and liveness.

The tone is subdued and not harsh, the blend of the instruments like one instrument.


Volume I of this series is played by the Kreisler quartet; the French Lowenguth, I was turned off. Compared to the famed Budapest, this is no better, or merely very excellent. He was slightly better.

Never heard of "it" in the singular before, like jazz music, I mean. It's highly special, the particular style of "virginals." plural, always wondering how they came to be that way. They're a single bioscope, or hands, or hands and Virginals, table-models (with or without legs), with a single set of pulchritude strings and a short keyboard. There were widely used in Elizabethan times for the instrument, and Mr. Robb manages to make them sound very different, as monodous as it can sometimes sound, what with the single strings, and color and liveness available for the playing.

as a medium-size harpsichord, Mr. Robb plays a fine best of it 16th-16th century section from the instrument.


This is no ordinary Harrow Glee Club—such as the groups in which I was, many years ago. This is the 1961 world tour group, truly the group of the day, as befits their ensemble for beyond that which is practicable for the respectable at-home singers, who must keep up their considerable and their lives as well. Part of the recording was made in Munich, and the tour car, and the house tour was over.

Des Prez Missa is sung, accordingly, with both fervor and remarkable unanimity of ensemble as well as pitch. The boys know the music intimately well; their voices are relatively

tightly hand-picked and so is their musical sensitivity. Not a dull moment. Especially since this interpretation is ultra-modern—i.e., it is fast, passionate, almost jazzy in spots, coming out completely the older tradition that made music such as this a misty, imaginative, austere visit to an unreal world. No longer!

I question only the rather complete absence of word-phrasing here, the shaping of musical ideas according to the emphasis of syllables, words, sentences, and the resulting free flow of rhythm, not syncopated, that is supposed to be a prime characteristic of the virginals. Of course nobody can prove it one way or the other; the new school of thought treats the words instrumentally, as-capitalizing on the syllables, but the word-phasis, I find, is beautiful. It is the most imaginative, but not musical, within its own mold.

I could not help thinking—perhaps this is the only important concept on first performance, in Beethoven's time? The Budapest brought death of a century plus or minus, one of as many as 200 years or more. It is, however, less imaginatively, but no less musical, within its own mold.

The harmony is played, bring us under its new conductor the art of choral showmanship. The sudden louds and softs, the crescendi, the dramatic continuity, make for hair-raising musical impact, where many a performance of this ancient composer is just plain dull, or worse. Thanks be, at least, Mr. Forbes brings old Joseph to life in full color. That's a lot accomplished.

The second side contains short pieces as filters of varying interest. The whole album is poorly edited—instant Stimulus, at the end of each piece. Makes you wonder of the otherwise unobtrusive background ambient noise.

Strauss Waltzes. Chicago Symphony, Reiner. RCA Victor LSC 2500 stereo

If only RCA had always let Fritz Reiner do, what he could do best, as Columbia did with Bruno Walter! Here's a case in point—a superb waltz recording, the essence of the best Vienna, even if it is straight out of Chicago. The combination of the past Reiner discipline with the unforgettable Reiner pleasure in this music is irresistible. Four waltzes and a polka from Johann Junior, they all with a brush, the more conventional, perhaps, but still a part of music.


A lot of this, but don't let is stop you—this is one of those, of its melodious kind, I've yet to hear. Music for harp and flute, plus assorted strings and a clarinet, all French and all full of flavor—even the relatively unknown Ropartz, a rather-Great-French man writing in the Twenties.

Atmosphere is the word. And this sort of music is not easy to play right. I do not know whether the unidentified Melos Ensemble is French or English, this label operates in many countries, but I can assure you its style is impeccably lovely and the lushly realistic. London recording goes with it to perfection. Just buy it and listen.

Ravel: Trio in A Minor

Mozart: Trio in A. Yehudi Menuhin, vl., Louis Kenner, pf., Gaspar Cassado, cello. Angel 33563 stereo

Three distinguished players emanate a warm, somewhat old-fashioned sound in their playing of these two very different works. Menuhin's mannerist in tone is another plus, and I have heard of this sort for some years. All are impromptu, written in the high style of the 18th-century—"which means, simply, that there is no climax to the effect, a lessness, a pre-authorial softness, that will deliriously make those listeners who yearn for the good old days in musical performance. (Well, fairly old days.)

Younger people, used to the snapper, dryer, more synthetic sound of today, may not do a bit the same here. Worth a try, if only to see how it used to be.

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CHARLES A. ROBERTSON

STEREO

Ravi Shankar: Improvisations

World-Pacific Stereo 1416

With all the talk about fewer rhythms and unusual time signatures in jazz, the question often arises as to how far jazz groups can go and still not lose their audiences. If this interest between East and West is any indication, the answer must be—pretty far. On the first side, Ravi Shankar lends a three and an unex- pected theme to a variety of jazz groups in joint improvisations with a jazz quartet. The world has yet to find out what music means; it is only from the.this union that the film Parkinson Hall, and Fire Night, which was suggested by the enormous brush fire lines around Los Angeles, until the last time the last title, drummer Louis Hayes, Dennis Budimir, guitar, and bassist Gary Peacock are also heard. While Shankar pieces like the theme from a recent feature film, perimeter being developed as leaders at Con- temporary. If well, a singer is very popular in this country of any ability, then Miss Humes is chalking up a high score. About the only one of the company's regulars still left to try her luck with is Kid Ory, and she may yet get around to showing her showman- ship in a traditional in the Good Time Jazz division. Her aim this time is to give new and unusual phrasing to some old favorites as Soli- tude When Days Are Done, Home, and The Very Thought Of You. Surely, rare insight is indi- cated when she hits upon something fresh and exciting to say about Bennies From Beyond, Joe Gordon, trumpet, and Teddy Edwards, tenor saxophone, for her pen is tinger. This is the time to release this album, for it comes to the forefront of standards and avoiding the commonplace. Wynton Kelly, who sits in as guest pianist, comes bearing a gift of the novel treatment of Some Day My Prince Will Come, currently a feature of his regular, Miles Davis. The whole rhythm section is of stellar quality, and the technique of guitarist Al Viola, Leroy Vinegar, bass, and drummer Frank Butler.

Helen Humes: Swingin' With Humes

Contemporary Stereo S7598

Since returning to recording studios three years ago, Helen Humes has limited herself to annual visits, each time in the company of different recording artists. This appearance was recorded last summer, and the supporting hornists are two of the hard-swinging mod- ernists being developed as leaders at Con- temporary. If well, a singer is very popular in this country of any ability, then Miss Humes is chalking up a high score. About the only one of the company's regulars still left to try her luck with is Kid Ory, and she may yet get around to showing her showman- ship in a traditional in the Good Time Jazz division. Her aim this time is to give new and unusual phrasing to some old favorites as Soli- tude When Days Are Done, Home, and The Very Thought Of You. Surely, rare insight is indi- cated when she hits upon something fresh and exciting to say about Bennies From Beyond, Joe Gordon, trumpet, and Teddy Edwards, tenor saxophone, for her pen is tinger. This is the time to release this album, for it comes to the forefront of standards and avoiding the commonplace. Wynton Kelly, who sits in as guest pianist, comes bearing a gift of the novel treatment of Some Day My Prince Will Come, currently a feature of his regular, Miles Davis. The whole rhythm section is of stellar quality, and the technique of guitarist Al Viola, Leroy Vinegar, bass, and drummer Frank Butler.

The Staple Singers: Hammer and Nails

Riverside Stereo RLP93301

Many students of gospel music regard The Staple Singers as the most prominent groups in the country, both for creative drive and great respect for tradition. While acquir- ing each of the quartet's recorded appearances on release, they have waited impatiently for one that would do justice to the soloists and bring ensemble to a new level of excellence. This undoubtably raises at the prospect of a sen- sitive and relaxed release, something a group's transfer to Riverside, but something went wrong in the studio. Ensemble passages are treated with great respect, something to take care of a chorus of twenty, while the dead atmosphere of a vocalist's booth surrounds the soloists. The electronic devices of Staples, father of the family group, seems to be the natural to the console. At least, it bears little relationship to what the other members of the family are attempting to accomplish. And adding to the burden is a wholly unnecessary bass player and drum- mer. The music itself is exceptional, especially the title song, but abrasiveness of The Staple Singers must still wait to hear them properly.

Edmund Ros: Dance Again

London Stereo SP44015

Dongos jumping from channel to channel are running new in stereo this fall, and they leap so gracefully as in this colorful Latin dance set. With all the resources of London's Latin plus LM 20 CH Plus, Edmund Ros still manages to hold onto restraint and good taste instead of falling into the tempt- ing trap of unthinking sensationalism. In fact, dongos play a very small part in the overall musical scheme thought out by composer, arranger, who evidently decided to let the rhythm take care of itself and concentrated on placing the brilliant lines of the orchestra in motion. Because Ros employs a larger and more varied instrumentation than usual Latin group, the choice of contrasting instruments is virtually unlimited. Included are outstanding examples of the merengue, merengue group, choice of contrasting instruments is virtually unlimited. Included are outstanding examples of the merengue, merengue, rumba, and salsa groups. This “trumpet- style” arrangement is also included.

Audio

1963

54

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sound. A newly appointed musical director for E.M.I. at the time, Noble learned to take full advantage of the high Altec sound and supervise sessions from the control room. Besides writing full-bodied ensembles, he made certain to bring out bright, clear solo voices and the widest range of dynamics possible. As recording was the group's primary purpose, the personnel consisted of top studio men and included such versatile performers at Nat Gonella, Stanley Black, Mania Lister, Lew Davis, Eiric Sidley and Freddy Gardner. While their solo seems commonplace now, the way in which Noble contrasted one against the other was something else out of the ordinary. And even today the dulcet tone of oblast Leon Gussen and the airy phrases of American baritone Danny Polo would be an eventful combination. Al Bowlings on all twelve of Noble's titles-Mad About The Boy, probably skipping the Noel Coward tune because changing the lyrics to feminine gender was still not considered cricket.

The earliest portion of Noble's songwriting career is covered, RCA Victor might well follow with a sequel, but enough memories should be stirred for now by The Very Thought Of You, Love Locked Out, By The Forside, and I'll Do My Best To Make You Understand. Bill Borden produced the label's first LP set, and a slight surface noise indicates nothing was taken off the top of the original presses. According to Borden's ample notes, Noble is living contentedly in retirement on the British Channel Island of Jersey.

Hud Valley's present occupation is known to every theatergoer, and the rush of business predicated the release of his early triumphs. While success never bothered the youthful singer much, it proved a rude shock to his Connecticut Yankees. The little lively group at the Helgh-Ho Club was full of personality and gave a good account of itself on its own local versions of the old radio theme, and Deep Night. No vocalist could ask for a more spirited accompaniment than Cliff Barsky and the piano. Valley, who studied under Wiedholt, became more interested in new business, played saxophone after a few years of good fortune. The band grew in size and acquired policy by the time the first Altec sides were recorded in 1942, but it sounds like a pretty faceless group of remakes of My Time Is Your Time, and I'm A Lover. The young and sprightly original versions of both tunes are preferable, and the album would be better if it had kept to the letter of the title.

**Calypso Dancing Belly To Belly**

**Cook 930**

About the only reason for this album title is to convey the idea that a man and woman dancing in European style with their arms about each other seems positively in-decent in some areas of the West Indian bush country. Only in Port-of-Spain and other sophisticated centers are such liberties permitted, and the thrill with wild rural improvisations has created what is known as calypso dancing. From tapes recorded in Trinidad and British Guiana. Emory Cook presents a representative sampling of five calypso groups, ranging from the small Via Cardinal Combo to massive bands headed by Tom Charles and Fitz Vaughn Bryan. The most popular and versatile is the new Clarence Columbia Orchestra, which has invested too much of its appeal on fashions imported from the States. However, one aspect of calypso dancing now gaining popularity among party goers in northern climes is something called the Limbo. An exercise for the spinal column and other parts of the anatomy, the Limbo consists of facing a suspended horizontal bar, preferably bamboo, and passing under it in rhythm at successively lower levels. A variety of temps are available here, and beginners need no warning to start with the slowest.

Donald Lambert: Giant Stride

Solo Art BJ18001

One of the few remaining graduates of the Harlem school of stride piano and a living
Tavern, but Lambert's legend. The fans of Mississippi's native country singer stem from about average by far. Lambert's growth went beyond the style of playing and in any of numbers he may resemble a figure out of the '70s at one moment and sound like Erroll Garner or Oscar Peterson the next. In every respect, he could be called Lambert's spiritual predecessor, and not simply for his playing of Misty. Both men's work spans a broad expanse of jazz piano, combining melodic, joyous swing and ballad tenderness.

The original Solo Art label came into being the same year as Blue Note, at a time when Commodore was the only other jazz-independent label. As this writer was in the studio with Dan Fraule at the label's first session, his feelings at the label's return can only be presumably affected. Blesh intends to release material prepared for his Circle label, and future plans also include LPs from Humphrey Lyttleton and Hope Blake. Anyone who has trouble locating copies can always reach the present at 38 East 4th Street, New York City. Acting on Peter Bartok's advice, he decided to take Lambert to the studios of Paul Tillman, an engineer known for his ability to record classical pianists. Only a monophonic version is available, but no artist could ask for a more sensitive handling of the treatise.

Mose Allison: Ramblin' With Mose
Prestige 7215

Ever since the delightful "Back Country Suite" marcelled Mose Allison's recording debut as writer of piano sketches, his followers have faithfully awaited the arrival of an LP entirely devoted to similar works. So far, each succeeding album contains a helping of standards along with three or four of the pianist's compositions, and the latest is no exception. Even the most patient must be ready by now to take matters in hand to obtain a volume of unencumbered Allison. The only solution seems to be the tape recorder, and some of the artifacts have undoubtedly extracted all the original setups from the eight LPs issued to date. Those who try to lift the individual pieces together in orderly fashion should proceed with great caution. It might be helpful if Prestige provided the composer's own chronological listing on some future liner note, or went so far as to prepare a special bulletin. Of course, it would spoil all the fun of making up a tape by hit or miss for some, but others will stick by their own choices in any event.

The proportion of originals to standards is about average on the present set. Five numbers are free arrangements by Allison's Mississippi boodoo. Also well worth including in this taped program is the vocal by Joe Ligon, "I Got a Right to Cry." But dedicated fans will already have a special tape of ALBION'S SAD JUGGLER. The latest addition, bassist Addision Farmer and drummer Ronde Free complete the trio.
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TAPE GUIDE
(from page 40)

do the following: record a 250-cps signal so that the VU meter reads 0 on playback; reduce the input signal 6 db (to allow for the mechanical lag of the meter); calibrate the meter, when used as a record-level indicator, so that it reads 0 VU on this reduced input signal. If the 250-cps signal on the test tape represents a 1 per cent distortion level, do not reduce the input signal when calibrating the meter as a record-level level indicator.

AUDIO • JANUARY, 1963

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THIS MONTH'S COVER

This month's installation is in the home of Dr. Ralph Yochim, 725 Leamington, Wilmette, Illinois.

In this installation, in order to place the speakers opposite the listening area, it was necessary to locate them on either side of the area between dining and living rooms. However, a Steinway piano, which had to be placed on a particular wall (it being the only inside wall in the living room), posed a difficult problem of decor to overcome.

Fig. 1. Room arrangement in Dr. Yochim’s home. Note speaker placement.

It was decided to construct a cabinet for the Acoustic Research AR-3, which would take the appearance of a music cabinet. This enclosure was constructed of “Avoir-dure” mahogany to match the piano. The other speaker was housed in the equipment cabinet where the AR-3 was floated on foam rubber isolation pads to eliminate feedback to the turntable. An oven lift top was provided for the McIntosh tuner and preamp and for the Thorens turntable. The cabinet was constructed of matching grained walnut and the side-opening speaker used invisible catches. A modern weave cane served as the speaker grill on both cabinets.

Components included a McIntosh MR-55A FM-AM tuner, a McIntosh C-20 preamp, two McIntosh MC-60 60-watt amps, a Thorens TD-124 turntable, a Rek-O-Kut S-120 arm with a Shure M3D cartridge, and two Acoustic Research AR-3 speaker systems.

The system and installation was designed by Allied Radio.

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www.americanradiohistory.com
Wow and Flutter

Q. My tape recorder produces noticeable wow and flutter at 7.5 ips. Also, there is slippage between the motor drive and pickup reel on fast forward. The idler wheels and all exposed surfaces have been cleaned with carbon tetrachloride, but no improvement has occurred. Also, the machine is inadequately oiled. Please suggest a correction, particularly for the wow and flutter. I find that I can correct the slippage on fast forward by increasing the spring tension.

A. The wow and flutter may be due to any or a combination of several factors, including spring tension adjustments, binding of a shaft, a slipping pulley, film of oil on an idler wheel, and so on. Wow and flutter are apt to be more pronounced at slower speeds because of the lesser inertia of the parts in motion, which is the reason why you may think you have this difficulty at 3.75 ips but not at higher speeds.

I believe that your tape recorder has separate idler wheels for the 3.75 and 7.5 ips speeds. Is it possible that you have cleaned one adequately and not the other? Carbon tet is not apt to be the most effective cleaning agent for rubber idler wheels. Commercial preparations such as those sold for cleaning tape heads, generally contain Xylene. On occasion, I have used vinegar with success; however, I want to be cautious in suggesting its use because it is an acid, and, unless used sparingly, may cause damage. If another cleaning of the idler wheels as well as shafts, pulleys, and so on, does not produce results, your problem is properly within the province of the service technician. Consult your dealer or manufacturer for the name of an authorized service agency.

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TRANSISTORIZED PREAMP

(from page 30)

or \( R_1 = 22,000 \text{ ohms.} \)

The emitter voltage \( -V_E = V_C + V_{BE} = 7.5 - 4.5 - 3.0 \text{ v.} \)

With \( I_B = -I_C = 0.5 \text{ mA} \)

\( = 0.0077 \text{ mA and } I_E = I_C + I_B = 0.5077 \text{ mA} \)

\( 0.5077 \text{ mA we get } R_E = \frac{V_E}{I_E} \approx 5900 \text{ ohms.} \)

The base-to-emitter voltage being \( -V_{BE} = -0.1 \text{ v.} \) the base voltage is \( -V_B = -V_E - V_{BE} = -3.1 \text{ v.} \)

Constant current bias is applied to the base electrode via the feedback resistor \( R_2 \) from the emitter of stage two.

\( R_1 \frac{-V_{BE} + V_{AT}}{-I_{AT}} \approx 500,000 \text{ ohms.} \)

The collector dissipation of stage one is \( P_{C} = I_C V_C = 0.5 \times 4.5 = 2.25 \text{ mw} \), and the power consumption \( P_{DC} = (I_C - I_{AT})(-V_{CC}) = 0.515 \times 19 = 9.8 \text{ mw} \).

Fortunately, nearly all calculated resistance values come out near standard EIA values. The small differences remaining are of no consequence since they are covered by the tolerance range of the resistors.

TO BE CONTINUED

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**TRANSMITTED TO**: AUDIO • JANUARY, 1963

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**INSTALL THE WHISPER FAN KIT**

Beats the heat that wrecks the set.

Reduces service calls by up to 40%.

Improves performance by minimizing drift due to temperature changes within enclosure.

So quiet you have to feel the breeze to know it's going.

Draws 7 watts. Costs pennies a year to operate.

Compact—only 4 11/16" square and 1 1/2" deep.

Installs in minutes. Fast, easy, simple.

Write for complete details...or ask your dealer...

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**ROTRON mfg. co., inc.**

WOODSTOCK, NEW YORK • OR3 9-2401

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TRANSISTOR AMP
(from page 24)

indicating whether it is in the right or left channel. There is a separate a.c. fuse for the power supply.

Safety Provisions

Much has been made of the ease with which transistors can be destroyed. It is true that a misused transistor will blow in a fraction of a second, while the same abuse to a vacuum tube will merely shorten its life, not instantaneously destroy it. On the other hand, a vacuum tube degrades in performance gradually from the first instant of use. The transistor, if operated within its limits, will perform at its initial level indefinitely. Even in conservative design, the life of a tube is limited to a few years if quality is important. The same conservative operation is applied to a transistor amplifier provides extremely long life.

In the Acousteck I, steps have been taken to ensure that operating abuses will do nothing worse than blow an easily replaceable fuse. For example, a short circuit across the output of most transistor amplifiers will immediately destroy the output transistors. If the output of the Acousteck I is shorted, the amplifier will either continue to drive across the short, or, at worst, the B+ fuse in that channel will blow. To minimize the chance of shorting the amplifier outputs, the old fashioned speaker terminals have been eliminated. Instead, rugged phone jacks are used. A pair of cables consisting of 15 feet of wire terminating at one end with a phone plug and the other with color coded spade lugs are supplied with each unit. To connect the speakers one simply plugs into the output jacks of the amplifier. Figure 5 gives a clear picture of the pains taken to provide structural features equal in quality to the electrical performance. Note, particularly, the girdle construction, heavy aluminum chassis, Mil-spec glass-epoxy circuit boards, and the large, sturdy heat sinks. The massive power transformer is so located that the unit can be lifted with just two fingers—one under the center of each girdle rod. This ideal center of gravity eliminates one of the most common causes of shipping damage. A black, perforated cage is provided that covers the entire chassis.

The Sound

Discriminating music listeners and audio experts listening to the Acousteck I under a variety of conditions and with a range of speakers were struck by the considerable improvement in sound over anything with which they were familiar. One interesting phenomenon noted in all demonstrations was the ability to play the system louder than possible with vacuum-tube amplifiers and still have clean sound. Women in particular liked the sound of the unit—even when played loudly, suggesting that perhaps women are more sensitive to transient distortion and appreciate the clean sound of this amplifier. The Acousteck I is rated at 40 watts per channel, from 8 to 16 ohms. Figure 7 shows that the clipping points are 67 watts at 10 ohms, 65 watts at 8 ohms, and 50 watts at 16 ohms. Its effective power seems much greater than even these figures indicate. This will require further investigation.

One point is clear. Solid-state power amplifiers with silicon output transistors are capable of setting new standards in reproducing music.

NOTE TO THE HOME EXPERIMENTER

Many readers of AUDIO are capable of taking a published circuit and building a unit from it. In the case of the Acousteck I, there may be many difficulties and a stiff cost. Several of the silicon transistors used in the circuit are designed specially for Acousteck by Transistor Electronic Corporation of Wakefield, Massachusetts. The nearest commercial equivalent to the ST1715 costs well over $20 each, and the nearest commercial equivalents to the ST1613 and ST4361 cost over $10 each. The Texas Instrument germanium 2N1046 drivers cost $10. (All prices quoted are for small-quantity lots.)

*Details about Tandberg Tape Recorders

MODEL 74
Complete Stereo Music System.
Features: 3 speed, 4 track stereo record, stereo playback with a power amplifiers and 2 built in speakers.
List $399.50

MODEL 64
Stereo Record/Playback Deck.
Features: 3 separate heads, monitoring on tape, multiplex input, 3 speeds, automatic tape stop, sound-on-sound. Remote control start-stop available.
List $498.00

MODEL 8
Monaural Record/Playback.
Features: 2 speeds, 2 heads, power amplifier, built-in speaker. In 2 track or 4 track models. Remote control start-stop, fast rewind.
From $219.50

Tandberg of America, Inc., P. O. Box 171, 8 Third Ave., Pelham, N. Y.

60 AUDIO • JANUARY, 1963
IF YOU WANT BETTER, CLEARER AND MORE NATURAL SOUND . . . USE SOUND JUDGEMENT!

There is only one way to build a tape recorder that gives the clearest, best sound. You must start with the very best components and fine, exacting workmanship. These are basic.

Specifically, you must choose a motor with enough power and it must be synchronous. You cannot skimp on the cost of this motor. Only a synchronous motor provides the necessary motion for flawless operation without noticeable wow or flutter.

Your tape recorder requires other essentials, too. The amplifiers must have the least possible distortion and the best possible frequency response. They must be designed for the least possible service. They should have military-type printed circuits. These circuits provide contact at all times, do not break down, and are easily serviced when necessary. The components must be reliable. They should have a rating of a multiple of the actual voltage or amperage required. Components such as these are expensive. But, economy here is false economy . . . and false economy leads to big service bills later on.

Your tape recorder must also be light and compact for easy carrying. Total weight should be around 20 lbs. which allows for inclusion of all operating features needed for ideal performance.

The magnetic heads for your recorder are, of course, most important. The recorder manufacturer must build these carefully with the precise gap needed for optimum performance. The position of the heads must be adjustable to within a few thousandths of an inch. This will keep the two or four recording tracks within established standards. These finely designed magnetic heads should also resist the abrasive action of recording tape. This prevents their being worn out in a short period of time. Consequently, they will last for many thousands of hours of recording pleasure.

Your recording instrument must also have a tape transport system that is smooth and reliable. The transport system should give you an immediate change of speed, without wearing out or breaking down. It must give you minimum tension and use only precision-built components. These quality components should be the result of months of research and testing by the finest staff of tape recorder engineers . . . engineers who could not be duplicated for any amount of money. Here again, any economies can lead only to poor performance. And, poor performance does not result in clear, natural sound.

A word about the personnel who design and construct your tape recorder. They should consist of a great number of qualified engineers (average key personnel length of employment is 18 years!) working along side of skilled craftsmen, artisans and assembly people — all of whom own a share in the manufacturing company. This concept of "everyone a co-owner" results in a deep personal interest in the design and manufacture of a product. And it means unchallenged quality for you.

As a final touch, your quality tape recorder should have the fine styling suited to any decor or for installation into any quality hi-fi system. Its case, knobs and top plate must be sturdy. This, too, guarantees many hours of uninterrupted, pleasurable performance.

Now you have your tape recorder! More accurately, you have a TANDBERG TAPE RECORDER. There is no outward, apparent difference between a Tandberg and others . . . but there is a FUNDAMENTAL difference. The Tandberg tape recorder superficially may look like others. But, when you check all the components mentioned above the differences are enormous! The superior quality is evident.

The Tandberg runs smoother. It is more reliable. IT DOES PRODUCE DISTINCTLY BETTER, CLEARER, MORE NATURAL SOUND.

MULTIPLEX CIRCUIT ALIGNMENT
(from page 32)

these adjustments, reduce the 19-kc signal gradually. This ensures that the circuits are so accurately tuned that they will remain synchronized even with low inputs. This may sound like a haphazard procedure, but it works. We have tried it on several multiplex tuners—some with the various circuits identified (as they all should be), some with none marked, and one without even a schematic. When the 38-kc output is at a maximum, the final steps take the form of "touching up" operations—rather like a vernier adjustment on those previously made.

For the final steps, feed a 1000-eps signal into the left input of the generator and a 60-eps signal into the right input. Adjust the signal levels so that they are approximately equal (an input of 5 volts on each channel will make this possible). With the pilot signal ox, feed the composite output to the input of the multiplex circuit. Connect the 'scope to

Fig. 7. Patterns obtained with modulations of 1000 and 60 cps on the respective channels, and 'scope connected to output of 1000-cps channel. (A), left, shows optimum adjustment of 19- and 38-kc circuits; (B), right, shows 60-cps modulation on 1000-cps pattern with incorrect adjustment.

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the left-channel output and adjust the horizontal sweep for 60 cps, synchronized to the line frequency. The pattern should resemble that of (A) in Fig. 7. Then readjust the 19- and 38-ke circuits very slightly to make the top and bottom edges of the pattern as straight as possible—misadjustment will cause notches to appear on these edges as in (B) of Fig. 7. If there is a separation control on the multiplex unit, trim it also for minimum notching.

Then connect the ‘scope to the right-channel output. The pattern should resemble that of (A) in Fig. 8. Readjust the circuits again, very carefully and minutely, to determine if there is any improvement over the adjustments previously performed with the left-channel adjustments. Misadjustment with the right-channel display will widen the trace appreciably so that the pattern resembles that of (B) in Fig. 8. The correct adjustment of the 19- and 38-ke circuits and the separation control will give a minimum of 1000 cps on the right channel, and a minimum of 60-cps notching on the left channel.

It is advisable to recheck the entire final adjustment procedure with the input signal reduced as much as possible. At a certain minimum signal input to the multiplex unit, the output patterns will no longer resemble their original form but will become a mixture of both—looking rather like the pattern from an audio amplifier which is oscillating on part of each cycle of the input signal.

**Conclusion**

While these instructions may not be strictly in accordance with those issued by the manufacturers of tuners or adapters, we believe that they will enable any careful technician to align multiplex equipment for close-to-optimus performance. While it is possible that more sophisticated equipment may give better results, it is inevitable that the servicing procedure must be simplified so that every hi-fi serviceman will be able to make complete adjustments on stereo circuitry. There was a time when it was thought impossible to align any radio receiver properly without a sweep oscillator and a ‘scope, yet today there is no low-priced sweep oscillator for AM alignment. FM receivers were considered even more difficult, but several of the modern kits make it about as simple as tuning in a station.

No part of audio servicing is actually very difficult. Of course there is still the problem of the intermittent, but a little common-sense applied along the right lines can reduce even this difficulty to a minor annoyance.

As we hope to show in future articles, the difficult we can solve immediately—the impossible may take a little time.

**Acknowledgement**

The author is indebted to Lester Karg for the use of the multiplex generator described, and to George Mordwinkin, who did most of the development work on it, for the circuit schematics, the detailed descriptions of the diode gates, and for the ‘scope patterns of Figs. 5 and 6.
BOOK REVIEW
(from page 2)

to distill out those attributes which make a particular hall liked for a particular type of performance. In other words it is now possible to define what is necessary to make a good, very good, or excellent hall.

Frankly we were greatly impressed by the scientific approach taken by Dr. Beranek. Our only reservation is directed at the validity of drawing such broad conclusions from such a relatively small sample. One of the small bits of heretofore useless information that has stuck with us from our college days is that a significant statistical sample is patterned to eliminate all of the intangibles except those being tested. It would seem that the main qualification for inclusion on "the list" was fame or position. But perhaps we are expecting too much at this time. A good start has been made.

The numerical rating scale developed in this book is obviously a numerical way of stating the various ingredients which go into a hall. In Dr. Beranek's scale, he has taken the terms he defined previously, seasoned them with the judgements of musicians, added a pinch of measurements, and came up with a recipe he likes. In reality there is much more to it than this simple simile would indicate—experience, sincerity, and humility. Anyone who reads Dr. Beranek's book is sure to be impressed by his earnestness and complete lack of pretention. In other words this numerical rating system is the best scientific effort of a knowledgeable and serious gentleman. It is too early to tell whether his assumptions are correct. In our judgement this is also true of Philharmonic Hall, In spite of the critical comments of the first few weeks. Somehow these early comments remind us of the reactions which usually accompany wearing new shoes; they pinch here and there and perhaps make strange noises until feet and shoes become thoroughly acquainted.

In Appendix I Dr. Beranek analyzes the prevailing method for calculating audience absorption and points out that it may very well lead to an erroneous value. Certainly it can be demonstrated that even the originator, Sabine, was unable to predict reverberation accurately using the number of people in the audience as an index of absorption. Dr. Beranek proposes instead that the area occupied by the seats be used. Relating this concept to the statistics of known halls seems to corroborate his assumption. All that remains is to prove it in the design of new halls. We are eagerly waiting for the answer from Philharmonic Hall.

An Important Book

As we said before, Dr. Beranek's book is important in that it provides a method of attack for a problem which has defied solution: a scientific method for designing good music-reproducing halls. Whether or not we agree with the particular answers he arrives at, we are in agreement with his approach. We do heartily recommend this book for every concertgoer as well as those professionally involved with acoustics and sound system design.

D. Saslaw

(As a service to AUDIO readers, we are making this book available through the Audio Library.)

LIGHT LISTENING
(from page 10)

second recording speed used. The meticulous care employed in checking out all circuits and the recording equipment itself certainly pays handsome dividends in most of today's top recording from Germany and this one is no exception. No equalizers or limiters were used in the production of this recording. While no one can quarrel with the sound on this disc, few of us will be tempted to throw away the competing versions of this music that we may happen to have in our libraries. The German ensemble under the direction of Hans Wege tries hard to hitch on to the saucy style of Leroy Anderson's compositions but it doesn't quite come up to existing performances by Arthur Fiedler or Frederick Frenzal—not to mention the recordings made by the composer himself.

Oklahoma/Carousel/The King and I

Capitol STCL 1790

When the movie versions of these Rodgers and Hammerstein shows appeared some years ago—"Oklahoma!" in 1955 and the others in 1956—Capitol acquired the master tapes of the scores recorded in stereo on Hollywood's sound stages. Issued as single albums, some of these shows were among the early stereo discs to reach me back in the days when tone arms and pickups were nowhere near as good as they are at the present time. Now that Capitol has brought out new pressings of all three productions in a deluxe album set, these deservedly popular recordings are now available in better sound. Although the original stereo discs show improved response with today's playback equipment, the newer pressings have better surfaces, slightly higher signal level and improved overall presence that puts them just about on a par with recently recorded movie tracks.

Electronic Applications Inc. of Wilton, Connecticut, USA, representatives of AKG Vienna, are so busy selling and shipping the new AKG D19-E* microphone and "Ear Witness" K-50** headsets that they did not have time to prepare copy for this space.

*$60.00 user net

**$22.50 user net

P.S. Best wishes for all our friends for the holiday season.
Ever since the first street vendor hawked his wares in some ancient city, music and selling, like love and marriage, have gone together. The rag-and-bone dealers, the scissor-grinders, the oil merchants and the rat-killers all used music to convey their sales messages. Their street cries were the forerunners of today’s “jingles.” But they were a far cry from what has become a multi-million dollar business.

The explosive growth of sales music is a postwar phenomenon brought about by television. Until the late 1940’s, advertising agencies produced nearly all the broad- cast commercials themselves. Because they concentrated their expression in newspapers and magazines, they maintained small radio and television departments. In a real sense, the majority of the commercials written in those days were “messages,” a word which announcers employ loosely to refer to anything from a jingle to a “dramatization.” With the emphasis now switching to the communications media, the agencies began to farm out the work of creating music and lyrics to independent producers.

Almost overnight a new industry sprang into being. Today, commercials for radio and television are turned out largely by some twenty-five companies, located in New York, Los Angeles, and Chicago. These hawkers are on much higher social, economic, musical and literary planes than their street-crying predecessors. The personnel of a typical jingles firm might include a composer who studied music under Hindemith at Yale, a lyricist with Broadway shows to his credit, and a versatile side man who has played recording dates of all kinds, from Stravinsky to rock-and-roll.

The influx of this specialized talent in a field once dominated by hack writers has had a profound effect on the “sound” of advertising. Aggressive, between-the-eye merchandising is still with us, of course, but the soft-sell commercial with imaginative musical treatment is now preferred by most agencies and sponsors.

Of the dozen-old jingle companies operating in New York, Forrell, Thomas and Polack Associates, Inc. is one of the most active. During its six-year existence it has handled an impressive list of clients including Trans World Airlines, Schaefer Beer, York Cigarettes, Wonder Bread, Ford, Chevrolet, Hostess Cakes, and others. The enterprising trio consists of Gene Forrell, a film composer, singer and conductor; Ed- ward Thomas, formerly a recording artist (guitar), arranger, and group singer; and James Polack, a musical comedy singer whose background includes stints with the George White Scandals and the St. Louis Municipal Opera. Before merging their talents, all three already had excellent contacts in the advertising field.

F.T.P. Associates rarely see the client who commissions their jingles. Once they land an account, they deal exclusively with the people from the agency. Together, hawkers and advertisers set the complicated machinery into motion that will one day produce a one-minute commercial.

In its initial stages, jingle-making has the flavor of politics—the agency suggests to F.T.P. a “copy platform” and a “campaign theme.” F.T.P. writes variations on this theme and submits them to the agency. The text approved, next comes the music. As many as seventeen tunes have been composed; and an elimination session is scheduled. Following this, Thomas brings his

Fig. 1. Gene Forrell (left) with singing group.
guitar and a rhythm section along with him to play and sing the three "distant-melodies" to the agency. His partners join in.

Finally, the advertisers settle on a tune. The client pays a nominal fee for recording a "demo." Usually, this trial session is performed by a skeleton instrumental group (piano and rhythm section) and a vocal quartet. If the demo recording costs exceed the agency's estimate, F.T.P. pays the extra charges. Three to five versions of the winning melody are recorded.

The tape or disc demo then goes to the agency, which in turn submits it to the client, who makes the final selection.

The recording date, the size of the musical forces, and the number of spots to be recorded are now decided upon. The jungle is to be given the full-scale treatment: strings, winds, brass, rhythm section, harp, two pianos, and a vocal sextet.

At last, the long-awaited day has arrived. The control room resembles a shuttle

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**New! B&W INSTRUMENTS for AUDIO MEASUREMENTS**

**MODEL 410 DISTORTION METER**
- Measures audio distortion, noise level and AC voltages
- Also a versatile vacuum tube voltmeter.
- Distortion levels as low as .1% can be measured on fundamental frequencies from 20 to 20,000 cps, indicates harmonics up to 100,000 cps. Distortion measurements can be made on signal levels of .1 volt to 30 volts rms. The vacuum tube voltmeter provides an accuracy of ±.5% over a frequency range from 20 cps to 200 KC. For noise and db measurements, the instrument is calibrated in 0 db steps from 0 db to +15 db, the built-in attenuator provides additional ranges from -40 db to +50 db in 10 db steps.

**MODEL 210 AUDIO OSCILLATOR**
- Provides a sine wave signal from 10 cps to 100 kc. Output level within ±1 db when working into 40 ohm speakers (reference 5 kw). Power output, variable to above 150 mw. Hum and noise, -70 db.

These instruments are supplied with many B.C. station installations for FCC Proof-of-Performance tests.

**BARKER & WILLIAMSON, Inc.**
Radio Communication Equipment Since 1932
BRISTOL, PENNSYLVANIA •スタイル 6-5582

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**LAFAYETTE**

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**NEW! Criterion™ 120-WATT ALL-TRANSISTOR STEREO AMPLIFIER KIT**

Amazing Performance!
A completely new integrated all-transistor stereo amplifier kit utilizing the latest, most advanced technology. Compare it with kit and wired amplifiers costing much more!
- 120 watts (60 watts per channel) 8-ohm load
- 76 watts (38 watts per channel) 16 and 4-ohm load
- 10 to 25,000 cps - 1 db at rated power
- 22 transistors, 14 diodes • Superb dynamic range • Heat-free circuitry • Freedom from microphonics • Complete stereo control facilities • Easy-to-wire printed circuit boards; many components are pre-riveted • Beautifully Styled

Xt-900WX Net 134.50

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**LAFAYETTE Radio ELECTRONICS**
Dept. AA-3 P.O. Box 10,
Syosset, L.I., N.Y.

NAME
ADDRESS
CITY ZONE STATE

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Audio • January, 1963

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www.americanradiohistory.com
NEW PRODUCTS

- 4-Speed Tape Recorder. The new Norelco Continental 401 (Model EL1334) 4-track stereo record and playback tape recorder is completely transistorized and features the 15/16 ips speed for up to 32 hours of recording on a standard 7-inch reel. The Continental 401 is self-contained. It includes two preamplifiers, two power amplifiers, and two loudspeakers, one of which is in the removable cover to permit realistic stereo separation during playback. The 401 records stereo and mono, and plays back stereo or mono tapes through the unit itself or through an external system. The machine has inputs for recording from microphone, tuner, and phone with facilities for mixing, muting, and special input jack for a footswitch control. An output jack for monitoring with stereo headphones has also been incorporated in the unit. Stereo monitoring is also possible via the Internal loudspeakers. The Continental 401 comes furnished with the Norelco dynamic stereo (dual elements) microphone. Specifications of the 401 are: Frequency response at 7 1/2 ips is 80-18,000 cps (± 3 db); signal-to-noise ratio is better than 48 db; wow and flutter (rms) at 7 1/2 ips is less than 0.14 percent; bias frequency is 50,000 cps; input sensitivity is 1 mv for microphone and 150 mv for radio-phonc. Built-in circuitry permits mixing the microphone and radio inputs. Price is $399.50.

- New Condenser Microphone Calibrator. B & K Instruments announces the Model 4220 Pistophone, a small battery-driven precision sound source for quick, accurate and direct calibration of measurement microphones, sound measuring instruments, and sound tape recording equipment. A calibration accuracy of 0.2 db is assured at a frequency of 1 kHz. The 1500 cpm and 184 db (referred to 2 x 10^-4 microbar). The Pistophone is rugged in design to fulfill the need for accurate calibration in the field and laboratory. The calibration procedure of filling a Pistophone cartridge over the condenser microphone is quite " idiot proof" and not subject to variations in the microphone. With the high level output of 124 db, accurate calibration can be performed even in very noisy surroundings. Each Pistophone is calibrated at normal atmospheric pressure. A barometer is supplied with each unit to indicate ambient pressure correction directly in db. Price is $245. B & K Instruments, Inc., 3972 West 166th St., Gower Island 11, Ohio.

- 50-Watt Public Address Amplifier. A new professional quality 50-watt public address amplifier featuring the latest in stereo, the EI-30-4A, is offered by Allied Radio Corp. This amplifier will meet most public address requirements and may be used effectively in halls, school auditoriums, churches, or other large gathering areas. Features include full mixing of four microphones; remote mixing facilities; sockets for plug-in low-impedance microphone transformers; calibrated sound level meter, separate bass and treble controls plus a master gain control. There are balance controls for output tubes and hum; boost and cut-type tone controls; an anti-feedback control, and a pilot light. Another important feature is an output jack for simultaneous recording. Special circuits are incorporated to reduce feedback and avoid trumpet burnout. The KN-3050 has an aluminum and black case. Its size is 6% by 17% by 11 inches and it weighs 29 lbs. The unit is priced at $129.50 (Allied Cat. No. 57 DU 025). Allied Radio Corp., 199 Western Ave., Chicago 86, III.

- New Sound-Column Speakers. R. T. Bozak has announced the availability of a new series of sound-column speakers for use in auditoriums, theaters, outdoor stadia, halls, and other large-audience gathering places. The units are designed to offer superior performance through clear, undistorted sound dispersion and for a footswitch control. An output jack for monitoring with stereo headphones has also been incorporated in the unit. Stereo monitoring is also possible via the Internal loudspeakers. The Continental 401 comes furnished with the Norelco dynamic stereo (dual elements) microphone. Specifications of the 401 are: Frequency response at 7 1/2 ips is 80-18,000 cps (± 3 db); signal-to-noise ratio is better than 48 db; wow and flutter (rms) at 7 1/2 ips is less than 0.14 percent; bias frequency is 50,000 cps; input sensitivity is 1 mv for microphone and 150 mv for radio-phonc. Built-in circuitry permits mixing the microphone and radio inputs. Price is $399.50. North American Phillips Company, Inc., High Fidelity Products Division, 250 Duffy Avenue, Hicksville, New York.

- New Sound-Column Speakers. R. T. Bozak has announced the availability of a new series of sound-column speakers for use in auditoriums, theaters, outdoor stadia, halls, and other large-audience gathering places. The units are designed to offer superior performance through clear, undistorted sound dispersion and full high fidelity quality. They feature groupings of Bozak M-109 outdoor speakers arranged in vertical array and enclosed in housings of 1/8-inch plywood. The company revealed that the new sound columns were used at a series of recent concerts given by the "King of Swing," Benny Goodman, and his orchestra upon their return from the Soviet Union. Mr. Goodman performed at the Yale Bowl, New Haven, Connecticut; Havlin Park, Chicago and at several other locations. Poet Bob Dylan performed at Stony Brook, Long Island. R. T. Bozak Mfg. Co., South Norwalk, Conn.

- Integrated Stereo Tuner-Amplifier. The new Kenwood Model KW-40 receives AM, FM, and FM-stereo programs and requires only the addition of a pair of loudspeakers to function as a complete system. The power amplifier, Kenwood claims, will deliver 20 watts per channel at less than 1% distortion. The control center has inputs for a low-level magnetic
Scott Stereo Tuner Kit
Wins Rave Reviews
from every Leading Hi-Fi Expert!

Just one year ago Scott introduced the LT-110 FM Stereo Tuner Kit. High Fidelity Dealers built this superb kit themselves, examined its many features, and recommended it without reservation. Enthusiastic kit builders deluged us with mail. Now the verdict is in from all the leading technical experts. Never before in the history of the industry has a single kit received such unanimous praise. We reprint a few excerpts below.

from ELECTRONICS WORLD
“Construction time for the unit we tested was 6½ hours, without alignment... in listening tests, the tuner showed its high useable sensitivity to good advantage. Using an in-door antenna which produced marginal signal to noise ratios on most other tuners we were able to get noise-free, undistorted stereo reception. It’s quite non-critical to tune, hardly requiring the use of its tuning meter.”

from AUDIO
"The LT-110 is so simple to build that we hesitantly recommend it for even the novice... We found that the useable sensitivity (IHFM) was 2.1 µV... a fine stereo tuner and an unusually easy kit to build."

from RECORD GUIDE
“...It seems to me that every time I turn around I am building another of H. H. Scott’s kits. And each time I end up praising the unit to the skies.

The Scott instruction books should be a model for the industry. They feature full-color, step-by-step, illustrated directions. Each resistor or other component is shown in the progressive phases in its color code and in its proper position...

There is no audible drift in the LT-110 whatever. You can shut the tuner off on a station and pick it up the next day, perfectly tuned, without touching the tuning dial. No AFC circuits are included in this tuner and none are needed.

This tuner kit has to be ranked on the same plane as H. H. Scott’s factory-wired units. It is an excellent product, and the conservative parts very likely to give long, trouble-free service.”

Now Sonic Monitor* Added
Scott’s unique Sonic Monitor has now been added to the LT-110. This foolproof stereo signaling device tells you audibly when you are tuned to a stereo station. If you want the best in kits, visit your Scott dealer. Choose from:

- LT-110 FM Stereo Tuner Kit...$159.95
- LK-48 48-Watt Stereo Amplifier Kit...$124.95
- LK-72 80-Watt Stereo Amplifier Kit...$159.95
- LC-21 Stereo Control Center Kit...$89.95
- LK-150 130-Watt Stereo Power Amplifier Kit...$169.95

*Patent Pending. (All prices slightly higher West of Rockies.)

Scott
Dept. 35-1

For more complete details on your LT-110 FM Stereo Tuner Kit and other superb Scottkits, be sure to include your new free Stereo Record, “The Sounds of FM Stereo”, showing how new FM stereo sounds, and explaining important technical specifications.

Name ___________________________
Address ___________________________
City __________________ State ___________

Exp: Mohan Exporting Corp., 456 Broadway, N.Y.C.
Can: Atlas Radio Corp., 35 Wingfield Ave., Toronto

Populat Electronics, Oct. 1962
NEW ANTENNA DEVELOPMENT FOR FM AND FM STEREO

Garrard Type A Turntable, and the Model M99/AT6 for use with the Garrard AT6 Turntable. These Shure cartridge assemblies are designed to track at 2 to 2 1/2 gams. When force on the arm equals or exceeds 3 gams, the cartridge retracts into the head, with no increase in tracking force. Excessive force on the arm results in a small, plastic, non-scratching "lip" on the cartridge head making contact with record. Price of either the M99/A or M99/AT6 mounted in plug-in head is $49.50, audiophile net. Shure Brothers, Inc., 228 Hartrey Avenue, Evanston, 111. A-7

• New Version of LT-110 FM-Stereo Tuner Kit. The Scott LT-110 FM Stereo tuner kit has been redesigned to include Scott's unique Sonic Monitor (pat. pending) This Scott invention enables the listener audi- bly to tell him when he is tuned to a station broadcasting in FM Stereo. To use the Sonic Monitor, the listener simply turns the switch to "Monitor" and tunes across the FM dial. When he reaches a station broadcasting in FM stereo, he hears a tone through his speakers. Then he switches back to "Listen" and FM stereo receiving. Other changes have been made in the LT-110. It is now packaged in Scott's non-metalic container. All parts are come mounted on special Part-Charls in the order used. There is a separate blister- packed Part-Charl for each page in the full-color instruction book. The instruction book has been rewritten, making it easier to follow. The face-plate of the LT-110 now has a brushed gold finish, making it a perfect match to Scott factory-wired units. H. H. Scott, Inc., Dept. P, 111 Bowdernhill Road, Maynard, Mass. A-8

• Moderate-Price 8-in. Loudspeaker. A new moderately priced high fidelity loud- speaker, the Michigan MCS, has just been introduced by Electro-Voice, Inc. This new loudspeaker, E-V officials claim, offers for the first time a combination of true high fidelity speaker characteristics and a price structure competitive with that of quality replacement-type loudspeakers. The wide range, low cost, and high efficiency of the MCS make it ideal for use in home high fidelity systems, quality back- ground music systems, home sound reinforcement systems, and many industrial applications. Features of the MCS loudspeaker are: a first model in J- V's new Michigan Line; include extra- slim styling, a rugged die-cast frame, and an edgesil- wound voice coil that provides 18 percent more efficiency than ordinary coils. The dual-cone design is claimed to provide wider range and wider dispersion than single-cone types. The MCS has a Fre- quency range of 50 to 12,000 cps and power handling capacity of 12 watts, program and 24 watts, peak. Inquiries should be made to: Sales Department, Electro- Voice, Inc., Buchanan, Michigan. A-9

• Stereo Tape Recorder. The new Roberts, Model 997 4-track stereo tape recorder fea- tures low-impedance stereo input, studio-type VU meters, 'motor-on' indicator lights, mute-monitor speaker switch, and simplified sound-without-record sound- ing. The 997 is designed to function as a complete sound system; it has inputs for stereo record changer and/or AM-FM and FM-stereo tuner, so that it can serve as the heart of a stereo system. It is priced at $499.55. Other features of the 997 in- clude a multiple-adjustment head; dual monitor speakers; lever-type automatic shut-off; dual head outputs; dual preamp outputs; dual power amplifier outputs; double fast rewind; automatic shut-off and interlocking controls that prevent ac- cidental erasure of recorded tape. The 997 will operate either vertically or horizon- tally. Tape speeds are 3", 7"/8", and 10 ips. It uses a 24-slot high-torque hysteresis- synchronous motor with dynamically bal- anced rotor and flywheel. Roberts Elec- tronics, Inc., 5920 Bowercot Ave., Los Angeles, California. A-10

• Line-Radiator Speaker. A new Line- Radiator public address speaker, the Elec- tro-Voice LR7, joins the firm's LR4 and

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68 AUDIO • JANUARY, 1963
NEW LITERATURE

- Printed Circuit Materials. Drafting Materials for use in the layout of printed-circuit masters are described in a 12-page catalogue available from Flexigraph Inc. The catalogue includes information on precision grids and tapes accurate to plus or minus 0.001 and die-cut symbols accurate to plus or minus 0.002. Flexigraph Inc., Morristown, N. J.

- Soldering Iron Catalogue. An 8-page catalogue describing Ungar's Imperial soldering iron is available free. This iron which is designed to meet the needs of production line assembly operations in electronic industries is completely described in so far as application, specifications, and performance. Also included are descriptions of the interchangeable Imperial components such as the pastel-colored tips. Information on a variety of accessories such as the "safety cord" and the "heat seal" compound is also included. Unzar Electronic Tools, Hawthorne, Calif.

- 1963 Catalog. Lafayette announces its new 1963 catalog, with the latest in electronics and stereo high-fidelity equipment, is now available to anyone upon request. The 1962 catalog contains 388 pages and is the largest and most comprehensive ever offered by Lafayette. Featured items include Lafayette's exclusive top-quality equipment in kit form and completely assembled, as well as the latest stereo high-fidelity components of all major manufacturers—tuners, amplifiers, preamplifiers, tape recorders, turntables, speakers, and so on. Also offered are complete selections of citizens band equipment, optics, books, tools, radio and TV components and accessories, cameras, public-address systems and parts—everything in science and technology for hobbyists, students, experimenters and industry. The free Lafayette 1963 catalog #650 may be obtained by writing to: Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L. I., New York.

- Application Manual for Transistor Heat Sinks. Astro Dynamics, Inc. has made available at no charge an 18-page manual containing information on heat dissipation. The purpose of these notes is to present some of the basic principles of heat transfer in a very simple form and to indicate the steps which lead to the proper selection of a cooling system for critical transistor applications. A nomograph is provided which enables proper selection of heat sink models suited to any given application. Inquiries should be addressed to John H. Sununu, Heat Transfer Lab., Astro Dynamics, Inc., Second Ave., Northwest Industrial Park, Burlington, Mass.

- Transistorized Voltage Regulators. The latest addition to RCA's Application Guide series, Transistorized Voltage Regulators, describes step-by-step design procedures and the solution to sample design problems for the three basic types of regulating systems: series, shunt, and combination series-shunt regulators. Each of these systems can provide constant voltage, constant current, or constant impedance across the load. The Guide covers design considerations and discusses the numerous advantages and capabilities of transistorized voltage-regulator types: small size, low cost, increased reliability and accuracy, and extensive control range. Copies of Transistorized Voltage Regulators, ICE-254 may be obtained by sending twenty-five cents to Commercial Engineering, RCA Semiconductor and Materials Division, Somerville, New Jersey.

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A speaker system of professional studio quality measuring only 12" x 20" x 7". Exclusive Weathers variable mass damping attains a transparency and smoothness of sound previously heard only in the costlier full range systems. Unique electrical crossover eliminates crossover coloration and ringing. Model SE-20B—$99.50.

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THE FINNEY COMPANY
34 West Interlake
Dept. A
Bedford, Ohio

CIRCLE 70C

FM RECEPTION

(from page 20)

Medium Range Reception, Stations from Different Directions

The reader by this time will probably have reached his own conclusion that this calls for a yagi on a rotator, and in most cases he's right. The problem is the same as the previous one with the only difference showing in the need to change the aim of the antenna.

However, in the special case of all desired stations being from either the front or the back of the antenna, there is a bi-directional yagi which receives equally well from either front or back and exhibits medium gain characteristics. Such an antenna, illustrated in Fig. 4, can save the cost and complexity of a rotator installation.

Fringe Reception, 40 to 70 Miles

Fringe reception can embrace a great range of conditions, since this encompasses the area where the intervening terrain may be of utmost importance. For example, an antenna on high ground, a few hundred feet or more above average terrain, can produce results at 70 miles equivalent to normal elevation results at 40 miles. Conversely, an antenna, located in a valley at 40 miles may give worse results than an antenna in normal terrain at 70 miles. Prediction of results is at best a risky thing, and reception can vary from good to impossible within an area of a square mile in rugged terrain.

The above should not be taken pessimistically, but it should not be disregarded in considering an antenna installation.

In general, one must try, but it is pointless to try anything other than a high-gain FM yagi, and if conditions warrant, an antenna rotator.

Certain rules apply. For example, the higher the antenna, the higher the signal, but also the longer the antenna lead. And antenna leads have loss. Usually, beyond some height, which varies in each location, increased height will be counter-balanced by increased line losses, and nothing will be gained.

When a practical installation of a single high gain yagi is not enough, two avenues of help are open. The first is to use two yagis—"stacked"—connected together to provide additional gain. Such stacking must only be done according to the maker's instructions: Improper connections or spacing can result in a loss rather than a gain.

The other avenue is the use of a low-noise preamplifier mounted at the antenna...
NEW GIBSON GIRL® STEREO 4 TAPE SPLICER

The new GIBSON GIRL® STEREO 4 is especially designed to meet the precise requirements of splicing 4-track tape. A new streamlined Gibson Girl shape protects program material on the tape, yet leaves tape edges free of adhesive. Splices glide past your tape head with never a hint of their presence. See the new GIBSON GIRL® STEREO 4 at your tape recorder and hi-fi dealer.

List Price $11.50

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CIRCLE 718

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Chicago 26, Illinois
CIRCLE 71C

AUDIO • JANUARY, 1963

next to your tape recorder

GIBSON GIRL® STEREO

The preferable system is the antenna-mounted type. Such preamplifiers amplify the signals as much as ten times, allowing the tuner to limit, and thus give hiss-free reception. Figure 5 illustrates an antenna-mounted unit and Fig. 6 a set-mounted preamplifier.

In effect, an antenna-mounted preamplifier takes the signal before it has been degraded by the lead losses and amplifies it so that the losses will not increase the signal-to-noise ratio at the tuner's input. In a way, it effectively places your tuner at the antenna, instead of a hundred feet or so away through the down-lead.

Super-Fringe Area Reception, Over 70 Miles

Super-fringe reception is only more of the same fringe area techniques, used with greater care. For example, four yagis may be stacked to provide added signal.

An antenna or array should not be just pushed into the air; the area should be probed for the strongest signals, up, down, sideways, and front and back. An antenna or array may be placed on top of a nearly hill and lines run as much as a couple of thousand feet, using amplifiers, to the tuner. These techniques should not be undertaken lightly. Write to an antenna or preamplifier manufacturer for their recommendations before going ahead.

Survey and probing work should be done only in the afternoon; signals are worse during this time of day. Survey should be made over an extended period so that a bad day doesn't fool you. Remember that fringe signals fade out, and they have short-term and long-term fades.

If all else fails, you can always move closer to the transmitter!!

LETTERS

(from page 6)

with changes of mechanical load.

The question of effective pulley diameter has only theoretical significance, since belt slippage requires that the final diameter be determined experimentally in any case. Recognizing that there is slippage has practical significance; it leads to the understanding that synchronous motor performance combined with correct pulley diameter does not guarantee noiseless speed over given operational range of mechanical load. Speed accuracy must be proven in a test like the "nickel test" proposed in the article.

As for slippage causing an increase of speed (by a sort of ratchet action of the pulley), it seemed logical in the absence of Mr. Subber's more standard explanation. If ratchet action is ever an influence, it is unproven, and I withdraw it.

EDGAR WILCHER
Acoustic Research, Inc.
24 Thordalek Street
Cambridge 41, Mass.

the most noise-free recordings you have ever heard

will be made on the new all-transistorized Norelco Continental '401' Stereo Tape Recorder. The only recorder using the newly developed AC107 transistors in its two preamplifiers. The AC107 is the only transistor specifically designed for magnetic tape head preamplifiers utilizing specially purified germanium to achieve the extraordinary low noise figure of 3 db, measured over the entire audio band (rather than the usual single frequency). This noise figure remains stable over large collector-emitter voltage swings and despite large variations in source resistance.

Hear the new transistorized Norelco Continental '401' - 4-track stereo/mono record and playback + 4 speeds: 7%, 3%, 1%, and the new 4th speed of 0.14% which provides 37 hours of recording on a single 7" reel • fully self-contained with dynamic stereo microphone, two speakers (one in the removable cover for stereo separation), dual preamps and dual recording and playback amplifiers • self-contained PA system • multiplay facilities • also play through external hi-fi system • multiplay facilities.


Rorelo

in Canada and throughout the free world, Norelco is known as 'The Phillips.'

CIRCLE 71A
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www.americanradiohistory.com
of years after I began this long stretch, now amounting to thousands of hours of broadcast experience, I started the brave attempt to make a partial living out of my work. As soon as the war ended I was on the full-time staff of the old WABF, one of the earliest FM stations, as paid "music director." But the funds and the enthusiastic workers, all set for the great FM expansion, were let go. Culture wasn't going to come that way. As we all know, FM, the ideal medium for "cultural radio," very nearly died then, until rescued by the LP, tape, and home hi-fi.

In all the years since, in spite of a number of fairly major efforts to launch a program for pay (one effort generously sponsored by this magazine) I have not been able to buck the system. True, a few pleasing sums came my way during brief sponsorship. Not enough, really, to pay for tape and postage, let alone equipment. True, a number of stations have accepted my programs for varied runs on the usual basis—the for the prestige it gave me. (It did, of course.) But by and all, I have had to finance my broadcasts myself, from just to postage to Ampexes, like the poet who prints his own poems.

My material, of course, comes to me gratis—for I review records! In that respect alone I am a good egg in our system; for I benefit all concerned: myself, the station, the listener, and the record companies. Also the musicians (who are paid, so to speak, at the source by the union's very practical recording fund arrangement), who gain the usual measure of acclaim and publicity by my broadcasts of their efforts.

But as for cash—no. And over the years as the dice began to harden, the situation to crystallize, I came to feel that though in many ways the system is excellent and gives us all our moneys' worth in culture and prestige—otherwise I would have long since given up—nevertheless a fundamental wrong is being perpetrated on American cultural talent by the permanent denial of a man's right to earn his living in the best way he can. That I do not like, for myself and for others in my position, including Professor Woodworth at Harvard. And so I have made myself, after all these years, an unofficial law, a compromise. To use an old and hard-bitten saying, you can't get blood out of a stone. As things are now set—and they are very set—there simply is no major source of cash for cultural talent on the air, always excepting celebrities and symphonies on networks, and excepting a small number of successful commercial broadcast operations like that of WQXR and its network in New York. (Also, of course, excepting those regular staff employees who produce programs as part of their jobs via many small FM stations.)

For Dear Old WNYC . . .

My compromise is simple. For dear old WNYC, New York, which I love for all its comfortable faults and because of its many superb virtues, I will go on providing material for ever and ever, as long as it is wanted. I have shelves and shelves of back tapes already. When inspiration fails, or time forbids, I can dip into these for useful repeats, and often do. They seem to be appreciated. But for other outlets I stand upon my dignity; I demand at least a token fee—to establish the fact that the station is getting something out of me. Token is what I mean. Enough, say, to pay for postage and a roll of tape and allow a few dollars over. That at least establishes the ethical principle that interests and attracts talent, all talent, which is good enough to broadcast is good enough to be paid for. The principle, as far as I know, is universally respected in other countries. We seem to think that either "culture" or government ownership implies no remuneration. We shouldn't.

Unhealthy Situation

So you see, FM's culture has now reached the point where its dependence on free talent is very nearly 100 per cent. Indeed, the implication is, a program of personal

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**Audio Etc.**

(from page 14)

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**There's a FAIRCHILD CONAX on top of the Empire State Building!**

WNEW-TV Channel 5 in New York uses the FAIRCHILD CONAX to maintain high average audio levels despite pre-emphasis problems. The CONAX is silently at work minimizing problems created by sibilants, finger snapping, the shrill sounds of children, the rattling of dishes, muted trumpets and cymbals, which are all part of WNEW-TV's program schedule. No more reduction of apparent loudness because of these high frequency problems.

FAIRCHILD CONAX has been engineered by FAIRCHILD to cope with the problem of distortion produced in recording and broadcasting by excessive, instantaneous high frequency peaks. The FAIRCHILD CONAX "previews" program material in emphasized form for efficient high frequency control. The device is based on the integrating properties of the human ear. The CONAX action is inclusive and instantaneous—1-40,000ths of a second.

- CONAX produces increased signal levels in recording and FM broadcast.
- CONAX reduces distortion in tape recording and tape duplication.
- CONAX minimizes channel crosstalk in stereo broadcasting.
- CONAX eliminates high frequency "splatter" between stereo channels and both channels.

Why not let the FAIRCHILD CONAX help you maintain high average audio levels.

FAIRCHILD RECORDING EQUIP. CORP.
10-40 45th Avenue, Long Island City 1, N. Y.

MAIL THIS COUPON FOR COMPLETE DATA

Dear Sir:
Please send me complete information on the Fairchild Conax

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**Stereo 45 RPM**

**This Symbol Identifies True Master Tape Sound**

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It has never before been possible for you to hear the thrilling sound of a master tape — the special tape from which records are reproduced.

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CIRCLE 738

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**Audio • January, 1963**
Who kicked the music stand?

That question would never have been asked if the engineer had been using the FAIRCHILD AUTO-TEN™ (automatic attenuator). The FAIRCHILD AUTO-TEN is basically a noise reduction system. If information falls below the operator selected threshold the channel closes down and opens only when information passes the selected threshold. The FAIRCHILD AUTO-TEN contains a control to cover time needed for complete attenuation or noise reduction. Real flexibility!

It does the job of units costing ten times as much and is easily installed in all studio consoles. The FAIRCHILD AUTO-TEN is invaluable for minimizing studio noise, preventing noise in multi-track tape transfer and minimizing feedback.

AN INTEGR/A/SERIES COMPONENT

Rotary type Model 661
Slide type Model 661TL
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CIRCLE 74A

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CIRCLE 74B

commentary should bring with it a cash donation—a sort of performers’ radio—to help sustain the broadcast! And the worst of it, for me, is that this is probably the truth. It costs a fabulous sum to keep a station on the air, even without stereo. We can raise the cash—for that. But we depend, so to speak, on our charity to give our stations a voice. Frankly, I don’t think this is a healthy situation. It promotes a false relationship between commercialism and culture that is already the bane of American life in too many other areas. It is doubly false, here, because many of our FM station owners believe, naively, that all radio talent swims in luxury, lading up the radio gravy! They are right in so assuming. It is right to assume the people who have talent and who work hard are getting paid.

It is even healthier to find people whose work is that of sheer dedication. The world would be a sadder place if everybody got paid for everything. But the true basis for work that is done out of love and enthusiasm is found in working together—in cooperation. It still makes the world go ‘round, whether it’s called fellowship, or amateurism, or volunteer work or even patriotism.

We in this country have not found comfortable ways towards this cooperation, between paid and non-paid efforts. We pay our teachers too little and our public relations men too much. We assume our rights to a profit here, and yet profit here, and yet take for granted a loss there. We hire paid professionals for charity fund-raising and give them their profit as their right. Sometimes, it becomes a bit too large. Inevitable—yes! The profit motive is potent but so is the non-profit impulse, which as we all now can, look as the greatest fire in human society when the occasion demands. But though the need for profit can always be taken for granted, the non-profit impulse is never there. For it must be paid, too, in satisfactions that are much more subtle than mere cash. You cannot take it for granted at all. Not even for “publicity value.”

I do not like the present situation in FM “cultural” broadcasting because, for all its practical workability, it reflects that same uneasy, false uncertainty as to who is paying whom (in terms of satisfactions) that leads us to pay industrialists more than teachers for equivalent work, that makes us believe, more and more, that things of the mind and art must be taken care of by foundations; whereas “practical” things are paid for in cash.

What do I suggest, instead? I wish I could tell you. My best suggestion is simply awareness. The more of us that know the details of our present setup, the better it will be for all and the sooner, maybe, will culture and a pay-as-you-go basis on the FM air. As for myself, I’m quite happy and still enormously enjoy the radio programs I turn out. I do what I can. Wouldn’t you?
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THE FINEST OF ITS KIND...
Get more FM stations with the world’s most powerful FM Telex Antenna systems.
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CIRCLE 75C

Audio • January, 1963

Industry Notes...
- Sherwood Shows Experimental Transistor Unit. At the recent New York High Fidelity Show, Sherwood showed an all-transistorized stereo "Receiver-of-the-Future." In the advanced experimental design stage, Sherwood's receiver, known as Model XP-1, features not only PM-stereo multiplex and AM reception but also dual 100-watt (music power) output. Other unique features are timer-clock control, push-button speaker-system selector, dusting meters and self-contained, motorized fan to cool the output transistors and power supply. Edward S. Miller, its designer, said "Although this design may not be produced as such, many of its design features undoubtedly will be included in the all-transistorized amplifiers and tuners expected to be mass-produced by Sherwood in 1965."
- Rossman Comes Back. Irving Rossman, former President of Pentron Electronics, has re-entered the electronics field by acquiring a controlling interest in Universal Audio, manufacturers of sophisticated electronic equipment for the sound, industrial, and recording industry. Mr. Rossman was in town to introduce new products for the company during the recent AES convention in New York. Rossman says that the company will round out its line in the near future with stock products for consumer purchases as well as additional professional items.
- Burgess Battery Company Appoints. Burgess Battery Company has appointed Charles H. Donahue, Jr. to the newly created post of Magnetic Tape Sales Director. According to Fred Kirkman, president of Burgess, the appointment of Donahue is an important step in Burgess' program to build a national sales organization to market the company's line of audio tape through regular tape distributor outlets. He indicated that Donahue will also be responsible for developing tape markets with original equipment manufacturers, professional broadcasters, and tape duplicators.
- Gotham Represents Tuchel-Kontakt. Gotham Audio Corporation announces its appointment as exclusive U. S. representa-
tive for the Tuchel-Kontakt GmbH of West Germany—manufacturers of audio and power connectors—for the distri-
bution of replacement connectors. Gotham Audio will stock in New York all those connectors which are found on equipment imported from West Germany and such other European countries using the Tuchel line. Among the manufacturers of imported equipment using these plugs are such names as Arriflex, Beyer, E.M.T., Grundig, Leits, Lyrec, Neumann, Telefonak, and many others. A short form catalogue of connector types is available from Gotham Audio.

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CIRCLE 75A

www.americanradiohistory.com
to make professional quality stereo tape recordings your recorder must have three heads

All professional tape recorders have three separate heads—one erase, one record, one playback. Record heads and playback heads have different gap widths. A wide gap record head is a must to record all the sound on the tape. A narrow gap playback head is a must to reproduce all the sound from the tape. Professional quality sound on sound recordings can be made only on a recorder with three heads.

The Concord 880 was designed for Connoisseurs of fine music—for those who want to hear and appreciate the difference between ordinary tape recordings and the fine professional recording and sound reproduction of the Concord 880.

Other important professional features of the Concord 880 include:

- All push button operation
- 4-track stereo record—playback
- New varisync flutter free
- Salient pole drive motor
- Sound with sound recording
- Exclusive Concord computerized channel indicator
- Three speeds
- Built in monitoring
- Dual full range speakers
- 10 watt dual amplifier
- Dual cathode follower high impedance outputs

The 880 includes two professional dynamic microphones in a compact unit perfect for use as a portable stereo recording and playback system—ideal as a permanent part of your hi-fidelity music system.

Compare the Concord 880 and see why it offers much more—
in performance—in features—in reliability—in value.

Make a recording quality comparison test at your dealers—
if you're a connoisseur you'll hear the difference.

If you'd like a copy of Concord's booklet, "All the Facts"
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CONCORD 880

CONCORD ELECTRONICS CORPORATION

809 North Cahuenga Boulevard, Dept. L, Los Angeles 38, California

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The finest FM Stereo Tuner ever built for the home

says Martin Gersten, chief engineer of WNCN, The Concert Network

Mr. Gersten talks from experience—both as an FM broadcaster and as a high-fidelity authority and enthusiast. And in all his experience he has never heard an FM stereo tuner that compares with the PILOT 780.

He first heard the PILOT 780 in September, 1962, at the New York High Fidelity Show.

He says: "The Concert Network station in New York City, WNCN, 104.3, was broadcasting music and interviews with manufacturers and dealers directly from the Show. We tried to monitor our station on several FM tuners. None of them, including the most expensive ones, could produce a satisfactory signal, that is, until we walked into the PILOT exhibit and tried the 780. The exceptionally clear, noise-free signal it produced was a revelation. Subsequent tests convinced me that this was the finest FM Stereo tuner ever built for the home. Today, I use this tuner in my home and, as far as I am concerned, it is in a class by itself."

The fact that the PILOT 780 outperforms all other tuners is no accident. Its 4 IF stages and sophisticated circuitry produce an FM Stereo performance matched only by professional broadcast monitor tuners costing hundreds of dollars more...FM sensitivity: 1.8 uv; harmonic distortion at 100% modulation: 0.2%; capture ratio: 1 db; selectivity: 44 db. Its unique signalsampling Multiplex circuit assures at least 30 db channel separation. Its automatic FM stereo indicator takes all the guesswork out of finding stereo broadcasts. And its flywheel control construction, in conjunction with its tuning meter, assures easy, accurate tuning. At $199.50 (less enclosure), the PILOT 780 is the greatest value on the high-fidelity market today.

The PILOT 248B, companion to the 780, is a 74-watt Integrated Stereo Amplifier with a frequency response (± 1 db) of 5-50,000 cps and only 0.1% harmonic distortion (IHFM). Given an excellent rating by HiFi/Stereo Review, the 248B features outputs for tape and headphones, 7 pairs of inputs and a total of 13 front and back controls and switches. Price (less enclosure): $269.50.

For those who desire the finest receiver ever built for the home, there is no substitute for the PILOT 746, a 60-watt FM Multiplex-AM Stereo Receiver which includes many of the features of the two units mentioned above, including 8 inputs and 14 controls for complete stereo and monaural flexibility. Price (less enclosure): $399.50. For more information, hear them at your PILOT dealer, or write:

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Introducing...

The Patrician 800, like its famous predecessors, is devoted to the reproduction of sound with absolute honesty. It speaks only when spoken to... with a voice that is no more spectacular—and no less so—than the music it is asked to duplicate.

As a result, the Patrician 800 is somewhat larger than most other speaker systems—even to its extraordinary 30-inch woofer—simply because a system of this magnitude is required to reproduce the deepest musical sounds accurately and without compromise.

In appearance, the Patrician 800 achieves a new standard of elegance in both Traditional and Contemporary designs... for this system was conceived as the ultimate reflection of your good taste in fine music and superb home furnishings.

We invite your critical appraisal of the entire new Patrician loudspeaker collection at your nearby Electro-Voice high fidelity demonstration center. Or we will be happy to send a catalog on request.