AUDIO

FEBRUARY, 1963

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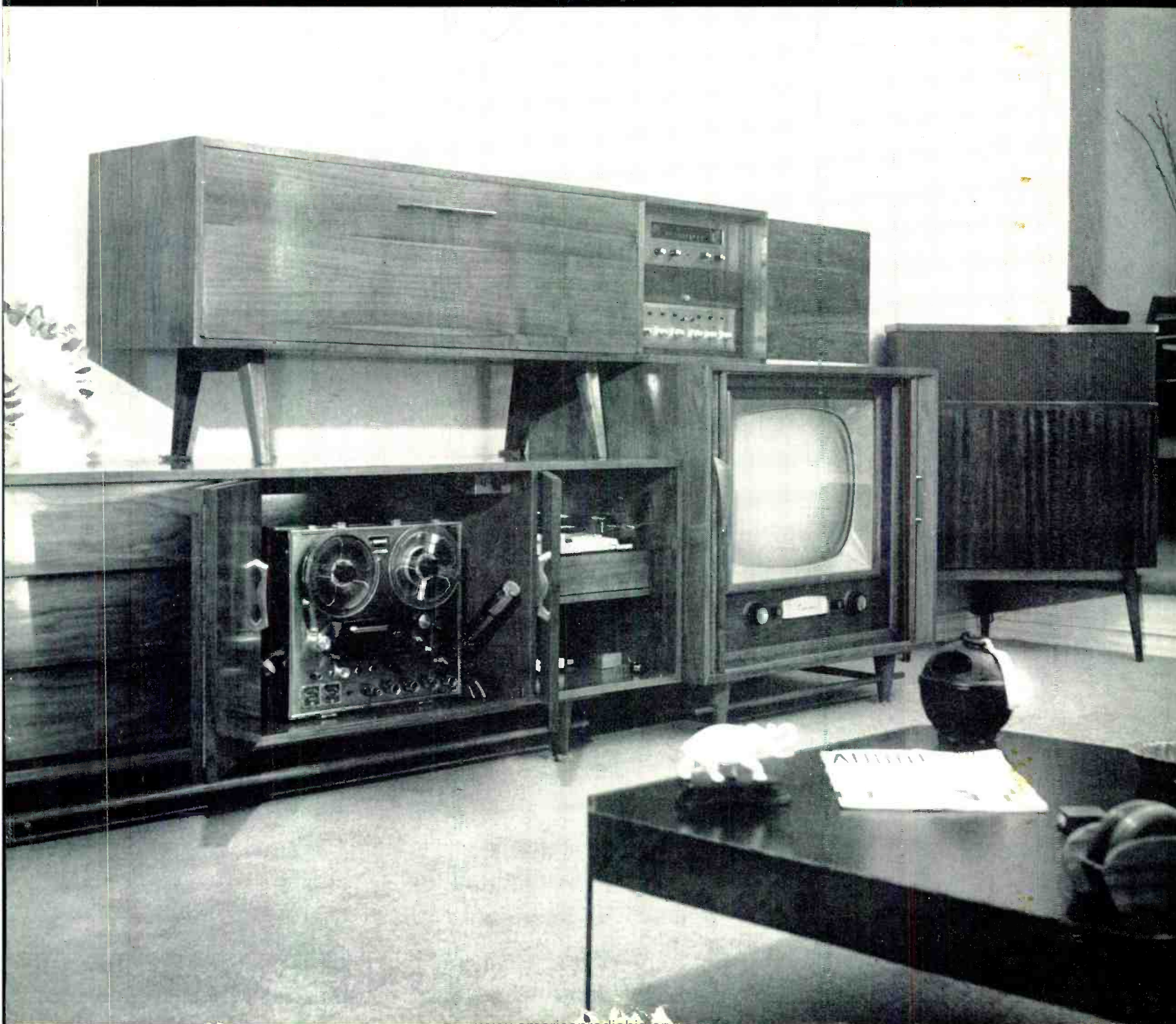

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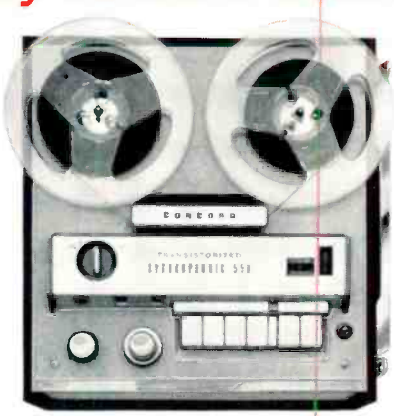

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AUDIO

February, 1963 Vol. 47, No. 2

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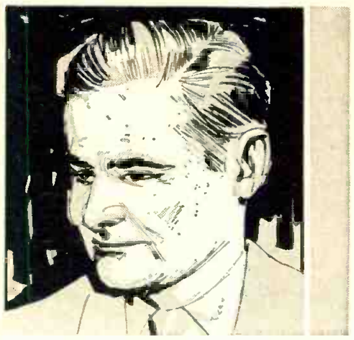

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Phonograph Wiring

Would there be any ill effects, such as ground loops or crosstalk, if I were to use twin-conductor shielded cable to connect my stereo turntable to my integrated stereo amplifier? I would use the shield as a common ground for both leads to the amplifier, thus eliminating one extra lead. Robert C. Knosalla, APO, San Francisco, California.

A. I see no reason why you cannot use a common shield to carry the signal from your cartridge to your integrated stereo amplifier. If separate preamplifiers are used there is often difficulty with hum. It is usually possible, however, to use your proposed scheme when an integrated system is employed. Although most of the run between the phonograph and the integrated stereo system can be made with a piece of dual-conductor shielded cable, the final few inches should be made with two pieces of single-conductor shielded wire—one piece for each channel.

This method provides shielding for each conductor right to the point of its connection with the equipment.

Whatever wiring scheme you chose, be certain to ground the turntable to the preamplifier. Do this with a separate piece of wire, the heavier the better. Do not allow the shield to be a portion of this ground system or you may have some difficulty with hum.

Action of Coupling Capacitors

Q. I was told that the size of the coupling capacitor at the output of a cathode follower of a tape recorder depends upon the impedance it will be looking into. This has something to do with time constants. Can you explain? Robert C. Knosalla, APO, San Francisco, California.

A. I will explain the problem of the size of the coupling capacitors used between a cathode follower and the circuit into which it feeds without utilizing the idea of time constants. First of all, it does not matter whether we are dealing with a cathode follower or whether we are dealing with a grounded-cathode amplifier. The principle is the same.

As you know, the reactance of a capacitor is inversely proportional to frequency. Hence, as the frequency decreases, the reactance increases. Let us assume that you have a resistance of 0.5 megohm into which the capacitor is to feed. Let us say that we have a capacitor whose reactance at 100 cps is 0.5 megohm. We can see that half the voltage will be lost across the capacitor and half will be available for delivery into the 0.5-megohm resistor. This is the same condition that we encountered when measuring the impedance of the cathode follower, as you will recall from a previous question which appeared in this column last month. Again, take note that the two elements—the capacitor and the resistor—form a voltage divider, just as was true of the internal resistance of the cathode follower and the external load, mentioned in that earlier discussion. In this instance, however, we have the element of frequency. As the frequency decreases to 50 cps—going back to the problem at hand—the reactance of the capacitor increases to 1 megohm. Therefore, ⅔ of the voltage will be developed across the capacitor and only ⅓ will be available for use across the resistor. Note that the output developed into the load resistor is decreased with decreasing frequency. This means that the response is no longer flat and that the bass is being attenuated. Let us now assume that we have a capacitor whose reactance at 100 cps is only 25,000 ohms. At 50 cps the reactance will be only 50,000 ohms. Notice that in this latter instance the reactance is such that only 1/10 of the voltage from the preceding stage is lost across the capacitor. The remainder is available for driving the load. This is less than 1 db loss. As the frequency decreases to 25 cps, the reactance is only 100,000 ohms. This means that ⅘ of the voltage will still be available for use across the load. By now we are down about 1 db in bass response. If there is a considerable number of stages in the amplifier, and if each one is down 1 db at 25 cps, you are likely to have a considerable amount of attenuation at this frequency.

You can see now that it is possible to have a cathode follower whose output impedance is 500 ohms but which will deliver very little of the low frequencies into a 500- or 1000-ohm load because the size of the coupling capacitor is too small to permit the transfer of these lower frequencies into a load of such low impedance. For this reason, many people meet with failure when they feed 500-ohm headphones directly from the cathode follower designed for use with power amplifiers whose input resistors are in the order of 250,000 or 500,000 ohms.

VU Meter Calibration

Is there a special way of calibrating a VU meter in a tape recorder? Robert C. Knosalla, APO, San Francisco, California.

A. There is no real problem in calibrating a VU meter, provided that there is a potentiometer or other method of changing the sensitivity of the meter so that different amounts of input signal can produce a reading of zero VU.

As you know, the sound of a tape recorder will not change substantially with increases in signal level until a point is reached where there is a sudden increase in distortion. The idea is to set the VU meter to read zero at the point just above which this distortion begins. Two per cent distortion is usually taken as the value which indicates zero VU. This is usually a har-


TYPE A
$79.50


MODEL AT6
$54.50

monic distortion measurement made at a frequency of 400 cps.

There is one further factor to take into consideration. The VU meter is a slow-acting device which does not "see" peaks which can cause distortion because they enter and leave the overload range so quickly that the meter has no chance to rise, even though the amplitude of the peaks may be such as to extend way beyond our zero reference point of two per cent harmonic distortion. Therefore, what is often done is to set the zero mark somewhere down below the overload point so that the peaks will not cause trouble. Often this point is set 10 db below the two per cent harmonic distortion level.

Cartridge to Headphones

Q. In monophonic or stereo, is it possible to connect a turntable directly to a headset and listen though the headset without an amplifier? If it is possible, please explain how this connection is made. How does the quality of sound with the headset compare to the sound from an ordinary speaker? Will I be able to obtain a full frequency range with this system (30-15,000 cps? With a Koss T-5 junction box, will I be able to control the volume through an amplifier? George Sit, Fort Hood, Texas.

A. Some of the higher output ceramic cartridges can be connected directly to the input terminals of crystal headphones with at least fair results. If lower impedance phones are to be used with these cartridges, then you will have to use some kind of matching transformer, and there will likely be some loss of low frequencies because of the loading of the cartridge. You see, you cannot find a transformer with an impedance high enough so as not to load down the cartridge. Thus, if you use the Koss phones, you would need a transformer. I believe that this company does supply such a transformer, but its impedance is not high enough to prevent the crystal or ceramic cartridge from being loaded as described.

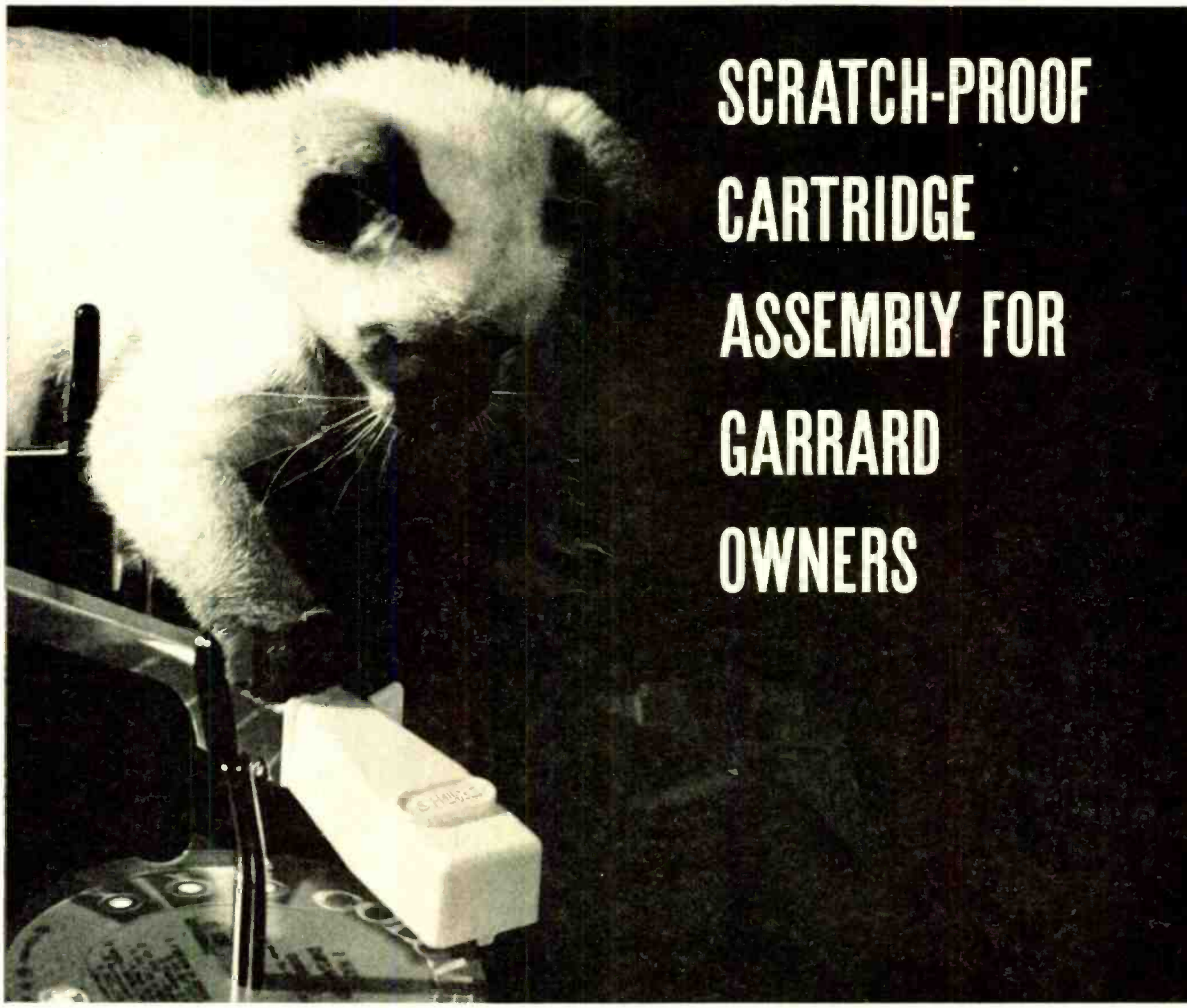
Under these circumstances, you may not obtain much sound volume. This may be a drawback to you. Magnetic cartridges are not suitable for this application because their output voltage is so low as to be inaudible.

The only other possibility is to use a preamplifier and connect its output into the phones by means of a suitable transformer. No specific information can be given on this because the impedance of the phones which you might use is not known. It is difficult to make this arrangement operate successfully, too, because the size of the coupling capacitor incorporated inside the preamplifier is often too small to allow for good bass response into a transformer which you might use in conjunction with the headset.

As to whether phones can sound as well as loudspeakers, the answer to this question depends upon the kind of speaker used and upon the kind of phones used. Unless you are willing to invest a fair amount of money in a really good headset, speakers will, as a rule, out-perform the phones.

As for the Koss junction box, I believe there are potentiometers mounted on it. If this is true, there is no reason why you could not control the volume produced by the headset. This assumes, however, that you have sufficient volume to begin with and that the impedance between cartridge and phones, or preamplifier and phones, is properly matched, and that the operation of the phones is in all other ways satisfactory. Æ new from **SHURE**

originators of scratch-proof high fidelity tone arms



Special note to music lovers and felinophiles: interesting to note that both cat and cartridge have retractile styli for gentleness and protection from scratching

MORE LIFE FROM YOUR RECORDS . . .
GREATER RECORD AND NEEDLE PROTECTION . . . FINER RECORD REPRODUCTION

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Patented and other patents pending

CARTRIDGE ASSEMBLY

WRITE FOR DETAILS TO: SHURE BROTHERS, INC., 222 HARTREY AVE., EVANSTON, ILLINOIS

LETTERS

Signal-To-Noise Measurement

SIR:

I read the article by Herman Burstein in the April issue of Audio. I liked what I read about his information on evaluating of signal-to-noise ratio. I don't think that the article went deep enough though. There is a way to measure the noise figure of any electronic equipment.

The method that I am familiar with involves a rather special piece of equipment, i.e. a noise generator. The noise figure of an amplifier can be measured by feeding a noise signal into the input of the amplifier and monitoring the output with an a.c. *vtvm* calibrated in db. When the value of the output rises 3 db, the level of the input noise signal should be measured. The input noise level then equals the noise level of the amplifier. The amplifier should first be checked to find out whether a low-level change of 3 db will give a corresponding 3-db change in output.

The noise figure of a FM tuner can be measured in much the same manner, but in most FM tuners there is an a.g.c. circuit that may not allow the 3-db change for a 3-db change in input. In order to find the a.g.c. bias point that will allow accurate measurement of the 3-db change an unmodulated signal is fed into the i.f. When a point is found where a 3-db change in this unmodulated signal reflects a 3-db change in output the test may be carried out as before. Inasmuch as most a.c. *vtvms* are not for use with the frequencies involved in FM, a noise generator with a db-calibrated attenuator should be used.

RICHARD MCLEARY
4535 Blount Ave.
Jacksonville 10, Fla.

Silicon Transistors

SIR:

A number of high-fidelity products and articles in the last few years have illustrated the considerable difficulty of securing good sound reproduction through the use of germanium transistors. In preamplifiers, the noise generation of cheap germanium devices has nearly poisoned the market against their use; in power amplifiers, the thermal and electrical instabilities so difficult to avoid have caused many sleepless nights. For instance, the relatively poor square-wave performance of the 200-watt amplifier (described in the November issue) is very much a consequence of trying to obtain rapid switching from such transistors as the 2N1982 having a 5000-cps beta cutoff.

It is my opinion that silicon transistors can and do provide far superior performance to their germanium counterparts. Although silicon devices were once used in military and high-reliability applications, their now-attractive prices and the current demand for higher performance seems to indicate their use. Not only do these units withstand much higher temperatures, but their greater bandwidths and far lower leakage currents enormously simplify problems of feedback-loop design and thermal stabilization.

I have been using an all-silicon 70-watt mono power amplifier for nearly a year. Including its power supply, it measures barely 100 cubic inches and weighs perhaps 12 lb. Due to its direct-coupled circuitry, the response at moderate power is ± 1 db from zero cps to 100,000 cps with low phase shift. Negative voltage feedback amounts to about 66 db and keeps 10,000-cps sinewave distortion below 0.03 percent at 50 watts. Current feedback, positive or negative, is available to obtain any reasonable output impedance including zero. A differential input stage keeps d.c. drift under 50 mv over a wide temperature range. Mesa transistors are used in the output stage and planar types or grown-junction types are used elsewhere. The total cost of semiconductors is about $120 and will diminish in the future.

MICHAEL LAMPTON
2201 Channing Way
Berkeley 4, Calif.

An Existing Audio Club

SIR:

In recent issues of AUDIO, interest has been shown in the organization of high fidelity clubs.

For the past five years our group has been in existence providing an outlet for Schenectady, Albany, and Troy audiofans. Starting with five "organizers," the Association has grown to over 125.

The members come from all economic and technical levels. They are offered monthly meetings covering all topics of audio, including demonstrations of the latest equipment, lectures on jazz and classical recordings, and many others. Included among our guest speakers have been C. G. McProud (who you might know!), E. T. Canby (ditto), Chet Santon (ditto) and Emory Cook (also ditto).

We have undergone many growing pains during the past five years, but have an organization which is functioning smoothly.

It is emphasized that we have *no* promotional interests; thus are free to criticize local FM stations for poor broadcasting, and supply unbiased evaluations on new equipment to our members.

If, in the next issue of AUDIO, you want to indicate where prospective members may contact us, the following may be used:

C. H. KREISCHER
Secretary,
Tri-City Hi-Fidelity Association
P. O. Box 78
Schenectady, New York

A Pox, a Loud Noise, and Tat

SIR:

A pox on all Canby razzers. I really enjoy ETC's articles and his approach to the art and science of well reproduced music. His skilled use of the English language, the written word, is something I envy. His accounts of twisting, tangled cables, and knob chasing of evasive stereo balance cause me to jump with glee; they remind me so much of what makes life interesting.

A. ZULTAN
118 Cartier St.
Ottowa 4, Ontario, Canada

SIR:

A loud noise (Bronx variety) for the gent from La Canada! He is evidently entirely unconscious of the possible applications of poetic license, and tongue-in-cheek.

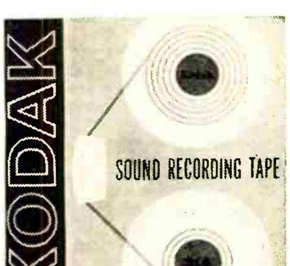
WILLIAM WADE BEEBE
2496 Vineyard Road
Novato, California

YOU SUPPLY THE FREQUENCIES...KODAK TAPE SUPPLIES THE RESPONSE

Listen! It's a new sound! The uncompromising, brilliant sound that you get only on new Kodak Sound Recording Tape. This superb new tape allows extended high-frequency response at lower distortion than has ever been possible. The reason is coating uniformity—achieved by the most precise techniques known to science. These techniques are the culmination of many years of experience in coating emulsion on photographic film.

Kodak Sound Recording Tape also has unusually high sensitivity and low signal-to-noise ratio. Result? Clearly superior performance! It is lubricated on both sides to prolong tape life and to preserve the recorder head. The unique 7-inch Kodak Thread-Easy Reel features instant loading and a built-in splicer.

Listen to this new standard of audio-tape quality and uniformity. Available now at your Kodak dealer's.



EASTMAN KODAK COMPANY, ROCHESTER 4, N. Y.

LIGHT LISTENING

Chester Santon

Balalaika Favorites — Mercury SR 90310

The next time you have reason to suspect that one of the four output tubes in your stereo system is voicing a few noisy sentiments of its own instead of merely amplifying the preamp's signal, reach for this record. There are several quite amazing low-level passages in some of the quiet tunes played by the members of the Osipov State Russian Folk Orchestra. Once you pick out your favorite reference passage, you'll then be able to spot trouble of any kind immediately by checking the very soft murmuring of these balalaikas. They are heard, under normal conditions, against a background of impressive silence, a silence now possible when 35MM magnetic film is used for the master recording. The dynamic range of this disc is as wide as anything produced so far on stereo records, yet there is no sign of the blasting that was so obvious when the use of peak expansion was popular. Instead, the effort is in the other direction: reducing the noise level inherent in the master so that the engineer doesn't have to crank up the gain when the music drops to a whisper. Try two selections on this disc and you'll see what I mean. The "Fantasy on Two Folk Songs" by Budashkin and "Evening Bells" arranged by Mossolov range all over the lot in dynamics. Another advantage enjoyed by this release as a reference record is the fact that there are no sustained notes from bowed string instruments to mask a recently acquired noise in your playback system.

The virtuosi of the Osipov Folk Orchestra include players of the domra and goosli as well as non-string instruments such as horns, pipes and accordian. From the standpoint of sound and playing skill, you can just about forget any other balalaika record issued before this one. After several spine-tingling performances, the real clincher comes at the end of Side Two during the one minute and nine seconds of an asrounding "Flight of the Bumble Bee" launched by the nimble fingers of these extraordinary instrumentalists.

Naif Agby Orchestra: El Debke — Audio Fidelity 5980

Here is another exotic item from the Middle East bazaar that Audio Fidelity's Sid Frey set up on Eleventh Avenue in Manhattan some years ago. It would take an ear more knowledgeable in Mid-East music than mine to figure out just how "El Debke" differs from previous AF discs of this type. A member of the Arab community would immediately appreciate the fact that the selections in this recording poke fun at lovers and deal on a humorous basis with the theme of love betrayed. The rest of us can glean something of the nature of the approach in this album if we take the time to examine the titles of the songs. The translations, however approximate, run in this vein: *Don't Tell Me, Be Wise* and, perhaps the most significant title of them all—*You Deserve It*. Naif Agby, the orchestra's leader, hails from the Lebanese town of Alhden. His many appearances in the cities of Beirut, Baghdad, Damascus and Cairo should be reason enough to accept his qualifications to dispense this form of entertainment in our midst. The album's sound is almost as steamy as the mid-riffy cover.

Steel Band Limbo Twist — Dauntless DS 4602

Trinidad is the scene of this recording issued on the black label of the Dauntless division of Audio Fidelity Inc. The well-oiled rhythms of the Invaders and Kintups Steel Bands are featured in a variety of tunes delivered in the style of the Limbo Twist. The concave tops of the oil drums that comprise the backbone of the Trinidadian's steel band are the meeting ground for a pretty weird assortment of tunes that you'd seldom find together on the music stands of any aggregation in the States. Rollicking, carefree melodies from the Caribbean rub shoulders with such unexpected partners as *Moon River*, *Funiculi, Funicula* and a far-from-home excerpt taken by stealth from the ballet score of Tchaikowsky's "Swan Lake". At its best, this is a low-key item but it does offer a fresh look down a not-too-trodden path.

The Great Barrel Organ — M-G-M SE 4068

The barrel organs of Holland occupy only a small part of the record catalogs but they more than make up for it in the assertive nature of the sound they produce. Standing about ten feet high on their heavy wheels, these traveling organs with the good-natured personality have gained a sizable group of supporters among record buyers in this country. The instrument featured in this release is the famous Jupiter barrel organ of Amsterdam. Some organ fans may buy this record, sound unheard, in order to learn how MGM's German affiliate goes about the job of miking this type of organ. They'll discover that Deutsche Grammophon's theories in this area are pretty similar to those of other labels. Every wheeze in the organ's "woodwind" compartment matches the distinctive thump of the rhythm section as the Jupiter barges through an assortment of marches, waltzes and gallops. The major concession acknowledging the existence of the American musical scene is a blowzy rendition of our own *Twelfth Street Rag*. No audiophile's Aunt Harriet can be expected to cotton to the way this baby will churn the air of your living room. If the idea of cobblestones for a sounding board appeals to you, this is your dish.

A Musical Adventure in Magic Tahiti — Columbia CS 8701

Columbia Records salutes the new version of the motion picture "Mutiny on the Bounty" with an unusual album recorded in Tahiti and the island of Bora Bora. In order to give record listeners a reasonably comprehensive idea of the music heard in the film. Columbia assembled for this album the same group of Tahitian drummers that takes part in the ceremonial dance of welcome for Fletcher Christian and Captain Bligh in the Marlon Brando movie. The instruments played by the twelve native percussionists fall into three groups, some of them more familiar than others. The first group consists of a trio armed with "toeres", a local form of wood block, each instrument of a different size and pitch. In another group, contrast of a sort is provided by a native instrument known as the "ofe". Made of split bamboo by native craftsmen, the raised section of this device comes to life when clobbered by Tahitians armed with bamboo sticks. The contingent of drums brought together for this recording comes in all sizes. The smallest items are about the size of bongo drums; the bass drums of deepest voice are hollowed-out trunks of coconut trees that have been covered by a sharkskin head. The full percussion crew goes to work on Side One of the record, stressing the traditional dances that are supposed to have been part of island life back in the days when the original Bounty arrived in that part of the Pacific. The titles of some of these dances have something of the ring of Hollywood in their makeup but, lacking any evidence to the contrary, we'll have to assume that the stuff is authentic. Considerably less striking are the songs currently popular in Tahiti presented on Side Two of this release by the same musicians heard on the first side. In view of the problems that must have faced the recording crew in the out-of-the-way locale, the stereo sound is more realistic than we have a right to expect.

Andre Kostelanetz: Fire and Jealousy — Columbia CS 8698

The process referred to by Columbia Records as Stereo "360 Sound" continues to deliver an auditory sensation that I find on the brittle side. The results, as they do in almost every formalized technique, vary in this process in accordance with the type of music being recorded. Some releases in the "360" style don't have quite the cutting edge in their sound that others do. This one is on the sharp side. The recent album of Jerome Kern's "Showboat" incorporating this technique was relatively mellow, possibly because a cast of soloists, chorus and orchestra cannot be compressed into the studio area occupied by the present-day Kostelanetz orchestra. The miking here is very close, bringing all sections of the band into the spotlight. The goal seems to be a piercing sound that will register as "presence" on stereo phonographs that cannot deliver really clean sound with a normal record. If you can figure out a way to reduce some of the artificial bite in the sound of this record, you may be able to enjoy it on a good system. The strings and some of the brasses tend to become edgy beyond the first half of the record. I find it the sort of edginess that does not respond too well to normal rolloff in the playback curve, leading me to suspect that the problem lies in the choice of mikes fully as much as it does in the actual recording characteristic used. The record is definitely worth trying to "save" at the preamp controls because Kostelanetz still insists on topnotch work from his men. They deliver just that in the disc's highlight items—Ravel's "Bolero" and the "Ritual Dance of Fire" from De Falla's ballet "El Amor Brujo".

Mantovani: Stop the World/Oliver! — London Tape LPM 70058

This is not the easiest assignment Mantovani has taken on in his years of turning out best-selling records and tapes. His problem here, it seems to me, lies in the slimness of the pickings in the musical content of these two recent musicals. There isn't much that any staff of orchestral arrangers could do in sprucing up the songs from "Oliver" and "Stop the World—I Want to Get Off." On the other hand, Mantovani, as one of England's best known maestros, could hardly afford to ignore the major musical shows Britain has sent to Broadway in recent years. He soldiers his way through these two scores with a devotion that borders on the patriotic. As for the relative merits of these productions in instrumental garb, it is difficult to say whether Anthony Newley's music for "Stop the World" will outlast Lionel Bart's "Oliver." Neither show has song material solid enough to stand on its own feet in competition with other tunes that have become more famous than the shows that spawned them. The main talking point London Records has in this release is the logical coupling of two "foreign" shows brought to these shores by producer David Merrick within a few months of each other. Mantovani does as much for these scores as any orchestra could when you consider the fact that both shows depend for their flavor on stage ingredients other than their music.

Perry Como: Songs from "Mr. President" — RCA Victor LSP 2630

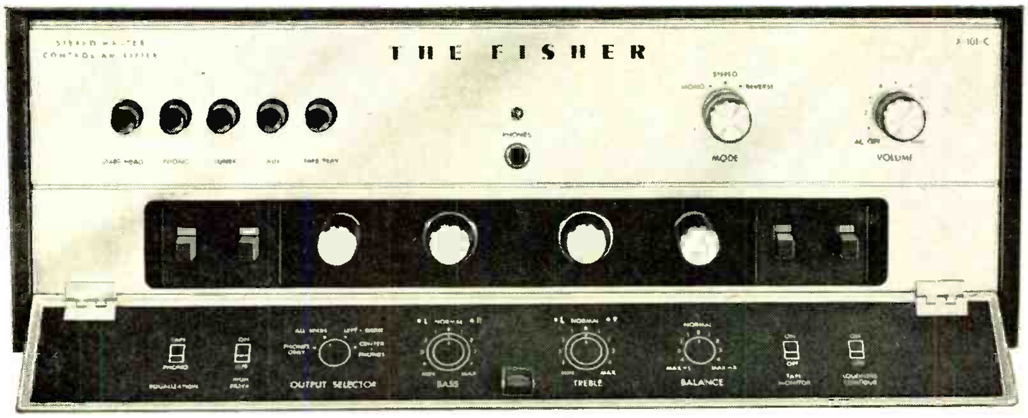
RCA's tour of the White House is in some ways more entertaining than the original cast recording of Irving Berlin's "Mr. President". The Chief Executive portrayed on stage by Robert Ryan can claim nowhere near the vocal talent Perry Como has displayed over the years. Since this is pretty much Perry's album, it's not surprising to find him taking over several songs which, in the show, belong to persons other than the President. Female vocalists Kaye Ballard and Sandy Stewart help out in some of the tunes along with the Ray Charles Singers and Mitchell Ayres' Orchestra, but the cream of the latest Berlin crop is here assigned to Como. He applies his self-relaxing style to most of the quiet songs in the score and throws in his lot with the rest of the cast when the occasion demands it in *Glad to be Home, In Our Hide-away* and the Finale, *This is a Great Country*. Mitchell Ayres paces the proceeding with tempos that the cast has come to expect in its TV shows. Bob Simpson's work at the console provides the presence we now take for granted in any Como production. In record sales and general popularity, this release could easily run a close second to the original cast album.

In the Mood for Gemutlichkeit — M-G-M SE 4067

Freddy Auf Hoher See — M-G-M SE 4084

The new International Music Series making its appearance under the MGM label in this release obviously does not intend to take

Here's how a really advanced stereo control amplifier...



becomes this simple to use!

The new Fisher X-101-C: sophisticated stereo design with the new 'basic' look.

Even without the dramatically new arrangement of controls, this would still be by far the most advanced single-chassis integrated stereo control-amplifier in its power class. That much is assured by its performance. Its Hinged Control Desk, however, makes it the first genuine all-family amplifier in high fidelity history.

For the audiophiles in the family, the X-101-C incorporates comprehensive controls of the utmost versatility. But for immediate enjoyment of stereo by even the least technically-inclined members of the family, only the 'basic' controls (Program Selector, Stereo/Mono Switch and Volume Control) are in view. The other controls – those that are not absolutely essential for instant use of the amplifier – are concealed behind an attractive, hinged cover. The result is the most uncluttered appearance and the most functional operation ever achieved in a stereo component – as well as the end of all uncertainty on the part of the non-technical music lover.

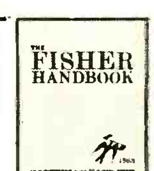
The X-101-C is rated at 60 watts IHFM Music Power (30 watts per channel) and features several important innovations in addition to its Hinged Control Desk. The exclusive Fisher Tape-Play System, for example, permits full use of all controls during tape playback and yet retains the convenience of monitoring while recording. A front-panel jack is available for the connection of headphones, and a special switch can silence the main speakers while the headphones are in use. A revolutionary new circuit development permits direct connection of a center-channel speaker without using an additional amplifier!

See and hear the new Fisher X-101-C at your nearest dealer. Even the briefest demonstration will convince you of its superb engineering logic and brilliant performance. Price: **$199.50***. The new X-100-B stereo control-amplifier, an improved 50-watt version of the famous X-100, **$169.50***.

The X-202-B, a highly advanced 80-watt stereo control-amplifier, **$249.50***.

The X-1000, world's most powerful single-chassis stereo control-amplifier (110 watts), **$339.50***.

FREE! $1.00 VALUE! The new 1963 edition of The Fisher Handbook, a lavishly illustrated 40-page reference guide, idea book and component catalogue for custom stereo installations.



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a back seat in matters of authenticity. Any skeptics who might be found at the nation's record counters are informed in bold print in the lower right hand corner of the album cover that these are Authentic Recordings produced in Hamburg, Germany by the Polydor division of Deutsche Grammophon. So strong a claim hardly seems necessary in view of the really small number of Nonauthentic Recordings invading our country with the sounds and music of other lands. MGM is taking further precautions lest this series be confused with their domestic output. They have permitted themselves the luxury of the intrusion of a lengthy German word in the title of the first record we're considering here. Both discs concentrate on the convivial side of present-day Germany, offering two views of Hamburg that are familiar to the straight tourist as well as the visiting sailor. In each release, we get an opportunity to sample a type of sound that our own record industry would probably classify as unadorned. I find it quite refreshing after some of the domestic stereo discs that have been loaded with an excess of echo in an effort to beef up their sound. The liveness captured here is the product of good halls and engineering crews thoroughly familiar with the hall's best points. In record # SE 4067, the atmosphere of a typical Bavarian beer hall takes care of the gemutlichkeit (casual cheerfulness is one of its many translations). Those unable to sing along in German will still find much to entertain them in the yeasty efforts of an uninhibited group of mixed voices and a robust beer garden band. The full effect of an actual visit to a medieval-style Hofbrauhaus seating some 4,000 revelers may still elude capture on a disc but this recording will come closer than most in creating just such an illusion.

The international songs of the city's waterfront occupy the other MGM disc from Hamburg. The album attempts to recreate the atmosphere of the part of town known to sailors the world over. The night life of Hamburg's Reeperbahn is said to have only one rival—the Canebiere section of Marseilles (immediately dubbed "can of beer" by visiting GI's during the last war). Most of the sea-shanties heard here are of German derivation. *La Paloma* and *What Shall We Do With the Drunken Sailor* help to make the collection a more cosmopolitan one. Someone known merely as Freddie is the soloist with the male chorus.

Gordon Jenkins: Hawaiian Wedding Song
Columbia Tape CQ 461

Left to my own devices while rummaging about in my tape library after the current month's reviews have been shipped off to Mineola, I have special favorites that I'm apt to play again and again. Most of the items digested on my own time, so to speak, have a particular appeal stemming from either the sound or the performance. Up until now, the select company of favorite tapes has included nothing in the way of Hawaiian stuff. It isn't that I've gone out of my way to nurse a grudge against Pacific strumming in general. Like most listeners, I've inclined toward the idea that once you've heard one Hawaiian album, you've heard them all. This reel from Columbia Records may change your mind about this sort of material, as it has mine. The first favorable impression comes with the sound of the tape itself. Sonically, this is an exceptional four-track reel. It sounds darn near as good as the two-track reels that still form a part of my collection. Signal-to-noise is the main indication here that you're listening to four-track instead of two. Hawaiian Wedding Song gives any well aligned four-track playback head plenty to do in the region above 10,000 cycles. The Ralph Brewster Singers dress up the album with their usual professional job. The baton work of veteran arranger-conductor Gordon Jenkins steers clear of the usual pitfalls of corniness in this type of musical fare. Part of the trick may lie in his avoidance of guitars and ukes. In "To You Sweetheart, Aloha," the strings imitate a band of ukuleles.

Julie Andrews: Don't Go in the Lion's Cage Tonight
Columbia CS 8686

Chalk up another solid example of Julie Andrews' versatility in this collection of songs that once enlivened vaudeville theaters and music halls on both sides of the Atlantic. Pursuing the comedy vein first opened for Columbia in the recent album recorded with Carol Burnett (Julie and Carol at Carnegie Hall). Miss Andrews goes back to the days when a comedienne could wow an audience with the lift of an eyebrow in such favorites as *I Don't Care* and *Everybody's Doing It Now.* Vaudeville fans who used to buy the Beatrice Kay recordings when they were available will certainly be interested in this collection. There are several items here that ordinarily would not appear in the repertoire of the typical American vaudeville star. Julie Andrews introduces a few British traditional favorites such as *Burlington Bertie from Bow* and *The Honeysuckle and the Bee.* To put the finishing touch on the music hall atmosphere, Columbia acquired the services of the Quartones—first tenor Merrill Staton, second tenor Chuck Green, baritone Ed Lindstrom and basso Ruby Williams. The work of the quartet as well as that of conductor Robert Mersey, himself no stranger to the musical scene in England, helps to pull up this release out of the category of the ordinary. Julie Andrews, however, sees it over the top with a performance that is sure to tickle anyone who has known for some time what these old songs have to offer.

Frank Sinatra Sings Rodgers and Hart
Capitol W 1825

It's always a bit of a surprise to learn just how good the average master tape of years gone by can sound today. This is a mono collection of tunes by Richard Rodgers and Lorenz Hart recorded by Frank Sinatra during his many years at the Capitol label. Some of these selections obviously go back quite a way because the Sinatra voice exhibits here a far fresher timbre than it has revealed in recent years. Yet the sound in this new pressing is just about as good as anything I've heard come out of present mono sessions. This is a fresh reminder that all that's needed to put some of the old master tapes back in the running again is to use an updated transfer system. In this way the disc buyer can enjoy a good part of the radiant and unforced warmth we've taken for granted in the sound of good master tapes made during the past fifteen years. Some of the very best Rodgers and Hart shows are represented in this album and Sinatra puts them over in a style that he probably couldn't match today.

Thousand and One Nights in Vienna
London Stereo Tape LCL 80099

Two Pianos Play Strauss
Richmond Stereo Tape RPX 49006

London provides tickets to Vienna in two price ranges with this pair of tapes. In the first-class compartment is the orchestral release of Viennese polkas, waltzes and marches played by the celebrated Vienna Philharmonic under Willi Boskovsky. Of the several reels by this orchestra and conductor prominent in the London tape catalog, this one offers the freshest sound in the entire group. Tape fans who have always been quick to recognize the real thing in Viennese light entertainment will need no further recommendation in this instance.

The two-piano team of Rawicz and Landauer, each man assigned to his own channel, is no match for the well-oiled precision of the Vienna Philharmonic in the lower-priced Richmond tape. Their arrangements of Johann Strauss favorites appear to be aimed at the individual who has tired of the conventional stereo treatment of this music. I still prefer my Strauss without this amount of directionality.

Jacqueline Boyer, Chanteuse
Capitol ST 10313

How often do we find an internationally known singing star presenting a generation that follows her with a singing offspring? The Jacqueline Boyer heard in this debut album is the daughter of the famous Lucienne Boyer, the French songstress whose discs were collected by many discerning record buyers in pre-LP days. Few of those collectors suspected that the name Boyer would come back to haunt them (in the nicest sense of the word) on a stereo microgroove disc recorded in France. 20-year-old Jacqueline carries on more than one family tradition here. Besides a piquant, light-textured singing voice that should easily carry her fame to a wide audience, she also uses accompaniments by Franck Pourcel who acted in the same capacity for her mother. There's no mistaking the fact that some very effective teamwork has gone into this album. The dozen Continental hits sung in French are full of tricky effects that make this a decidedly different release. Mlle. Boyer, who has been singing for the past four years as a professional, is scheduled to appear in this country in 1963. On the basis of this recording, she may start a new vogue in our entertainment world. Æ

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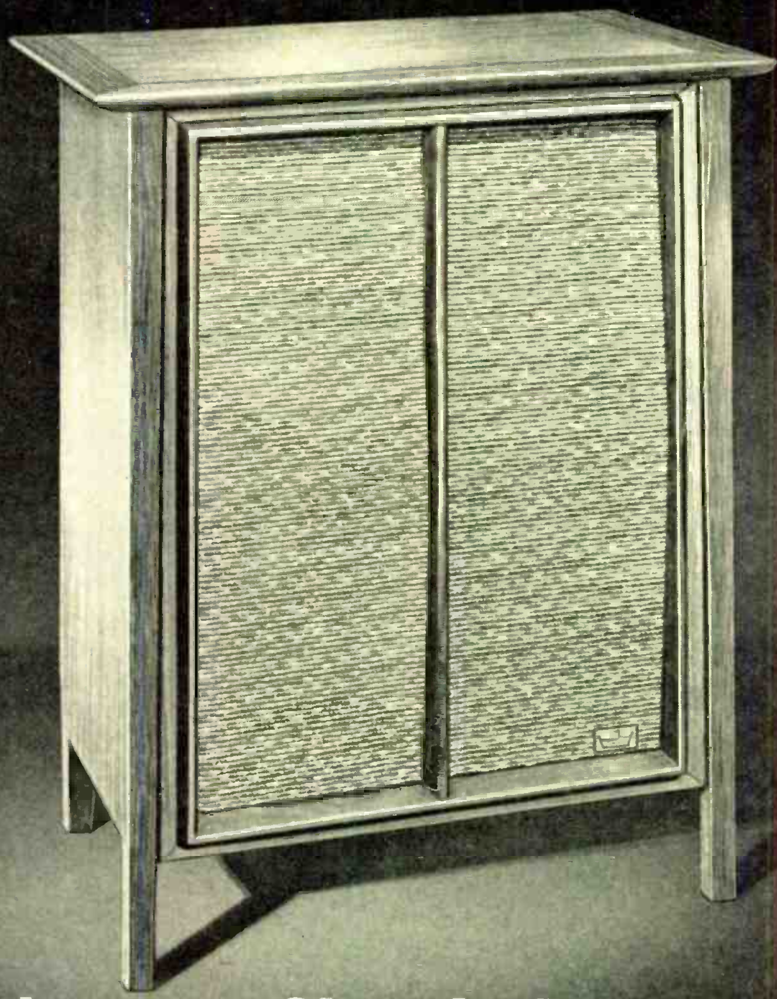

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From the first moment of its appearance, the Classic Mark II won instant and unanimous acclaim as the most exciting new instrument in the world of music reproduction. Its range, its presence, its spaciousness and dimension are truly outstanding, even when compared with the so-called "world's bests." Its reputation, however, posed this immediate challenge: Could University now create a speaker system with the essential qualities of the Mark II, but in a more compact size... and at a more moderate price? Could University now bring the pleasure of uncompromising big system high fidelity to a broader range of music lovers?

The challenge has been answered with the new Classic Dual-12, created by a totally new approach to the design of speaker systems. Instead of the conventional 3-speaker arrangement, University's Dual-12 incorporates two 12" speakers...plus the Sphericon Super Tweeter! One 12" speaker is a woofer specifically designed for optimum reproduction of the ultra-low frequencies (down to 25 cps); the other, a woofer/mid-range, reinforces the woofer, removes the peaks and valleys that cause harsh, strident sounds in ordinary systems and provides flawless mid-range performance. The renowned Sphericon is included to assure silky, transparent highs soaring effortlessly up to 40,000 cps! Power Requirements: 10 watts. Size: 23¾" x 31⅓" x 15½". Oiled walnut finish. **$229.95** Hear it at your hi-fi dealer, or write: Desk R-2,

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AUDIO ETC.

Edward Tatnall Canby

CHANGERS: *PLUS ÇA CHANGE . . .*

My title is part of an old french phrase that tells us, wisely, about all things that change: the more they change, the more they're the same. I've been trying a record changer again and the phrase came automatically to mind.

It all goes back to last spring, when RCA Victor put out a blast of publicity, along with the launching of a new RCA changer, to the effect that there was a new and professional concept of integration, or something, that pervaded the dynamic field of home equipment. Unfortunately, I tossed it out in a moment of absentmindedness; but the gist of the message, quite easily to be read between the lines, was significant. What RCA was saying, ever so subtly, was (if I read rightly) that the mass-produced industry had finally been spurred into doing something (other than advertising) about component competition. Little David, it seems, was making a dent in our technological Goliaths.

Now by happenchance I was shipped a new U. S. changer this last summer, not the RCA but a Goliath's first cousin once removed, out of Zenith. This one, too, has a professional integrated look to it, reflecting the same concern with the inroads of componentry upon the common man. No doubt about it, things *have* been done. And yet . . . *plus ça change*. . . . The Zenith recently went to work for me, the first changer of any sort I've tried for some years. Sheer curiosity. I just had to see what it felt like to use a new-type domestic-production model again after these years of component arms, long and short, thick and thin, adjustable and non-adjustable, ever lighter and ever more dynamic.

It was fun. First, because there were, in fact, noticeable improvements. Second, as you can guess, because the fancy new changer, under all its flossy and attractive restyling, felt so very familiar, down to the last discreet clunk and clank, like a '63 Ford that, under the hand, drives surprisingly like a '49. Brothers under the hood. A changer is still a changer, let me tell you, integrated or whatever.

I think we can take seriously the honest changer advances, as constructive reflections of component influence. One does not measure these things by AB performance comparison. The two ways of manufacturing, of designing, tooling, selling, are still technologically too far apart for a standard changer suddenly to become a component overnight. But within mass production technology there is always room for gradual change, a bit at a time as production allows, given the honest desire for it. There has been that desire, lately.

I am aware, of course, that some changers, notably the imports (sold at a solid price), do indeed sport specs that begin to compare with good componentry. On the other hand, most of the millions of changers sold to the American public are only marginally different from those of some years back. It is thus significant to find even modestly basic improvements in some of the major lines now offered. Like RCA and Zenith, for example.

Twelve Inches

What improvements? Well, my eyes popped, first, to see a genuine twelve-inch turntable. We hadn't seen a table of that size in production changers since before the war. The larger table implies a lot. It states clearly that the demand for heavier, steadier, quieter driving power—as in good components—is really being felt across our land in high places. (It struck me as a bit like the compact car impact on the big motor companies—long denied, then finally conceded.) Other improved drive aspects go along with the big turntable, including careful rumble treatment for stereo reproduction. (That, in turn, implies a significant degree of bass reproduction in the machines where these changers will be used.)

Then there are the new light changer arms, rather ingeniously de-coupled from the drags of the not-very-delicate changer mechanisms. I was astonished at Zenith's, though perhaps Garrard's, out of England, goes even further. Both have adopted the dynamically balanced arm, following the finest of component manual arms; now you can play either one uphill or sidewise, though whether it will change a record upside-down I do not know. Others, Zenith included, have moved away in other fashions from the old "light" changer arms, held up by crude springs and subject to relatively horrible side pull, resonance and what-have-you. The progress in this area is really quite remarkable and worth any component man's careful study.

Zenith, for instance, has adopted a tricky version of the "arm within an arm," long ago used in an early Pickering manual model and since adopted by many component arm makers. Zenith's main arm, however, still moves up and down from its rear pivot. The sub-arm is hung inside the cartridge shell, nothing more than the cartridge itself, hinged at the rear and held up by two tiny springs against its own weight. Maybe this isn't the most sophisticated suspension in the world but it is surely a lot more precise and more carefully thought out than the old and crude arms. The cartridge does track at acceptably low pressures, as do others in these new models, yet the changer mechanism works in the usual manner. Attribute this, if you will, to the constructive influence of componentry. I do.

Ceramic

Then there's the cartridge. Nope—not a supermagnetic. Here, the big makers have resolutely stuck to the ceramic and for inescapable reasons, both in durability and economy throughout the circuit. No preamp. No hum pickup problems. The ceramic and magnetic cartridges in the U. S. have come to epitomize the whole area of essential difference between what we call component equipment and what—in componentry—we call "mass produced" equipment.

The ceramic stereo cartridge, to be sure, has solid advantages in its present high state of development. Of course in its simpler versions it is vastly cheaper to produce than any magnetic. In its fancy two-element versions, which sell for a healthy price and compete for component-style recognition, it provides essentially the quality available in magnetics, plus excellent channel separation and the usual high output and zero hum pickup. Ceramics have been fighting to gain a place alongside of our magnetics for many years now and their makers have cockily refused to give an inch, on any grounds at all. Some of the most aesthetic hi fi outfits in our business stick to ceramic quality—Weathers, for instance. So it is correct to say that the home-style changer with a top-quality ceramic is able to produce a quality output worth anybody's consideration.

In Europe to this day the ceramic seems to be taken for granted as the hi-fi norm. I'd be willing to guess that a good part of the European-made magnetic output is designed for export, not domestic consumption.

And yet . . . Well, I've been listening carefully to Zenith's ceramic, the recently developed CBS cartridge. It is surely one of the best of the breed. Offhand, I could not hear any immediate difference when I shifted away from my familiar and top-quality magnetic and plugged in the ceramic. I still cannot say positively that there *is* a difference. And yet . . . somehow, now I think I hear a recognizably *ceramic* sound. How can one analyze such an evanescent, will-o'-the-wisp difference?

First, I seem to hear the faintest, fragile remnant of an effect that used to be only too full-bodied, the all-too-familiar edgy rasp that was the hallmark of our old 78-rpm crystals before the war. Maybe I notice it now merely because I remember it well. I react, as to an allergy, at even the minutest trace. Yes, I think I heard it.

And then, too, there is another once-familiar attribute of the ceramic-crystal, due of course to its well-known constant-amplitude characteristic: a *very* slight thinness in the bass response. Yes, in theory this is equalized-out; I used a ceramic input in my preamp, labelled RIAA. Nevertheless, I sense the slightly weak bass, perhaps partly as a result of the *extremely* slight increment of treble harshness.

Am I dreaming? Did I really hear these differences, so very minute? I think so. But just barely. That I'll admit, to Zenith's credit.

Still a Changer

And yet a changer is still a changer. I was astonished to find, after these years, how easily the familiar controls fell under my fingers in their new and unfamiliar stylings, and how quickly the old annoyances came through, to plague me exactly as always! Temperamentally I'm not a changer man.

Here was the same old jointed central spindle with the edgy little shelves on it to catch the record, the same familiar overhead arm, moving across and then stiffly down, to hold the records from flopping sidewise, the same automatic OFF position to which the machine returns every time it gets a chance, usually when you don't want it to—with that unstoppable series of leisurely clicks and bumps and thumps and pauses. There's the REJECT, which one must lean against to get the machine going at all. And there was that measured ca-

dence of mechanical motions—not really slow but seeming endless when you must wait for them, like a pot that doesn't boil. And there was also the inevitable slightly off-the-runway landing of the arm, enough to slice off a couple of notes of music! No fault of Zenith's. Changers—and records—are like that, just as human fingers inevitably flub the same procedure in manual operation. (But I'd rather do the missing myself than stand and listen to a machine do it.)

Same old automatic action, too. Zenith picks the right size disc by the familiar feeler arm, drops it down, or turns itself off, essentially as changers have been doing for almost a quarter century. It's all very reminiscent, even the rhythm and the sounds in the operation of the change cycle. Push the REJECT in mid-disc on these new changers and you still get the same old dying gasp from the music, a sort of gulp and choke with a downward sag in pitch, as the arm sails away; the next record drops and plays as though nothing had happened. Oh, how well I know the changer mechanism! Clank, swish, pause, prrr, wait, play. . . .

Manual???

Aha, an innovation! I suddenly discovered something else new. The Zenith's control moved in two directions from OFF. One was towards the usual start-reject. The other way brought up a bold little sign that said MANUAL. So—at last, the changer people had come to terms with our illogical demands for non-automaticism! I pushed the knob to MANUAL, hopefully, moved the arm over by hand and started a record. Good! Felt almost like a real component hi-fi arm. It was light enough to produce a comforting loud squawk as I lowered it to the grove and I had the usual familiar thought—it can't do any harm it's so light. It didn't. Yep, this was a real handy changer on MANUAL and I dug it.

But just as I was settling down handily for a long session of hi fi, Zenith upped and played a nasty trick on me. The same old double cross. I came to the inner grooves of one of Quarante Cinq's new 45-rpm LP's (I play them very nicely on such equipment) and I wanted to re-trace a half inch or so at the end to see how the loud music sounded at the inside. I picked up the "manual" arm—and instantly Zenith snatched it out of my hand and went into the old change cycle. *Manual???* I snorted, and tried again. Not a chance. It was absolutely impossible to play the last part of any record over again, by any strategem short of smashing the entire mechanism.

OK, OK, I know. What the great American public wants, Zenith will tell me, is a manual player that's automatic. Or a changer that plays manually. So you give 'em some of both. People want to start their records manually but they're too lazy to stop them. You do that automatically. Have your cake and eat it. Oysters and sugar, I say, Not for me, please.

Not for me! by manual, I mean MANUAL. I *enjoy* the sound of a record after it's finished, going quietly 'round and 'round. I turn it off when I get a mind to, and no machine snatches any arm out of *my* hand. I felt tricked, disillusioned, cheated. Manual, my eye!

So, please, don't tell me anything more about manual changers until you've got something good. Like, say, a changer that changes *only* when you wave a magic wand. By hand, of course; no automatic wands, please.

EXECUTIVE SEARCH

After waiting some two years to be sure, I think I can declare the following correspondence, of which I offer excerpts, closed.

I always did wonder how you people out there got your lucrative jobs, the ones that enable you to patronize the stuff *we* recommend to you hereabouts. After all, you gotta have cash to buy hi-fi quality, not to mention stereo and multiplex. Now I know. To some people, jobs come easy. Like this, for instance:

"Dear Mr. Canby,

Our company, a management consulting organization, is seeking to assist one of its clients in filling the position described by the enclosure. If, after reading the enclosure, you feel qualified and interested, we would be pleased to pursue the matter further with you. . . .

Very truly yours,
________, Director of Executive Search."

Was I interested? Did I feel qualified? Well, read further:

"THE COMPANY. Near century old, highly respected * * * manufacturer of electric call, signal, and alarm systems . . . attractive plant, pleasant working conditions, congenial associates. . . . THE POSITION. Report directly to chief R & D. Design and develop audio and radio intercom and signal systems for institution use—primarily schools and hospitals. Responsible for projects from inception to production, and ultimately for any subsequent design changes. Work largely on own initiative but with guidance from marketing department. . . . REQUIREMENTS. Minimum 5 years qualifying experience with heavy emphasis on audio systems . . . E.E. degree or better (equivalent experience could be acceptable). COMPENSATION. $9000 to $12,000 depending on experience. Excellent additional advantages in insurance, bonuses, profit sharing."

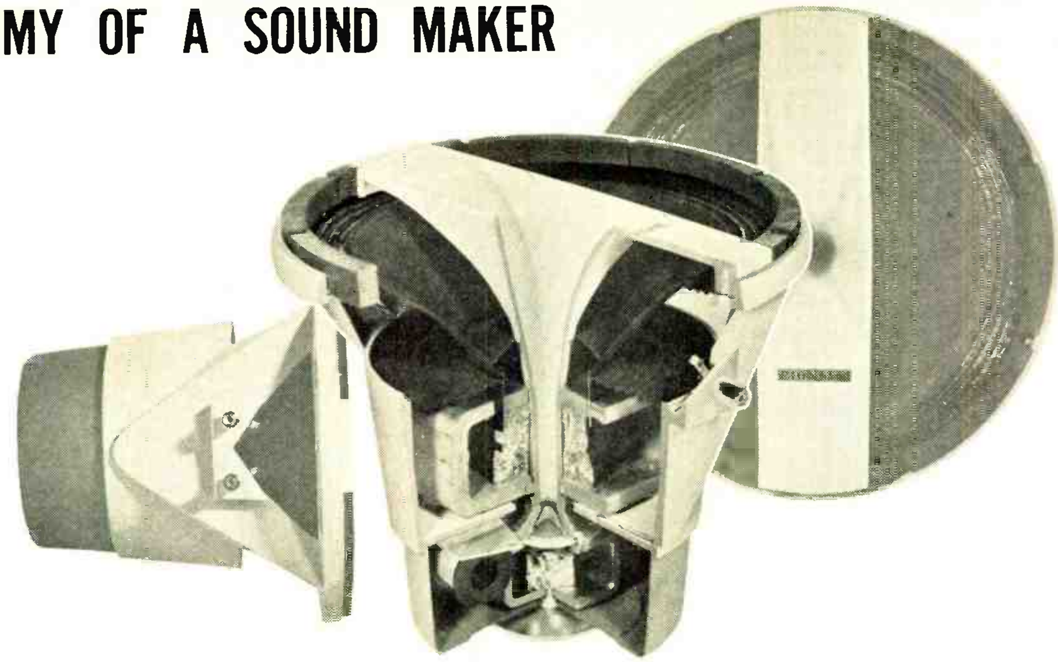
Now isn't that a lovely plum to dangle before an old audio man like me? I could eat those bonuses and I dig insurance like crazy. I'll share anybody's profits, too, given half a chance. With those congenial associates, indeed, I suspected I'd learn even more about the business than I would contribute. Clover, indeed! Real hay.

Now as to those requirements. Minimum of 5 years. Hmmm. I've been in this rather centrally located audio position now for some sixteen years. And surely the emphasis in my department on audio systems has been consistently heavy, right along. No question about *that.*

Electrical Engineering? Well, to be sure, I don't have an E.E. Mine is an A.B., plus an advanced M.A. in music. (That was somewhat before I fell into audio, as described in these pages in 1956.) Still you can't get too far away from music these days, even via intercoms in institutions. We have music in men's washrooms, and in hospital wards, and grounded jet airliners. We have it, too, in every school classroom. Seems to me there'd be a legitimate need for an intercom or signalling system that would do justice to the art of music in all of these—in schools, hospital wards *and* in other institutions, not to mention the non-institutional private home. (We could revamp our product for the retail trade easily enough, couldn't we?) There have been so many alarming attempts to perpetrate music via remote controls, center-channel bedroom systems, den speakers, patio extensions, under-water transducers, pillow

(Continued on page 72)

ANATOMY OF A SOUND MAKER



This is the brand new PAX-25F, a 10-inch 2-way loudspeaker just put out by PIONEER.

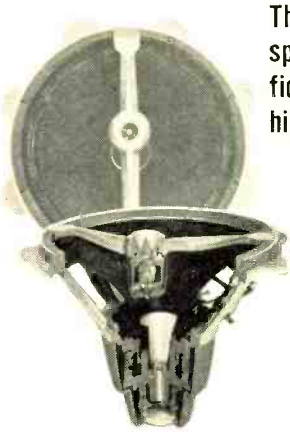
A new model 10-inch 2-way loudspeaker, the PAX-25F, has been placed on sale by PIONEER, world-renowned manufacturer of high fidelity components. As the photograph shows, the well-designed exponential horn-type tweeter built within the 10-inch woofer is a completely independent unit equipped with its own specially-designed magnet assembly and diaphragm assembly. This makes it possible to virtually eliminate all intermodulation or interference distortion which hitherto have been considered almost inherent problems in multi-way speakers.

The woofer unit far surpasses other woofer units in its class in its high efficiency. This high efficiency has been achieved through the careful selection of only the very best materials, the most modern design and construction, and production facilities second to none. It is capable of reproducing faithfully low frequency signals as well as — if not better than — larger diameter woofer.

A relatively low crossover point was selected to avoid any fluctuations of peaks and dips in the mid-ranges, and to provide smooth overall frequency response.

Specifications

Model No.		PAX-25F
Voice Coil Impedance		16 ohms
Resonance Frequency		27 – 37 cps
Frequency Range		32 – 16,000 cps
Maximum Power Input		20 watts
Power Input		15 watts
Sensitivity		101 db/watt
Crossover Frequency		2,000 cps
Equivalent Mass		25.5 g
Total Flux	Woofer	156,000 maxwell
	Tweeter	25,000 maxwell
Flux Density	Woofer	10,000 gauss
	Tweeter	10,700 gauss



The 15-inch 3-way PAT-38X loudspeaker, the ultimate in high fidelity loudspeakers, born of the highest standards of technology.

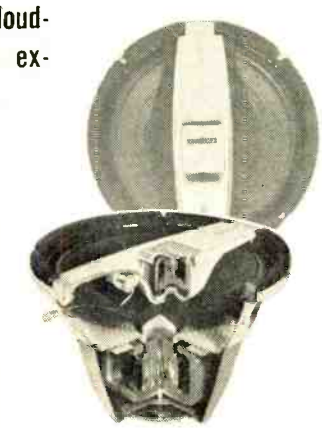
Specifications

Model No.		PAT-38X
Voice Coil Impedance		16 ohms
Resonance Frequency		21 – 29 cps
Frequency Range		20 – 20,000 cps
Maximum Power Input		60 watts
Sensitivity		103 db/watt
Equivalent Mass		77 g
Total Flux	Woofer	290,000 maxwell
	Squawker	70,000 maxwell
	Tweeter	20,000 maxwell
Flux Density	Woofer	10,000 gauss
	Squawker	13,200 gauss
	Tweeter	13,500 gauss

The 8-inch 2-way PAX-20G loudspeaker, featuring a built-in exponential horn-type tweeter.

Specifications

Model No.		PAX-20G
Voice Coil Impedance		8 or 16 ohms
Resonance Frequency		50 – 70 cps
Frequency Range		40 – 20,000 cps
Maximum Power Input		15 watts
Sensitivity		102 db/watt
Crossover Frequency		3,000 cps
Total Flux	Woofer	62,500 maxwell
	Tweeter	14,000 maxwell
Flux Density	Woofer	10,000 gauss
	Tweeter	9,000 gauss



PIONEER

PIONEER ELECTRONIC CORPORATION

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EDITOR'S REVIEW

SOUND REINFORCEMENT IN THE CONCERT HALL

RECENTLY we have been engaged in investigating the sound reinforcement systems in concert halls and theatres. We were interested to discover that the sound of some musical performances is reinforced by the built-in system. Thinking about this a little we can easily understand why it would be desirable. For instance, in *About Music* this month Harold Lawrence points out that the harpsichord carries very poorly in the concert hall. It makes sense then to add some "vitamins" to the performance by means of the sound system. Of course this does place a responsibility on this system; it must be able to reproduce music *musically*. To audiofans this would seem to indicate a wide and smooth frequency response. And yet it is rare, if ever, that the specification for a concert hall sound system calls for more than a 70 to 12,000-cps range. On the basis of specifications alone it would seem that many home high-fidelity systems would provide better sound than is available in the concert hall for certain types of performance. If this is true should we not turn that old slogan around and have the concert hall sound like the home?

In a sense it seems rather strange when we realize that the concert hall is not necessarily the standard for sound quality. Of course one should not conclude from this that it is not necessary to attend concerts (or at least those which sound better in the home). The live concert can impart something that records can't—a direct and immediate communication from the performer(s) to *you*.

As a result of our research into concert halls and theaters, we intend to present several articles about the sound systems contained therein. Naturally we tend to concentrate on halls that we know about in our own back yard, but we would welcome your thoughts as to halls we should, or might, investigate. Perhaps, with enough interest on our part, we can encourage the concert hall managements to seek sound systems as good as, or better than, the best systems available for the home.

By the way, to avoid any misunderstanding, we should make it clear that a system with a narrower frequency response doesn't necessarily sound worse than a wide-range one. In concert halls careful attention is paid to matching the sound system to the acoustics of the hall so that maximum sound quality is obtained. Most home systems are far from ideally coupled to their environment. In addition, a certain amount of direct sound is radiated at a live performance. Our point is simply that wider range systems than commonly called for in concert halls are available. We *want* the concert hall to be the mecca.

CLUBS

Since we first mentioned the topic of audio clubs last year we have been surprised to discover how many successful clubs are actually in existence. An example of a successful club is the Schenectady Audio Society whose story we will present next month. Actually there is much to be learned from them on how to set up a club in your own area; there plan and method of operation are quite practical and simple.

We would like to repeat again that we stand ready to help those who would like to pursue their interest further in society with like-minded people. For example, we may be able to help locate sources of speakers if you tell us the subjects. Or we may be able to put you in contact with other groups nearby. Or we may be able to give advice on technical matters. We would *like* to have you flood us with requests because we think clubs can be valuable and enjoyable.

ANTENNAS FOR STEREO

Last month we presented an article which discussed the need for an antenna in order to receive FM-stereo well. We would like to go on record as agreeing with this idea wholeheartedly. From our experience, and the experience of many readers who have taken the trouble to write to us, the stereo signal is much harder to receive well than the mono FM signal. This was to be expected since the original FCC information indicated about a 30 per cent loss. Actually, many people have discovered that the loss is closer to 50 per cent. Thus, if you receive mono well but not stereo, you undoubtedly need an antenna. If you already have a satisfactory antenna, then you will have to investigate a booster, a higher gain antenna, a more directional antenna, and so on. Unfortunately, it is not a simple problem, but if you wish to receive FM stereo loud and clear it is likely an antenna will be necessary.

INSTRUCTION BOOKS

This is in the nature of a progress report on instruction books. Last year we took a long, hard, and generally unfavorable look at instruction books for kits. We decided to take another look at this time in order to determine whether there had been any marked change. We are unhappy to report that there has been no decided change for the better except in isolated cases. Frankly we are at a loss to understand why a company will spend so little to back up the relatively large investment is has made in engineering a kit. Also we just do not understand why kit manufacturers want to make it so hard for those of us who build a large number of kits. Its unfair, that's what it is!

COMING EVENTS

Show attenders are in for a pleasant season of shows starting this month. Naturally not everyone will be able to attend them all since they are in different cities, but wouldn't it be fun if we could (and had the time to spare). Anyhow here are the shows:

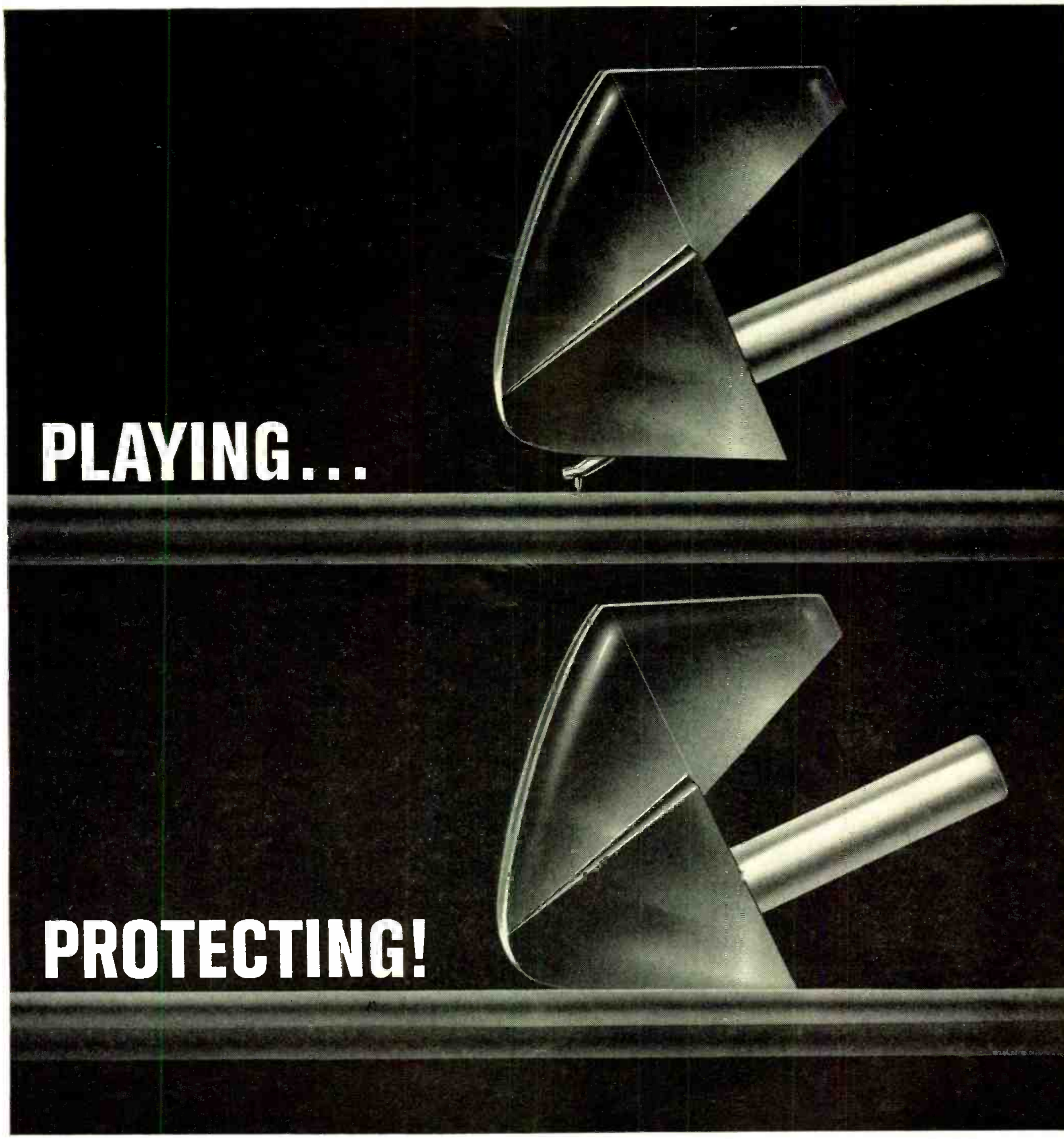
The Washington High Fidelity Music Show will be staged at the Shoreham Hotel in Washington, D.C. Dates of the show are February 8, 9, and 10.

The San Francisco High Fidelity Show will be staged in the Cow Palace from March 6 through the 10th. This show features home products in addition to high fidelity components.

The Los Angeles High Fidelity Music Show will be held at the Ambassador Hotel. The dates are March 31 through April 7.

Paris offers the International Components Exposition from Feb. 12–16, and the Festival of Sound from Mar. 7–12.

London's Hi Fi Show is set for April 25–28.



PLAYING...
PROTECTING!

Vertical Tracking Improvements in Stereo Recording

B. B. BAUER*

A revolutionary discovery shows that the recorded modulation slant on a stereo record differs from the geometry of the cutter because of lacquer "springback," and vastly reduced intermodulation distortion can be effected by a corrective mounting of the cutterhead.

STEREOPHONIC RECORDS and equipment for playing them made their appearance on a wide scale some five years ago. At the present stage of development, both the records and the equipment have reached a high state of perfection and have enjoyed wide acclaim. One criticism has been heard from time to time: With some stereophonic pickup-record combinations, a careful listener is able to perceive a certain type of distortion which is not discernible with monophonic records under similar conditions. This distortion has been traced to an improper vertical-tracking-angle relationship between the pickup and the recorded wave. At CBS Laboratories, under Columbia Records' sponsorship, it

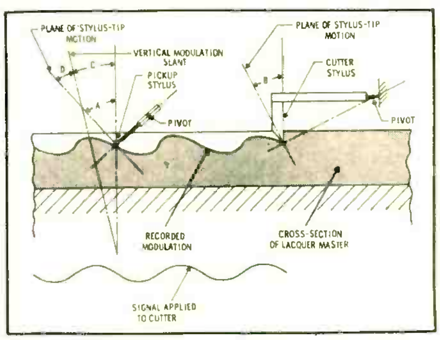


Fig. 1. Diagrammatic representation of vertical tracking angle, A, vertical recording angle, B, and vertical modulation slant, C. Because of lacquer springback, C is smaller than B.

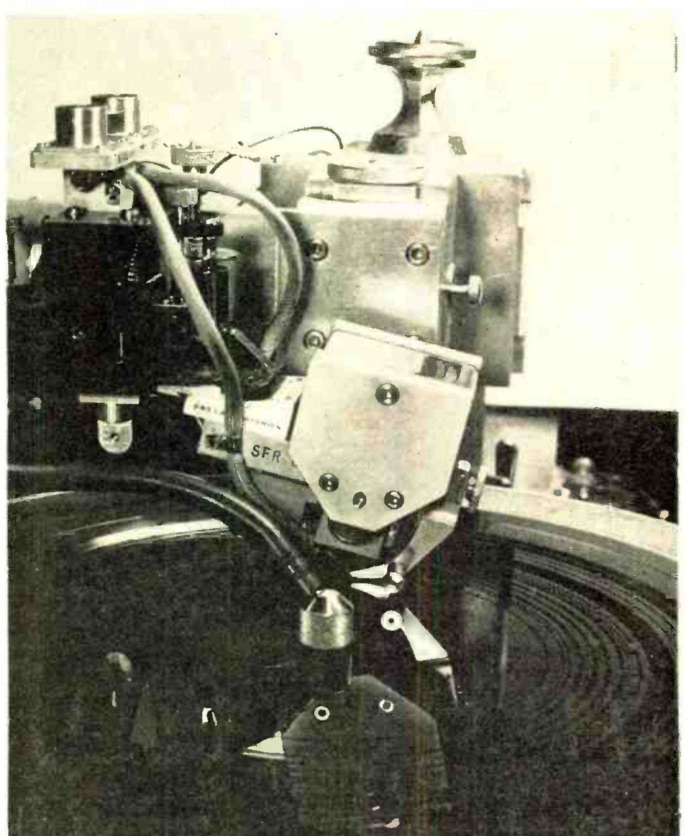
has been further discovered that the interaction of a stereophonic cutter with the lacquer master causes the vertical modulation to have a slant different from that suggested by the cutter geometry. This contributes to the distortion. A new method and apparatus for determining and controlling the recorded modulation slant and for measuring the vertical tracking angle of pickups has been evolved. This refinement has added significantly to the quality of stereophonic record reproduction.

Vertical Tracking Angles

The principal information content in a stereo record resides in the sum signal of the 45/45-deg. modulation which appears as a lateral cut, and this is not affected by the vertical tracking angles. However, the stereo information is identified with the difference signal which is contained in the vertical mode. Therefore, proper tracking of vertical modulation assumes increasing importance with records having considerable channel separation, especially toward the end of the record where wavelengths are short.

Since the cutter and the pickup suspensions are pivoted above the record surface, the stylus-tip motions are contained not in a vertical plane, but in one slanted away from the point of suspension. (*Fig.* 1). The slant angle of the pickup is called the vertical tracking angle A, and the slant angle of the cutter is called the vertical recording angle B. Assuming that a sinusoidal vertical signal is applied to the cutter, the modulation actually cut can be expected to be contained in a coordinate system with inclined ordinates. The inclination angle of the modulation ordinate is called the vertical modulation slant C, and the difference between the vertical tracking angle and the vertical modulation slant is a vertical tracking error angle D. If D is zero then the pickup will reproduce an undistorted signal. It had been assumed from the beginning of stereophonic recording that vertical modulation slant was equal to the vertical recording angle, but we show later that this is far from being the case. Actually, the modulation slant is substantially smaller than the recording angle.

Next we consider the relationship of records and pickups. The wide disparity



Westrex cutting head arrangement for obtaining a 15-deg. vertical modulation slant.

* *CBS Laboratories, Stamford, Conn.*

of vertical tracking angles in commercial pickups has been known for some time. Angles ranging from 10 deg. to more than 40 deg. have been measured. The Westrex cutter which is widely used in the U.S.A. has a vertical recording angle of 23 deg. Some European cutters are intended to provide a 0-deg cut. Only recently the RIAA has recommended the use of 15-deg. vertical modulation.

This angle has been under discussion for some years and one would think that the pickup designers would have attempted to span the two known cutter dimensions even before the recommendation of the RIAA had been made. The 15-deg. angle undoubtedly was a compromise with the European manufacturers who are limited in the cutting angle they can readily provide by the form factor of their cutter designs. But lest those manufacturers of pickups, whose tracking angles currently equal or exceed 23 deg. feel slighted, let me say that the compliance with the new RIAA standard, to make any sense at all, must be interpreted to mean that modulation slant produced by the Westrex cutter must be *raised* to 15 deg. rather than *lowered* to 15 deg. With this interpretation of the standard, the quality of reproduction is improved with all the existing stereophonic pickups.

Vertical Modulation Slant

It has been discovered at CBS Laboratories that the modulation slant produced with the conventional Westrex cutter system is nearer to 2.5 deg. than to 23 deg. This discovery occurred quite accidentally. We were trying to measure pickup distortion in the vertical mode and for this purpose an intermodulation test record was needed. At the same time, recognizing a need for transient-response measurements, we decided to place a square-wave modulation on the same record in the lateral, left, right, and vertical modes. This record became the CBS Laboratories Stereophonic Test Record STR-110. The STR-110 indeed represents the type of modulation obtained with the standard Westrex cutter system. Upon replay of the vertical square wave, it was noticed on the oscilloscope that the lengths of the two halves of the reproduced wave were slightly unequal. Fortunately, we did not yield to the temptation of overlooking this phenomenon, but instead proceeded to examine the groove with a microscope. Now, as shown in *Fig.* 2, a square wave (A) becomes a triangular wave (B) on a velocity basis, and when such a wave is recorded in the vertical mode with a cutter having a recording angle other than 0 deg., the peaks of the wave are shifted along the recording line from *a* to *b*, so that the recorded groove presents a sarcophagus pattern (C). Of course, when such modulation is played with a pickup having an appropriate vertical tracking angle, symmetry is restored and a perfect square wave is reproduced. However, microscopic examinations of the modulation of the STR-110 revealed not a sarcophagus pattern but a rhombus pattern (D) which implied that the 23-deg. recording angle produced near-0-deg. slant modulation!

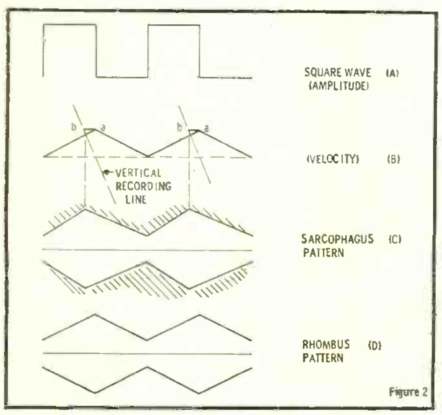


Fig. 2. (A) Square wave applied to the cutter amplifier. (B) Motion of recording stylus. (C) Sarcophagus pattern produced by slanted cut. (D) Rhombus pattern with 0-deg. modulation slant.

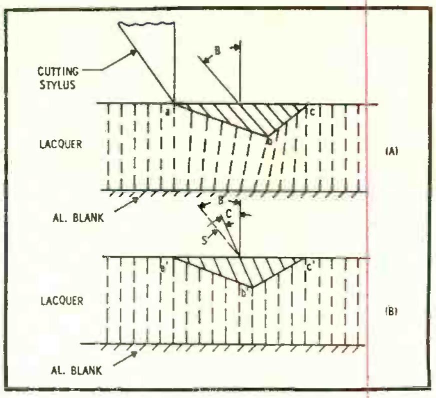


Fig. 3. Stressing of lacquer during cut. (A) Followed by springback after cut. (B) The resulting modulation a′-b′-c′ is less slanted than the line of cutter motion a-b-c.

Adjusting the Modulation Slant

We did considerable head scratching to explain this phenomenon. It was deduced at last that a heretofore unsuspected effect existed in the vertical recording process. This effect, we figured, could be caused only by the longitudinal elasticity of the lacquer or the transverse elasticity of the recording stylus in combination with the alternating stresses which occur in vertical recording. The lacquer elasticity appears to play the preponderant role.

The action may be explained as follows: Say a cutting stylus (A) in *Fig.* 3, with a recording angle B to cut a triangular velocity pattern, similar to that in *Fig.* 2. Initially the lacquer is in an unstressed condition. As the disc advances to the left so that successive horizontal intervals pass by the cutter, the tip of the stylus moves along the slant lines, and cuts the shape *a-b-c*. While the cutting action takes place, the shearing forces push the material forward, as shown by the slanted dash lines, the slant being proportional to the depth of cut, and greatest at *b*. As the cutter emerges at *c*, the stress again is diminished. After the cutter has passed by any point, the material springs back taking on the form shown in (B) of *Fig.* 3. It is seen that the triangle *a′-b′-c′* has an equivalent vertical modulation slant C which is smaller than the recording angle B by the amount of a springback angle S, which is commonly 20 deg. This explains why a Westrex cutter with a 23-deg. recording angle produces a modulation slant only one-tenth that amount. It has been determined experimentally that the cutter must be inclined by an additional 14 deg. to end up with a 15-deg. modulation angle. The adjustment of cutting angle is made conveniently by adding a 14-deg. wedge to the cutter mount, and using a special stylus with 14-deg. tip orientation, as shown diagrammatically in *Fig.* 4. A new test record, the STR-111, was recorded in this manner and demonstrated at the 1962 Fall National Convention of the Audio Engineering Society. The resulting modulation slant of the STR-111 is just about 15 deg. The square-wave modulation now has the desired sarcophagus shape shown by the photomicrograph in *Fig.* 5. In this manner a method for producing the modulation slant prescribed by the RIAA has been achieved.

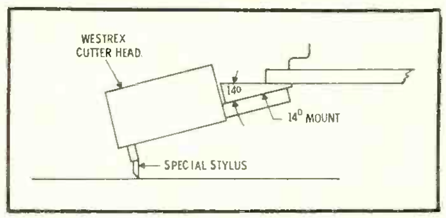


Fig. 4. Modifications of the Westrex cutter for producing a 15-deg. modulation angle.

It should be said in passing that actual measurements of modulation slants are not easy to make, and this may account for the fact that the springback effect had not been discovered previously. We believe that the most meaningful and convenient way of measuring modulation slant (as well as the pickup tracking angles) is by use of intermodulation test bands as in the STR-110 and STR-111 test records, as described below.

Implications of Modulation Springback

The discovery of springback in stereophonic recording has certain extremely

(*Continued on page 46*)

Receiver with Transistors Plus Tubes

WILLIAM CORNELL*

Hybrid sets can combine the best of tubes and transistors.

When an individual enters a situation in which a majority of the existing problems have previously been solved, it is referred to as being "handed to him on a silver platter." The transistor would, indeed, appear to have been handed the entire audio industry "on a silver platter," the problems of experimentation and development of audio circuitry having been solved many years prior to the commercial availability of the semiconductor. The transistor, during its slightly more than a decade of existence as opposed to more than a half century for the vacuum tube, appears to represent the most significant advance in electronic component conception since the introduction of the control grid into the DeForest and Fleming valves. The principal reasons for the rapid advancement of transistors into audio circuitry, without undergoing years of development, are obvious: The electron tube represented a new product heralding a new era of scientific achievement; new conceptions of tube design had to wait until the then-unknown circuitry was perfected. Indeed, until a need even existed for such circuitry. The transistor, on the other hand, does not have to wait for lengthy audio circuit experimentation. The circuitry has been developed.

The question now arises: In what applications should the transistor be employed, and why? The precise answer may vary according to many factors, but it is necessary to consider the following questions prior to developing any new transistorized device designed to augment or replace an existing component which employs vacuum tube circuitry:

Will the transistor function as well?
Will it function *better?*
Does it possess advantages, in a given application, greater than those of the vacuum tube?

In many cases, the answer is affirmative: The transistor may provide longer life with better performance while simultaneously enabling the designer to make use of considerably less demanding requirements for power, physical space, and maintenance. In the audio field, rather unfortunately, it would seem that the thought of an improvement in quality, by means of transistorized circuitry, has been somewhat overshadowed; emphasis seemingly has been placed primarily on the minimal requirements for space and power. In many instances these assets are valuable (as in the case of the prolific manufacture of miniaturized radio receivers, transmitters, and recorders) wherein *quality* of sound is *not* required and may be sacrificed for the needed advantages of light weight and minimal power requirements. In other instances, however, the transistor has been employed in alleged "high fidelity" amplification circuits wherein quality has *again* been sacrificed, seemingly without reason, in order that a unit of small size, light weight, and low power requirements might be produced. Why these latter considerations should take precedence over the principal requirements of high fidelity in a device designed for *permanent* installation is open to lengthy debate.

Fig. 1. The Altec Lansing Model 351A transistor amplifier. The dimensions are only 5 × 10 × 8 inches and it weighs less than 15 pounds.

In the field of *voice* communication, minimal space and power requirements are, obviously, of greater importance than wide range and relatively high power; it is in this field that the transistor first found greatest acceptance as an audio device. Units measuring less than 2 × 2 × 6 inches produce a gain of 39 db over an unusually wide range of audio frequencies, yet the total operating voltage needed is less than 26 volts; the total current requirement, 20 milliamperes. The time-honored and invariably cumbersome 130-volt supply is thus eliminated; the performance of the unit is superior in all respects to previous vacuum tube devices employed in telephone circuitry. As an inherent "fringe benefit," these transistorized repeater/compressor amplifiers generate a negligible amount of heat while enjoying a life span approaching infinity, hence they may be installed in almost any type of housing as problems of maintenance are virtually eliminated. These units are precision devices; their specifications do not vary beyond governmental laboratory standards. Here, then, is a prime example of proper design and usage of transistorized circuitry; no qualities have been compromised; most qualities have been markedly improved.

At Altec Lansing it is believed that, although transistors are not the universal panacea many claim, enough benefits exist to warrant serious study and experimentation into the fields of all-transistor and partial-transistor circuitry design of professional-quality audio equipment. The basic premise is simple: Design and manufacture an audio amplifier of relatively high power, wide range, and low distortion which will satisfy the professional user. The first amplifier of this type, the Altec 351, is shown in *Figs.* 1 and 2. The 351 delivers an IHFM power output of 50 watts (40 watts at less than 2 per cent THD) over the fre-

* *Altec Lansing Corp., 1515 S. Manchester Ave., Anaheim, California.*

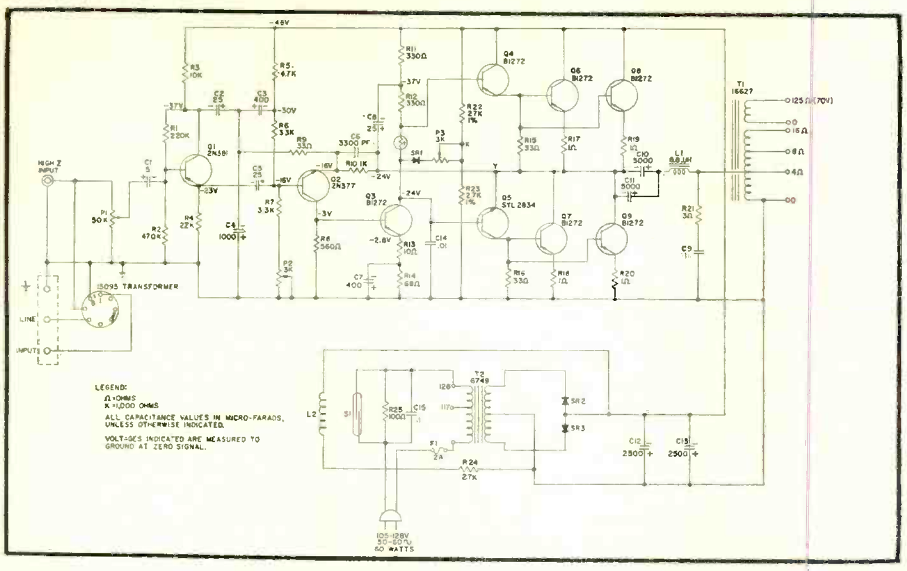


Fig. 2. Schematic of the Model 351A.

quency range from below 20 to above 20,000 cps, yet the unit measures less than one cubic foot and weighs less than 15 pounds. (Although small size and light weight were not immediate design considerations, as previously discussed, the benefits of each may be readily recognized.)

Thus the practical application of transistorized circuitry was applied with notable success; it then became the opinion at Altec that a unit might be made available for the "home" consumer which utilized similar advancements in transistorized circuitry for high power and low distortion incorporating all the needed features of a complete high-fidelity receiver-amplifier and control center. Such, then, was the beginning of the 708A "Astro" (see *Fig.* 3), wherein it was determined to *retain* all the advantages of vacuum-tube circuitry, yet utilize the most recent developments in transistorized circuitry. The entire AM and FM receiver sections of the 780A utilize vacuum tubes (in this case, of the frame-grid type) for optimum performance. Transistorized r.f. circuitry was found to offer no advantages (as opposed to vacuum tubes) which would compensate for the notably greater construction difficulties, and attendant price increase for the finished product, which would have attended the manufacture of a completely transistorized unit.

The Circuit

Because the Astro is a complete control center for stereophonic reception and amplification, the audio section is, obviously, comprised of two identical channels, from input jacks to output terminals; for somewhat greater ease of discussion, only the left channel (Channel A) will be described. The first audio stages, for preamplification of low-level signals from a tape head or magnetic disc reproducer, are transistorized. Transistors were chosen for this specific purpose because of the large amount of low-frequency amplification (equalization) necessary to compensate for the various amounts of bass attenuation characteristic of tape and disc-reading procedures. An electron tube, because of its heater-cathode arrangement, may induce unwanted line-frequency hum in either its fundamental form of 60 cps or (if d.c. is employed on the tube filaments) in an harmonic multiple of this frequency, necessitating elaborate and costly filtering circuitry. The transistor input stages eliminate the need for extensive filtering as there is, obviously, no heater-cathode arrangement with which to contend. Maximum efficiency with minimum power requirements are thus obtained with these units (2N35's) in addition to freedom from vacuum tube microphonics and variations in operating characteristics due to aging.

The 12AU7 (*V603*), shown in *Fig.* 4, serves as a split-load phase inverter, providing zero gain, but producing the two signal voltages, 180 degrees out of phase, necessary for driving the output stage in push-pull. These signal voltages are then fed to the input of a special low-voltage dual triode (ECC86/6GM8; *V604*) having unusually low plate resistance and impedance while performing as a relatively high current-amplification device—an excellent driving source for the transistorized power output stage. *V604*, incidentally, obtains its operating voltage from the same 20-volt source as the power transistors themselves. The center-tapped choke (*T601*) is also of special design, having bifilar windings of matched resistance to provide a portion of the proper forward bias voltage for the transistor output stage by means of the voltage drop from the vacuum tube plate current. The remaining forward bias is supplied by the thermistor (*T*) which, because of its temperature compensation characteristics, permits progressively smaller amounts of current to flow as the current drain (caused by the increasing amounts of self-generated heat from the transistors) increases. Because the thermal dissipation of the transistors is dependent on the amount of bias present, therefore, the limitation of the bias current—in proportion to the amount drawn because of self-heating—reduces such thermal dissipation and serves as an additional limiting factor to prevent transistor failure. The close coupling provided by the bifilar winding causes both sections of the driver tube (*V604*) to contribute equally the drive power required by the individual class B output transistors.

Both sides of the tube, therefore, are driving one side of the output circuit at all times, dependent upon the phase swing; greater driving power is thus obtained with no additional circuitry. The entire driver stage is thus used for either side of the transistor output, supplying signal voltage to the base of the 2N381 transistors (*Q601, 602*). Each 2N381 is, in turn, connected to a power transistor (34235; *Q603, Q604*) in a Darlington compound circuit, providing an extreme increase in the input resistance of *Q601*

Fig. 3. The Altec Lansing "Astro" AM-FM Stereo receiver.

and *Q602* as seen by the vacuum tube driving source. The Darlington compound circuit is, essentially, two or more transistor collectors tied together with the emitter of the first directly coupled to the base of the second. Power transistors, such as the 34235, have an inherently low input impedance and require considerable input power for satisfactory driving; in addition, the load presented to the driving source is extremely nonlinear because of the very characteristics of the transistor itself (i.e., as the applied voltage varies, the output current of the transistor does not vary proportionally). The higher the input impedance of the transistors, the greater the linearity of the circuit; with the Darlington connection, the input impedance of the power transistors is raised to a figure approaching 100 times that of either transistor individually, resulting in excellent linearity and outstanding stabilization. In addition, although the greater portion of the signal load is carried by the 34235 power transistors, the 2N381 units provide *additional* peak power when required.

The extreme increase in input impedance from the Darlington method of connection occurs because of the inherent characteristics of the semiconductor itself, wherein the short-circuit current-transfer ratio (i.e., collector current *versus* emitter current) of the compound circuit is equivalent to the sum *minus* the product of the ratio of each transistor separately. The input signal to the power transistors equals unity *minus* the short-circuit current-transfer ratio of the 2N381 transistors, *multiplied* by the current entering these same transistors. As the variation of the input current to a 2N381 *increases,* the collector-versus-emitter current of this transistor is *reduced,* causing more current to flow to the 34235 power transistor. The total output current is, therefore, the sum of the collector currents of the 2N381 and 34235 transistors. It should be mentioned that the collector-versus-emitter current ratio of the Darlington arrangement is also considerably greater than the ratio of either transistor separately—approaching the desired 1:1 value. As the amount of one approaches that of the other, the power gain of the circuit (essentially an impedance gain) is increased to a point approaching the aforementioned multiple of 100. The stabilization of such a circuit is outstanding, one transistor stage automatically compensating the other for nonlinear characteristics.

Feedback, in push-pull, is then coupled from the output circuit to the cathode of each section of the *V604* driver tube, so that the active side of the class B output is, in turn, fed back to the active side of the driver circuit.

The Output Stage

A transistorized output stage has the property of being able to work into the low impedance of a loudspeaker voice coil. This provides for an output-transformer-less coupling arrangement, if but a single output impedance is required. When it is desired to work correctly into speaker loads of varying impedance, however, some form of coupling arrangement must be made in order to avoid severe power loss with attendant distortion. Many transistorized output stages attempt to operate OTL outputs into loads of varying impedance by adding resistances; this serves to effect a proper match but does not remove the power loss, which in some instances may exceed 50 per cent! To prevent such an occurrence, the circuitry of the Astro incorporates a special autotransformer, designed by the Peerless Transformer Division of Altec Lansing, whereby loads of 4 or 8 ohms may be properly matched to the output stage with minimal power loss. An autotransformer was selected for this purpose for several reasons: First, because the ratio of the transistor

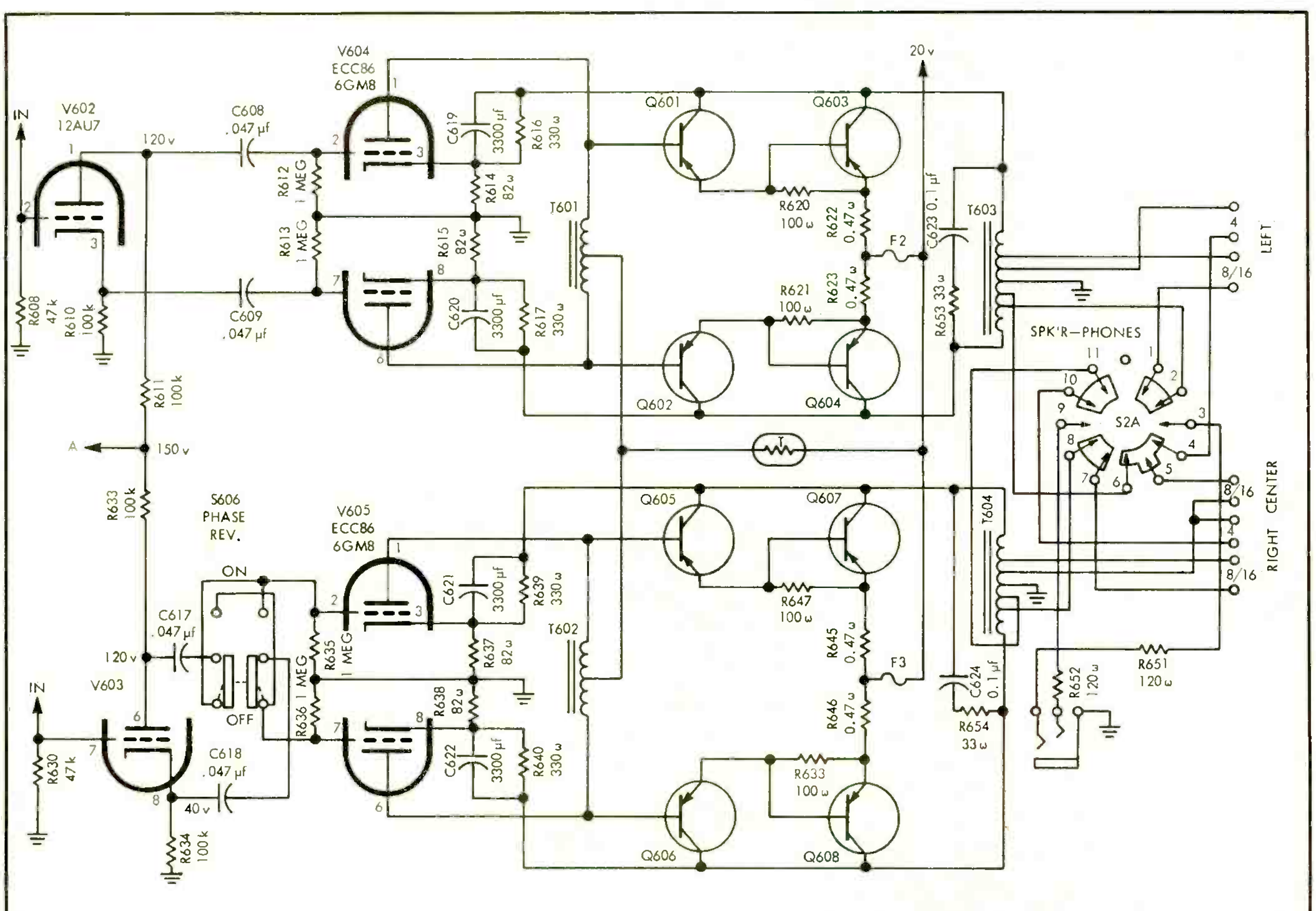


Fig. 4. Schematic of the output and driving stages of the "Astro."

output impedance to the proper load impedance of the voice coil is relatively low, the autotransformer is able to operate well within its limits of tolerance as a matching device (autotransformers are ideally employed when the impedance ratios involved are not too large); secondly, the leakage-inductance loss between the primary and secondary windings of a conventional output transformer is avoided, resulting in higher efficiency and better response; third, the autoformer is a relatively small device, compared to a standard output transformer of equivalent high quality, capable of handling full power at 20 cps—hence both the cost of the transformer and the cost of providing a larger area in which to mount it are spared the consumer without any compromise in the final sound quality.

All speaker lines of the Astro are balanced to ground, both for the well-recognized optimum performance and minimum inductive pickup of unwanted signals; the grounded center tap effectively cancels the transmission of d.c. to the speaker voice coil, and also eliminates any magnetization (saturation) of the transformer itself.

The pilot models of the Astro as originally conceived and designed, afforded amplifier output impedances of 8 and 16 ohms. It was found, however, as testing progressed using loudspeakers of various manufacture, that the *rated* impedance of these transducers was often at considerable variance with the *actual* impedance, in regions within the reproduced frequency range. With vacuum-tube circuitry, this has always been a point of concern but was never recognized as a major problem, the principal indication of such a situation being the reduced life of the output tubes; with power transistors, impedance mismatch is far more hazardous. As the internal impedance of the transistor is approached, the self-generated heat, caused by the increasingly greater amount of current drawn, reaches a point where the transistor can no longer withstand it; when this occurs, the transistor usually destroys itself in a fraction of a second. To a power transistor, an incorrect match between output circuitry and load may be considered a "partial" short circuit with the margin of safety dependent on two things: The self-generated temperature rise produced by such a downward variance from the required impedance, together with the ambient temperature surrounding the transistor itself. The thermal dissipation of the transistor caused by an increase of d.c. power in the output circuit which changes the division of power between the load and the output transistors, is, therefore, dependent *both* on the measures taken to *remove* such heat, together with the ambient temperature under which the transistors must operate. The margin of safety is dependent on these two items, the first of which depends on the amount of power by which the transistors are driven.

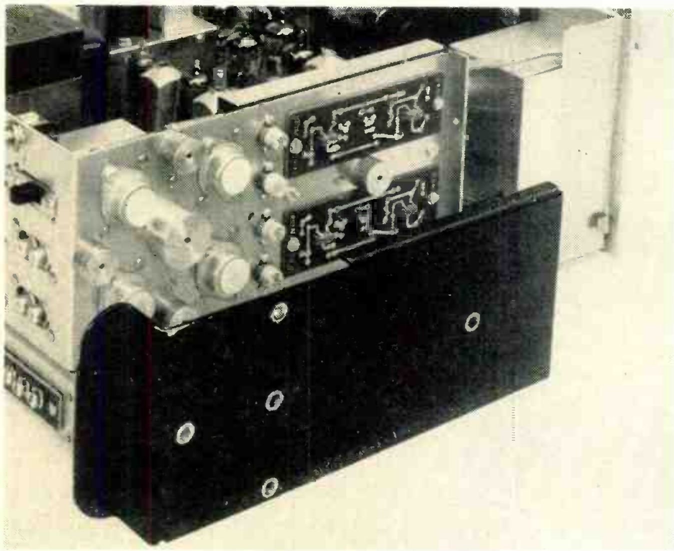


Fig. 5. Closeup of the transistorized stages of the "Astro." Input transistors, together with associated printed circuitry, are on the right; the driver transistors are mounted in a vertical line in the the center; the four power transistors are at the left. The large metal spaces transmit heat to the large black heat sink (shown removed).

A transistor itself has virtually no provision for heat dissipation, therefore some external means must be provided for the removal of any increase in heat, potentially injurious to the semiconductor element. One of the most effective means of increasing the capabilities of transistors to withstand increased thermal dissipation without failure has been the use of a conductive mounting or "heat sink." This device, literally no more than a small metal sub-chassis upon which the transistors are mounted, is shown in the photograph, *Fig*. 4; its purpose is to remove the self-generated heat from the transistors during operation. Such an arrangement was found to perform most satisfactorily under all normal conditions. The heat sink used is comprised of two small metal plates; the transistors are mounted on the first section which is then coupled to the second by large metal spacers for maximum thermal conductivity. The second section (removable, as shown) is dull black to effect the greatest amount of heat radiation from the transistor mounting flanges; additional ventilation is provided by convection through the space between the two heat sinks.

It should be mentioned at this point that the heat sink is also employed for another purpose, in addition to preventing the transistors from destruction due to both self-generated and ambient heat: The operating characteristics of a transistor are adversely affected by a temperature rise, thus a power transistor having a rated output of (e. g.) 50 watts at 25-deg. Centigrade might well derate itself to less than 10 watts, should the mounting flange temperature double, regardless of the cause. The heat sink, then, is a most important facet of transistor amplifier design—and the engineering of the illustrated heat sink is an integral factor in obtaining a power output of over 27 watts per channel from the unit without risking transistor damage from thermal dissipation, under conditions of normal operation. (The figure of 27 watts per channel, IHFM measurement, was obtained at *normal* operating temperatures—*not* at 0-deg. Centigrade!) We have now discussed the various methods employed to remove heat from the transistors in order to increase both life expectancy and performance. To correct the *immediate* cause of the self-generated thermal dissipation so that no additional measures are needed with regard to the removal of heat from the transistor output stages, the following was undertaken:

It has long been recognized that loudspeaker impedance varies with frequency—a characteristic which, as mentioned, creates *comparatively* less of a problem with vacuum tube circuitry. With the thermal dissipation qualities of the power transistor, however, any variance *downward* from the matched impedance causes the transistor to draw progressively more current, generate more heat, and eventually destroy itself. Impedance curves were taken of several loudspeakers of different manufacture; few maintained their rated impedance throughout the range of audio frequencies reproduced. One unit, rated at 8 ohms, showed an actual impedance of $2\frac{1}{2}$ *ohms* at that portion of the sonic spectrum between 8 and 12,000 cps; obviously, if power transistors were properly matched to this "rated" 8-ohm speaker, a short circuit would develop whenever a high-frequency component was in the signal. It


CITATION A

is for this reason that the original 8- and 16-ohm output taps of the pilot models were changed to the present 4 and 8/16 ohms; in this manner, the chances of the transistors seeing a major short are considerably lessened. As a final measure of protection, a fuse (F_2) was inserted in the B + supply to each power transistor; the value of the fuse was calculated so as to disconnect the emitters of the 34235's from the current supply immediately an unusually high increase in current drain occurs. The fuse, a standard 2-ampere 3AG type, readily available, has been found to furnish protection to the transistors even under conditions of a direct short circuit in the power output circuitry—protection of paramount necessity where power transistors ("the fastest fuses in the world" when the calculated margin of safety is exceeded) are employed. It is because of this factor, the variance of impedance with frequency, that loudspeaker manufacturers must give greater attention to speaker voice-coil design; for the present, transistor amplifier users must be certain that the *minimum* impedance of the speakers used does not drop *below* the impedance of the output tap to which such reproducers are connected.

Prior to making an evaluation of the unit as a whole, some mention of the design parameters utilized by the Altec engineers should be made; these, generally, assume the form of problems, inherent to the existing circuitry, which "must be solved" if the unit is to function as originally conceived on the proverbial drawing board. There existed two major items of concern, each directly related to the inclusion of transistors in the power amplifier circuitry; the first is the problem of coupling the traditionally high-voltage, hi-Z vacuum tube to the low-voltage, low-impedance transistor. There are, basically, only two problems paramount in the design of a combined (hybrid) transistor-tube circuit:

1: The effect of heat generated by the vacuum tubes, on the transistors, and the *control* of this heat generation (control and effect of *self*-generated heat from the transistors themselves having been covered earlier): Actually, this presented little cause for concern because of the relatively large area enclosed by the chassis and/or case, together with the fact that no vacuum tube power output stages are employed and silicon rectifiers are utilized in the power supply. Two prime sources of heat are, therefore, almost totally eliminated, the total vacuum tube wattage (created by the r.f. and audio tubes) being minimal.

2: Effecting a correct "match" between the high-impedance vacuum tube and the low-impedance transistor: The vacuum tube (6GM8/ECC86), coupling the intermediate vacuum tube stages of the audio amplifier to the driver transistors, is of special design, permitting operation from a relatively low-voltage power supply. Because such low-voltage operation is possible with this particular type of tube, current characteristics are provided which are not too dissimilar from those of the driver transistors themselves—hence we find a "matching device" closely approaching the ideal: a tube which presents the required *infinite-impedance grid* to the preceding *tube* audio stages, yet providing a *low-impedance driver source* needed for the 2N381 driver transistors.

Incidentally, it is because of this low-voltage 6GM8/ECC86 that the same power supply may be employed for both it and the transistorized output stages; therefore, the necessary polarity reversal is already present, permitting direct coupling between tube and transistor (which, in turn, facilitates the generation of the necessary forward bias for the transistors by means of the voltage drop across the coupling choke and the thermistor).

The low-voltage power supply itself represents yet another "design parameter" because of the comparatively high degree of regulation required as opposed to vacuum tube stages. The low-voltage supply, powering both the transistorized output stages and the 6GM8, possesses extremely good regulation, due to:

1. The inherently low forward voltage drop of the silicon rectifiers used; and

2. The unusually high margin of safety of these rectifiers (rated at 18 amperes apiece, or a total of *36 amperes,* of which only *4 amperes* are drawn at *full output* with both channels in use); and

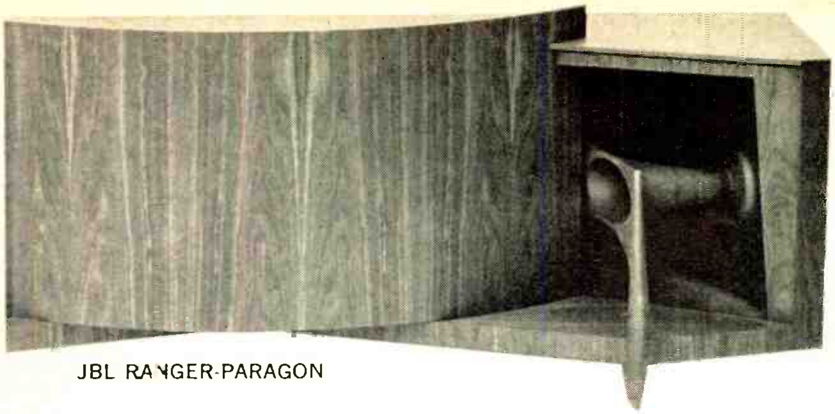
3. The extremely large amount of capacitance used in the low-voltage supply (a total of *10,000* μf is employed for maximum filtering and regulation!).

The maximum output of the low-voltage supply is approximately 21 volts at zero signal level—dictating the voltage rating of the driver and output transistors. The low-voltage supply drops to about 17 volts under conditions of a continuous (sine wave) signal, thus the continuous power output rating of 20 watts per channel is obtained (at 1 per cent distortion). The difference between this *continuous signal rating* and the *IHFM rating* of 27.5 watts per channel could well be expressed as the result of the power loss, owing to some lack of perfect regulation of the power supply input.

Since the latter subject is at hand: All stated measurements—both those contained in this article, together with the additional specifications contained in the various pieces of published material pertaining to the unit under discussion—were taken in the identical manner (and, in most cases, on the identical equipment) used for laboratory checks on vacuum tube components meeting professional broadcast and recording standards. No leeway was permitted, merely because the unit described utilized a transistor output stage for each channel.

This, then, represents a brief description, from inception to achievement, of the unit. The hybrid tube-transistor audio stages provide adequate power to drive even inefficient speaker systems at a substantial level with no sacrifice in range and transient response, and with minimal amounts of IM and harmonic distortion. The latter is, in part, due to the exceedingly small inductance required in the output-coupling autoformer to properly match the loudspeaker load. For those who might tend to think of the Astro as "another package unit," bear in mind the fact that, were equivalent vacuum-tube circuitry employed in the preamplifier and power amplifier stages, the entire component would require approximately *twice* the present dimensions (less than a cubic foot) and at least double the weight, together with an operating temperature which would prevent hideaway custom installation.

It has long been the custom, at the conclusion of articles regarding the new application of a recent product development, to speculate somewhat on the future of the product itself. The author does not intend to imply that "pretty soon, everyone'll be using transistors..." (nor, for that matter, that everyone will be using the 708A!). Vacuum-tube audio circuitry continues to undergo notable experimentation and continued refinement. Perhaps the argument of tubes versus transistors closely resembles the heated contests of the 1920's between the gasoline and steam engines—each is superior in its own right for a given purpose; each is equally impractical when little attention is paid to correct usage. This is representative of that which Altec engineering has attempted in the Astro—the application of two electronic components, the one complementing the other. Transistors are not the compleat answer to the Unanswered Audio Question, no more than the steam engine represented the final transportation advancement over the horse drawn carriage, but—as have the vacuum tube, the Armstrong Circuit, the condenser microphone, the dynamic loudspeaker, and their multitudinous cousins all contributed—so will the transistor. Whatever proper means are used, there can be but one effect: Good Sound. Æ



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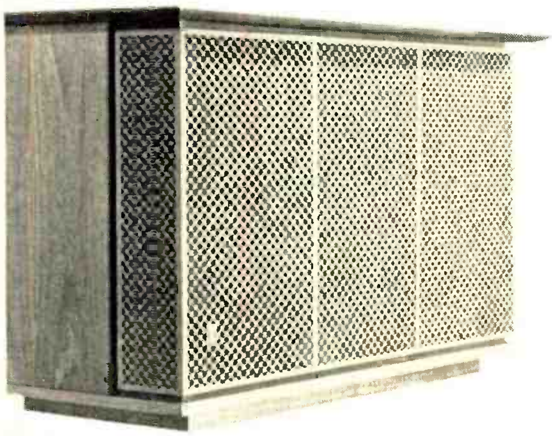

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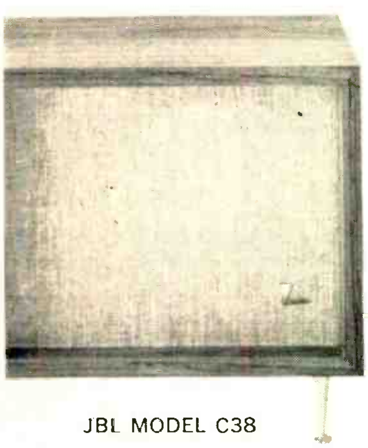

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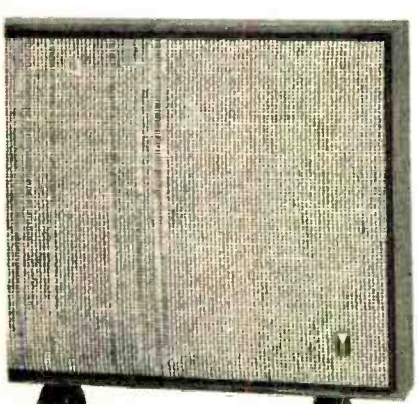

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A. M. SEYBOLD*

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The setup shown in *Fig.* 1 is used for all types of organs and pianos. In the tuning of electronic organs, however, the speaker voice-coil voltage is preferable instead of the microphone. If audio tones are to be minimized when the organ is being tuned, the loudspeaker can be disconnected and a 5- or 10-ohm resistor clipped in its place.

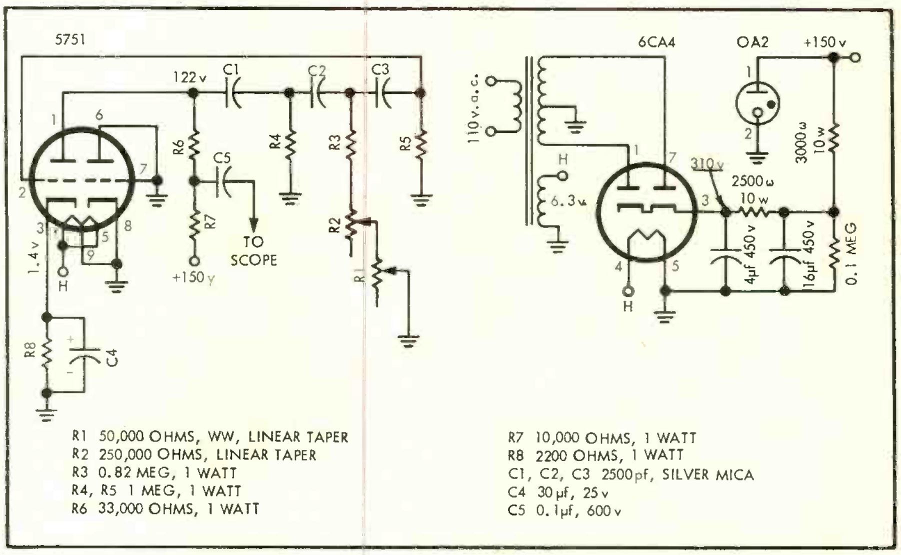


Fig. 2. Circuit of the tuner-oscillator and power supply. Oscillator stability is improved by the use of a premium-type 5751, by voltage regulation from the OA2, and by separation of the oscillator from the power-supply. This latter precaution minimizes temperature drift.

General Procedure

Briefly, the general procedure for tuning is as follows: First the 220-cps "A" of the organ is synchronized with 60 cps from the line. This "organ A" then becomes the reference frequency to which all other tones in the scale are tuned. The tuner-oscillator is connected to the external-sync input of the scope, and its frequency is set at 27.500 cps. The 220-cps "A" is played, and the range-setting knob of the tuner-oscillator is varied until the pattern on the scope synchronizes, and shows exactly eight stationary sine waves. This pattern establishes the oscillator check point. The note "G#" (415.305 cps) is then tuned by setting the oscillator to 27.687 cps and tuning the organ "G#" until a scope pattern which contains exactly 15 sine waves remains stationary. The note "A#" (466.163 cps) is next tuned by establishing a 27.421-cps oscillator setting and 17 synchronized sine waves. The remaining eight notes of the scale are tuned by the same method.

If the instrument being tuned is an electronic organ of the divider type, tuning as described above is all that is required. If all tones must be tuned separately, however, as in the case of pipe or reed organs, pianos, and some electronic organs, the tuned notes are used along with the scope to tune the related notes of the remaining octaves. Both the simplicity and accuracy of this electronic tuning system depend on oscillator control through a very narrow but accurately calibrated range of frequen-

* *Electron Tube Division, Radio Corporation of America, Harrison, New Jersey*

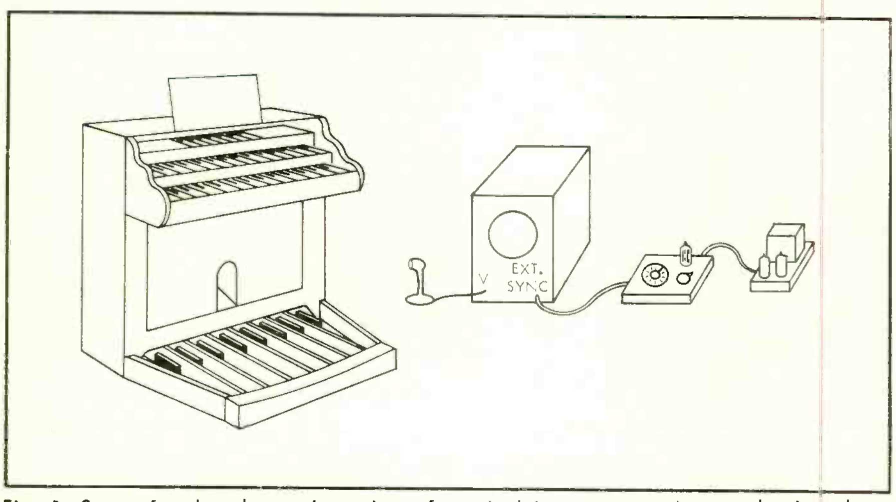
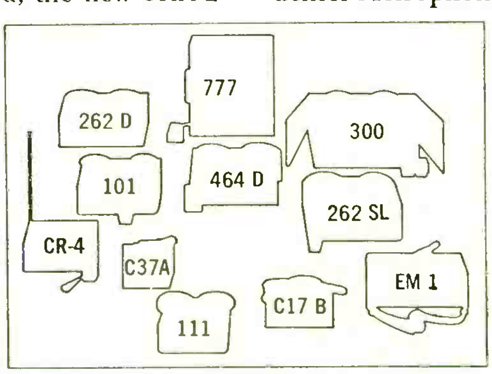


Fig. 1. Setup for the electronic tuning of musical instruments. A crystal microphone connected to the vertical input of the oscilloscope picks up a single tone from the organ. The scope is synchronized by the tuner-oscillator, which is powered by the regulated supply on the right.



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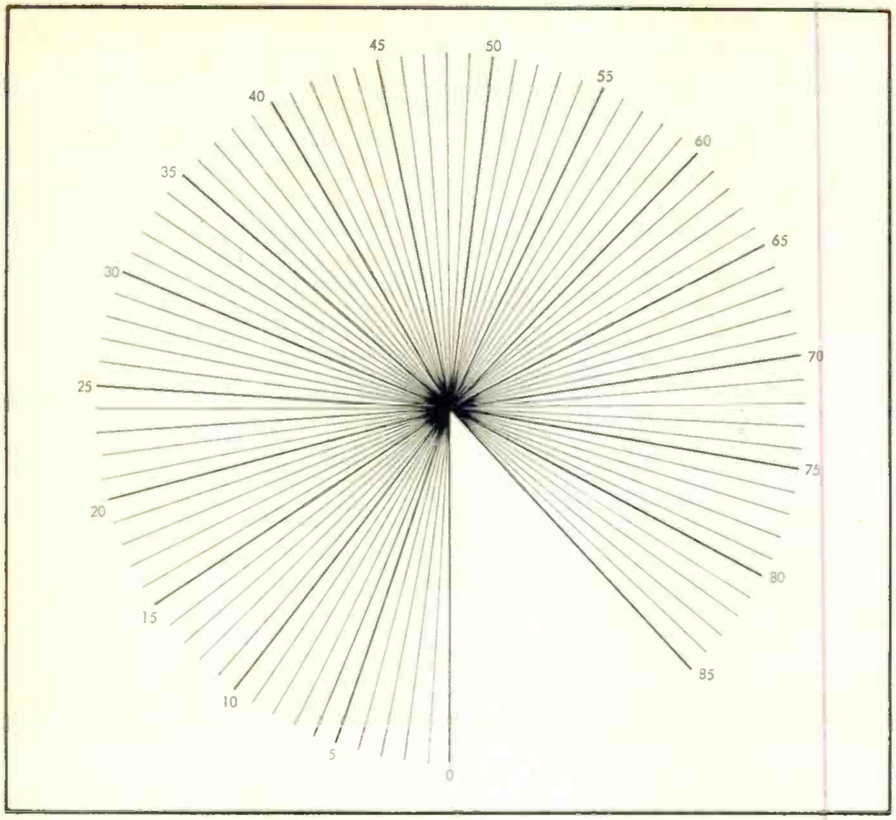

Fig. 3. Dial face for the tuner. A reproduction of this figure should be carefully prepared and applied to the tuner-oscillator panel. A hole should be made at the exact center for the shaft of R1, and a large-diameter knob used with a sharp pointer.

cies. Although the oscillator range is only 0.4 of a cycle, it is divided into 80 dial divisions, each of which can also be visually divided. In addition to stability the tuner-oscillator must have frequency-controlling components that can be calibrated accurately with available equipment. The circuit diagram shown in *Fig.* 2 meets these requirements; the only additional equipment required is a clock or watch having a second hand.

Construction of the Oscillator.

Because the oscillator is built on a chassis separate from the power supply, most parts that dissipate heat are kept away from the frequency-controlling components and thereby minimize frequency drift. For this application, a phase-shift oscillator is used because it is inherently stable, consists of standard parts, and functions well at low frequencies. In addition, a linear variable-resistance element can be used with this oscillator to determine small frequency increments accurately.

Capacitors C_1 to C_3 and resistors R_1 to R_5 comprise the frequency-controlling phase-shift network. Variable resistor R_1 has a linear taper. Although R_2 does not necessarily have to be linear, linearity is helpful in setting up the oscillator range which is controlled by R_2. The layout of the parts is not critical, but enough panel space should be provided around the shaft of R_1 to accommodate a dial face. (This face can be copied from the one shown in *Fig.* 3 if great care is taken in making an accurate copy. Otherwise cut out *Fig.* 3 and paste it to the panel.) The dial for R_1 should have a pointer sharp enough to permit reasonable estimations (tenth of a division) on the dial face.

After the oscillator and the power supply are wired and the circuit is functioning, the oscillator range should be checked. Connect the oscillator output to the "external sync" terminals of the

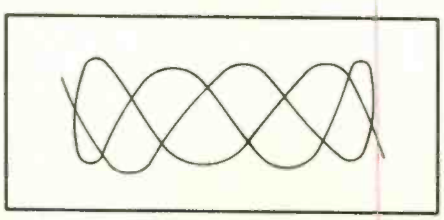

Fig. 4. Pattern obtained when the organ A is tuned to 220 cps and when a 60-cps signal from the a.c. line scans the scope horizontally. The identifying features of this pattern are the six central areas, each bounded by three sides.

oscilloscope. Use a microphone pickup from a piano or organ, or a direct pickup from the speaker of an electronic organ, and feed the "vertical input" of the scope with a 220-cps musical "A". The notation for this tone is "A3"; it is the pitch of the third "A" above the first "C" at the left end of a standard piano keyboard. (In the case of organs, a more customary notation for the note would be "23", the number of the playing key which is reached by counting from the bass end of a standard 61-note clavier.) Sound the A3, and set the oscilloscope frequency knob in the vicinity of 27 cps. Adjust the external sync-signal gain control (called sync sensitivity control on some scopes) so that the external oscillator controls the scope frequency.

Set the tuner-oscillator dial at 36.0. Vary the range knob (R_2) from minimum to maximum resistance while watching the A3 pattern on the scope. If a pattern containing eight sine waves can be held in synchronization at a setting near the center of the range knob, the oscillator is ready for calibration. If synchronization is obtained at the low-resistance end of the range knob, change R_3 from 0.82 to 0.75 megohm. If the sync point is too near the high-resistance end of R_2, change R_3 from 0.82 to 0.87 megohm by placing an additional 50,000-ohm resistor in series with the circuit.

If synchronization is not attained with the range knob, check the circuit for possible errors in the size of capacitors or resistors in the phase-shift network. The capacitor across the cathode resistor should also be checked, and the voltages should be within ± 20 per cent of those indicated on the circuit diagram. Variations greater than ± 50,000 ohms for R_3, R_4 and R_5 should not be needed to obtain synchronization between the tuner-oscillator and the 220-cps A3.

A synchronized pattern on the scope indicates that the tuner-oscillator is set at 200/8 or 27.5 cps. When this frequency is attained with the 36.0 oscillator dial setting and the range knob near a central position, calibration of the oscillator can begin.

Oscillator Calibration

The calibration of the oscillator dial should begin after the oscillator has attained temperature equilibrium (about a 1-hour period). Although the calibration precedure described below sounds complicated, it is really quite easy to follow. Because the equipment is calibrated only when it is first built, it is worthwhile to follow the steps below carefully to obtain accurate dial calibration:

1. Check the 220-cps A3 note from the

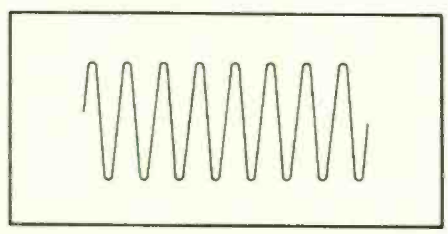

Fig. 5. Pattern obtained when scope is synchronized with the tuner-oscillator at 27.500 cps, and the organ A3 is tuned to 220 cps. In tuning organs, an 8′ flute stop is used to obtain a sine-wave pattern.

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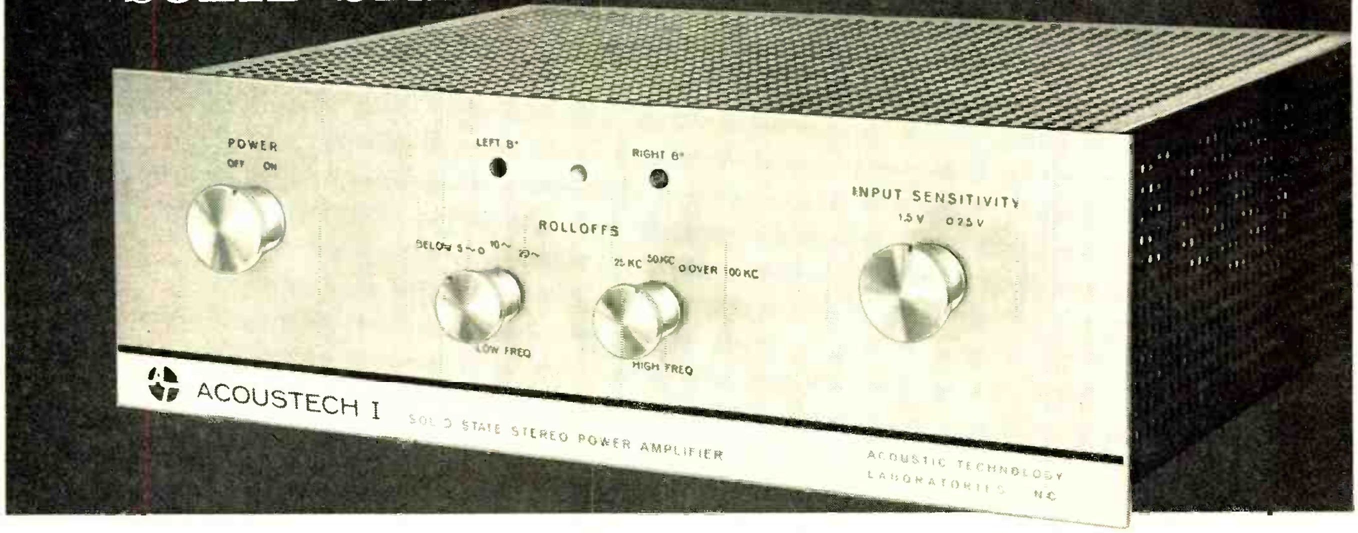

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". . . in its design and construction . . . resembles industrial or military equipment [see figure at right] . . . its circuits are assembled on glass epoxy boards [1] . . . each output stage uses four silicon power transistors which are mounted on large finned heat sinks [2]. A quick acting fuse [3] protects each output stage from damage caused by overdriving or accidental shorting of the output terminals."

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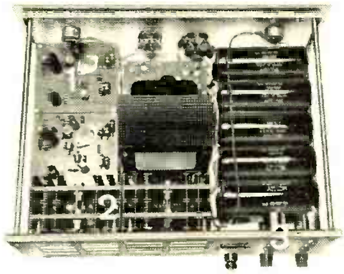

*Julian D. Hirsch, co-director of world famous Hirsch-Houck Laboratories, has long been recognized as one of the most reliable and discriminating experts in the field of audio testing. He was formerly associated with the highly respected Audio League, a testing organization known for its early recognition of significant new breakthroughs such as acoustic suspension loudspeaker systems.

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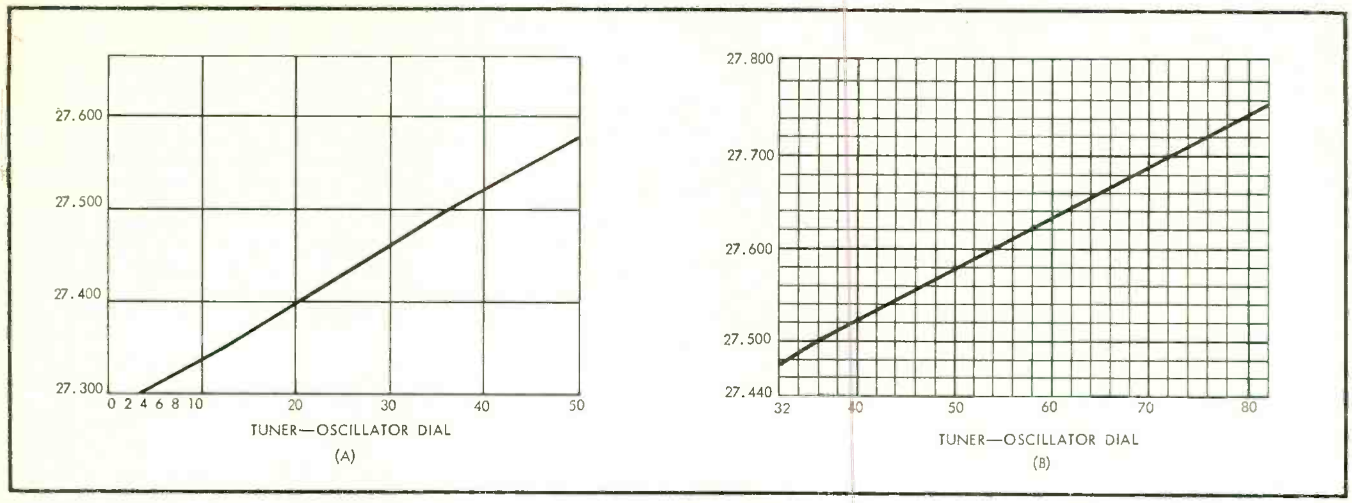

Fig. 6. Two sheets of 8-by-10-inch graph paper are used to plot the calibration curve for the tuner-oscillator dial. This expanded scale provides the definition required for accuracy to three decimal places at 27 cps.

organ by scanning the scope horizontally with a 60-cps sine wave.[1] *Figure* 4 shows what the pattern produced should resemble. If the pattern does not stand still, tune A3 in the organ until the correct pattern holds perfectly still. A3 is now tuned to 220 cps.

2. Connect the tuner-oscillator output to the "external sync" terminals of the scope. Set the scope frequency control near 27 cps and adjust the sync sensitivity so that the external oscillator takes over control of the scope sweep frequency. Set the tuner-oscillator dial pointer at 36.0. Play A3 and vary the range knob (R_2) until a pattern containing 8 sine waves (*Fig.* 5) is locked in. To establish closest synchronization, the return trace at the left end of the scope pattern should start the sine wave at the steep center of the slope, and not at the top or bottom of the sine wave. This setting of the range knob fixes 36.0 on the tuner dial as a 27.500-cps reference.

3. Set the tuner-dial pointer at 24.0. Play A3, and count the number of sine waves that slide past the end of the scope pattern in exactly 30 seconds. If these sine waves total 17, the change rate is 17/30 seconds, or 0.566 per second. Because there are 8 sine waves in the full pattern, then 0.566/8, or 0.071, is the number of cycles per second by which the oscillator deviates from the original 27.500 cps which synchronizes the pattern exactly. By subtracting the 0.071 cycle from 27.500 cps, a calibration point of 27.429 cps is established for 24.0 on the dial.

4. The tuner dial is then set back at 36.0, and A3 is played. If the pattern stands still, both the organ and tuner-oscillator are stable and thus retain their frequency control. If this check does not indicate stability, the range knob must be reset and Step 3 repeated.

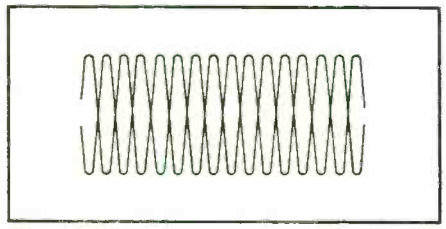

Fig. 8. Pattern obtained when D#5 is tuned at the dial setting for 27.656 cps. When tuned exactly, the starting points for the two traces at the left end of the pattern should stand still.

5. Set the tuner dial at 12.0. While playing A3, count the number of sine waves shifting past the end of the pattern in 30 seconds. If 35 waves pass in 30 seconds, the change rate is 1.166 per second. Dividing this rate by 8, the number of waves in the full pattern, results in 0.146 cycles per second. By subtracting this number from 27.500, 27.354 cps is established as the frequency for 12.0 on the dial. These figures equal those obtained in the calibration of the first model of the tuner. Although the numbers obtained in the calibration of similar oscillators will not be exactly the same, they will be equivalent, and can be used to plot the calibration curve of each oscillator.

6. After the 12.0 dial point is calibrated, recheck the 36.0 setting for stability as in Step 3. Repeat Step 5. if the range knob has to be reset.

(*Continued on page 59*)

[1] A similar method for tuning "A" from a 60-cycle line was presented by W. H. Meyer, Jr., in *Electronics World*, Dec., 1959. A line-synchronized sweep pattern was described in that reference as compared to the line-scan pattern used here.

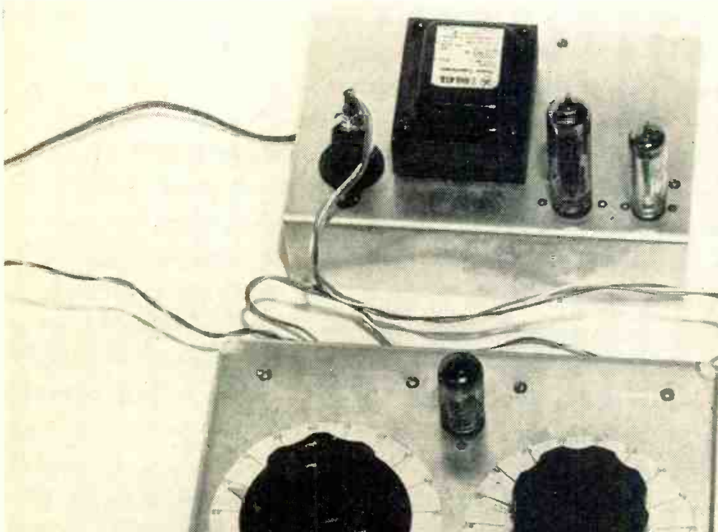

Fig. 7. Photograph of the tuner-oscillator and power supply.

TOTAL ENGINEERING / BUSINESS—COMMERCE—INDUSTRY

Today, with the battle for mens' minds reaching a feverish pitch, thought transmission in modern business is increasingly critical. For this reason, Electro-Voice is called in time and time again to contribute good, clear, crisp sound at moderate cost. From sales meetings to paging systems, from production control to audio-visual training, modern business today depends on Electro-Voice microphones to solve the most difficult communications problems—reasonably, quickly, permanently!

OMNIDIRECTIONAL MODEL 611 traditional styling, rugged construction, 50-9,000 cps, List $45.00. **MODEL 623** general-purpose slim dynamic, 60-12,000 cps, ideal for recording or PA, List $57.00. **MODEL 636** "Slimair" *dynamic, for finest PA and recording, 60-13,000 cps, List $72.50†. **MODEL 647** dynamic lavalier for hand, chest or stand use, 60-10,000 cps, gray enamel finish, List $82.50. **CARDIOID MODEL 664** dynamic Variable-D* element rejects sound from back, cuts feedback, 40-15,000 cps, List $85.00†. **MODEL 729SR** ceramic cardioid with relay control switch, ideal for paging, general purpose, 60-18,000 cps, unaffected by heat, humidity, floor stand adapter and desk stand provided, List $26.50. **SOUND SPOT* MODEL 644** unidirectional dynamic is most directional PA microphone available, 40-12,000 cps, "slotted-line" design cuts wind noise, List $110.00.

Hi- or Lo-Z available on 623, 636, 647, 664 or 644 by simply changing cable connections. 611 also available either Hi- or Lo-impedance. All models except 647 and 729SR use high-pressure die-castings with satin chromium finish.

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The swift and effortless flight of the fastest jets, the relentless struggle by police and fire departments against crime and disaster, the national safety in peace and war . . . wherever voice communications are vital, there you'll find Electro-Voice microphones specified because they transmit messages most clearly, despite noise, weather or abusive treatment. No wonder E-V microphones are chosen by the major radio and TV networks . . . prominent recording studios . . . aircraft, civil and military. But perhaps the ultimate proof of their quality is the use of E-V microphones by our U.S. astronauts. Nowhere else is E-V *TOTAL ENGINEERING*—a concept developed during 35 years of creative microphone design — more evident, or more needed. A constant re-evaluation of sound problems, plus exhaustive testing of new materials and techniques — that's E-V *TOTAL ENGINEERING* inherent in the more than 50 models designed for your every sound pickup need and shown on the following pages!

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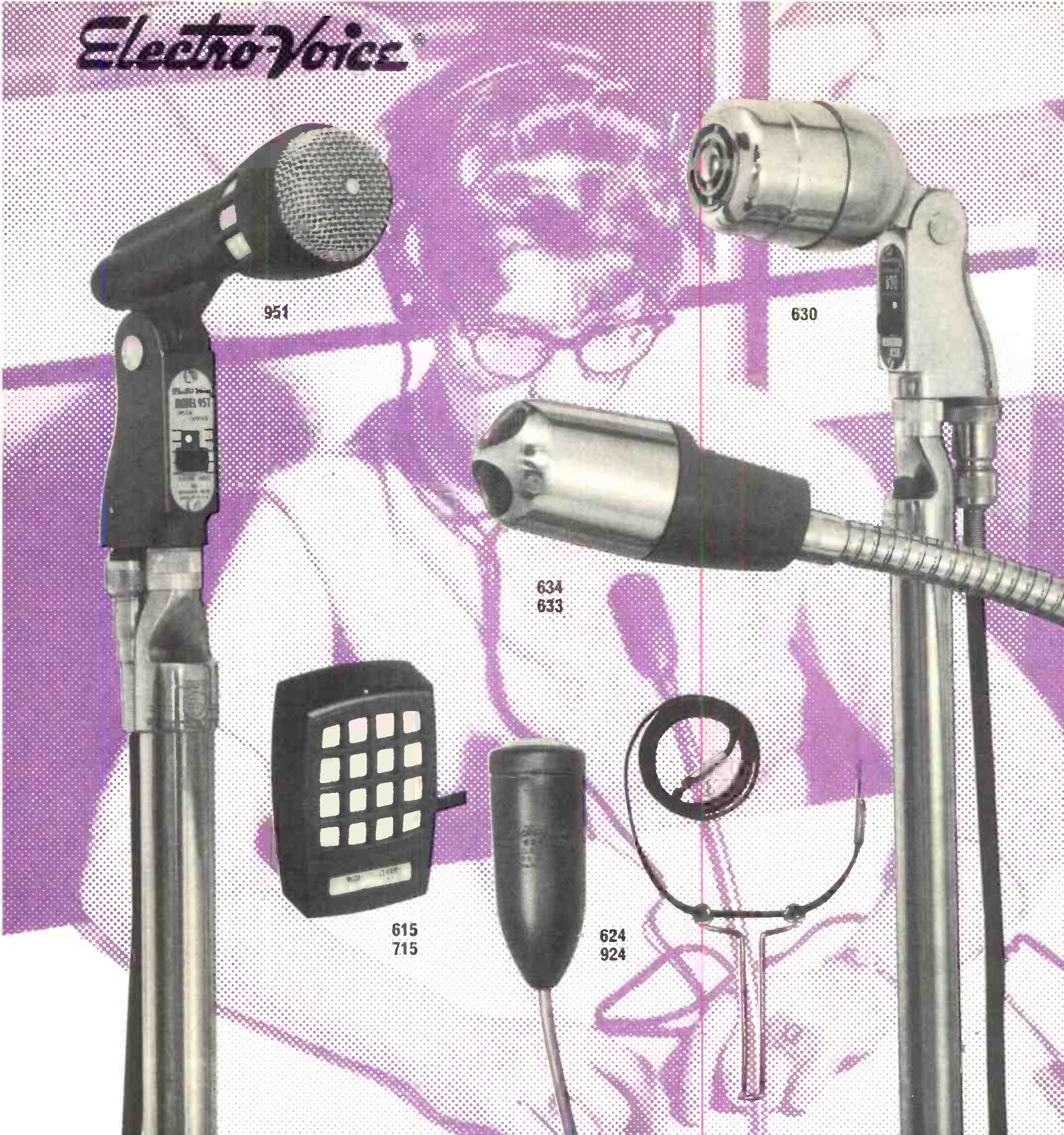
All E-V Professional microphones match any Lo-Z input (50-150-250 ohms), Hi-Z also available on 648. Complete list of accessory stands, clamps, windscreens, filters and Lo to Hi-Z matching transformers available. Microphones finished in non-reflecting gray epoxy finish (except 635). All Professional microphones unconditionally guaranteed for two years (except finish)—guaranteed for life against defects of material or workmanship.

Electro-Voice®



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In the classroom, in the auditorium and gym—and now, in the language laboratory—Electro-Voice microphones serve with the same distinguishing excellence that has earned E-V the "seal of approval" of every major TV and radio station in the United States. Despite accidental abuse and continual use, E-V microphones prove *Total Engineering's* ruggedness without sacrificing clarity of response—a real achievement proving the true economy of specifying E-V microphones for every application!

OMNIDIRECTIONAL MODEL 624 dynamic lavalier or hand-held model, 100-7,000 cps, Hi-Z or 150 ohm, List $42.50 (MODEL 924 crystal version, Hi-Z, List $20.00). MODEL 630 dynamic for general purpose recording and PA, 60-11,000 cps, Hi-Z or balanced Lo-Z, List $52.50. MODEL 634 dynamic for paging and language labs, 65-8,000 cps, Hi- or Lo-Z, List $31.50 (MODEL 633 for stand mounting, List $35.00). MODEL 615 dynamic economy recording model, 80-8,000 cps, Hi-Z or 150 ohms, List $25.50 (MODEL 715 ceramic version, Hi-Z, 60-7,000 cps, List $13.00, MODEL 715S with push to talk switch $15.00, MODEL 715SR relay-control switch, List $17.50). **CARDIOID** MODEL 951 crystal, lowest cost Variable-D* cardioid available, 50-11,000 cps, cuts feedback, reverberation, Hi-Z, List $54.50.

All E-V microphones except crystals are eligible for FCDA purchases.

A High-Quality Transistorized Stereo Preamplifier

ERHARD ASCHINGER

PART FOUR OF A SERIES

THE WAYS IN WHICH the required performance specifications of the equalizer can be realized and calculated in advance are illustrated below. For reasons of calculation convenience it will be necessary to derive a number of reasonably simple but nevertheless sufficiently accurate approximate formulas. For complete understanding of the derivations a few thoughts will be spent upon four-terminal network theory and feedback theory.

Only linear devices shall be used in all circuits. Thus, we may apply the law of superposition which says that each of a number of different influences upon a circuit may be considered separately, all others imagined non-existent for that moment. The linear superposition of the individual results then gives the desired result due to the sum of all influences upon that specific circuit.

Derivation of approximate formulas. For small-signal and low-frequency application the transistor may be considered as an active linear four-terminal network. Its behavior then is completely described by four independent, real parameters. The relationships between the input and the output terminals may be represented in a variety of ways. The following considerations will be based upon the $[h]$ matrix representation of the four-terminal network, since the h parameters are easy to measure, directly obtainable from the graphical transistor characteristics, and convenient to use in circuit design.

From the network equations, (referring to *Fig.* 15),

$$v_1 = h_{11}i_1 + h_{12}v_2$$
$$i_2 = h_{21}i_1 + h_{22}v_2$$

and the equations for the input and the output circuits

$$v_1 = -i_1 R_G$$
$$v_2 = -i_2 r_L$$

we can determine the formulas for input impedance, output impedance, and voltage gain of the network. We get

$$r_i = \frac{v_1}{i_1} = \frac{h_{11} + |h| r_L}{1 + h_{22} r_L}$$

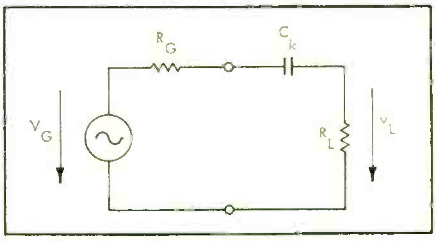

Fig. 15. Four-terminal network.

where

$$|h| = h_{11}h_{22} - h_{12}h_{21}$$

is the determinant of the $[h]$ matrix. Similarly we may write

$$r_o = \frac{v_2}{i_2} = \frac{h_{11} + R_G}{|h| + h_{22}R_G}$$

and

$$g_v = \frac{v_2}{v_1} = -\frac{h_{21}r_L}{h_{11} + |h| r_L}.$$

Up to now, no decision has been made as to the type of transistor connection. All the equations hold for any of the three possible transistor-circuit arrangements, provided that the appropriate parameters are used. Since in our case all stages are operated in common-emitter configuration, we have to insert the h_{ike} parameters, the subscripts e indicating the common-emitter connection. With small-signal transistors these h_{ike} parameters are normally furnished by the transistor manufacturer.

Common-Emitter Stage with Series Feedback

A common-emitter stage with an unbypassed emitter resistor may be considered a four-terminal network formed by the series coupling of two four-terminal networks, a normal common-emitter stage and a network consisting of R_E, as illustrated in *Fig.* 16. Due to the feedback caused by R_E the matrix $[h'_e]$ of the new four-terminal network will be significantly different from the $[h_e]$ matrix. To get the $[h'_e]$ matrix of the feedback amplifier we have to transform the $[h_e]$ matrix of the transistor stage into the corresponding $[Z]$ matrix, which has to be added to the $[Z]$ matrix of the four-terminal network formed by R_E. The resulting $[Z]$ matrix is transformed back into an $[h]$ matrix, which now is the desired $[h'_e]$ matrix of the composite four-terminal network.

Performing these tiresome transformations we get the h'_{ike} parameters of the common-emitter stage with series feedback expressed in terms of the h_{ike} parameters and R_E:

$$h'_{11e} = h_{11e} + \frac{R_E(1 + h_{21e})(1 - h_{12e})}{1 + h_{22e}R_E}$$

$$h'_{12e} = \frac{h_{12e} + h_{22e}R_E}{1 + h_{22e}R_e}$$

$$h'_{21e} = \frac{h_{21e} - h_{22e}R_E}{1 + h_{22e}R_E}$$

$$h'_{e} = \frac{h_{22e}}{1 + h_{22e}R_E}$$

and the determinant of the set of equations

$$|h'_e| = \frac{|h_e| + h_{22e}R_E}{1 + h_{22e}R_E}.$$

By inserting the h'_{ike} parameters into

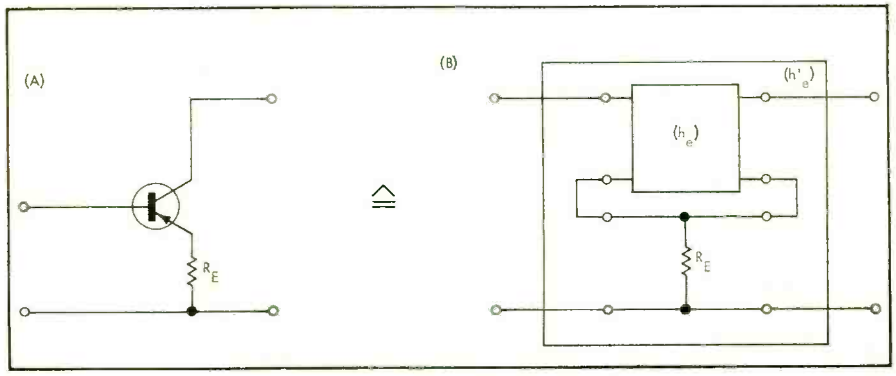

Fig. 16. Common emitter stage with series feedbacks: (A) a.c. equivalent network; (B) four terminal network representation.

the equations for voltage gain and impedances, we get

$$r = \frac{h'_{11e} + |h'_e| r_L}{1 + h'_{22e} r_L}$$

and

$$r_i = \frac{h_{11e} + \dfrac{R_E(1+h_{21e})(1-h_{12e})}{1+h_{22e}R_E} + \dfrac{|h_e| + h_{22e}R_E}{1+h_{22e}R_E} r_L}{1 + \dfrac{h_{22e}}{1+h_{22e}R_E} r_L}$$

Validly neglecting the following:

$h_{22e} \ll 1$ and therefore $1 + h_{22e}R_E \approx 1$

$h_{21e} \gg 1$ $\qquad 1 + h_{21e} \approx h_{21e}$

$h_{12e} \ll 1$ $\qquad 1 - h_{12e} \approx 1$

$|h_e| \ll 1$

we get a sufficiently accurate, simple approximate formula for the input resistance of the entire network

$$r_i \approx \frac{h_{11e} + h_{21e}R_E}{1 + h_{22e}r_L} \qquad \text{Eq. (1)}$$

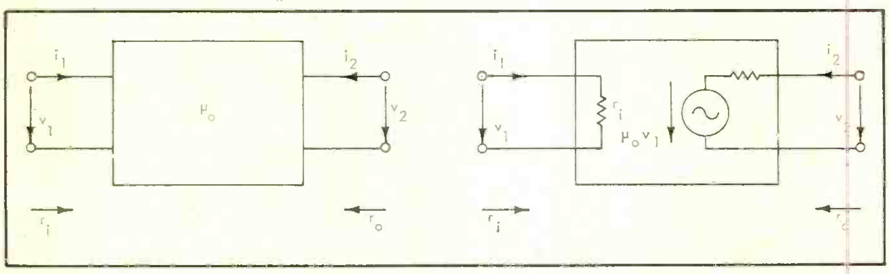

Fig. 17. Active linear four-termintal network and corresponding simplified equivalent network.

The output impedance is

$$r_o = \frac{h'_{11e} + R_G}{|h'_e| + h'_{22e}R_G}$$

$$r_o = \frac{h_{11e} + \dfrac{R_E(1+h_{21e})(1-h_{12e})}{1+h_{22e}R_E} + R_G}{\dfrac{|h_e| + h_{22e}R_E}{1+h_{22e}R_E} + \dfrac{h_{22e}}{1+h_{22e}R_E} R_G}.$$

Assuming that

$$h_{22e} \ll 1 \; ; h_{21e} \gg 1 \; ; h_{12e} \ll 1$$
$$\text{and } |h_e| \ll h_{22e}(R_E + R_G)$$

we get a reasonably simple formula for the output impedance

$$r_o \approx \frac{h_{11e} + h_{21e}R_E + R_G}{h_{22e}(R_E + R_G)} \qquad \text{Eq. (2)}$$

The voltage gain of the network is

$$g_v = -\frac{h'_{21e} r_L}{h'_{11e} + |h'_e| r_L}$$

$$g_v = -\frac{\dfrac{h_{21e} - h_{22e}R_E}{1+h_{22e}R_E} r_L}{h_{11e} + \dfrac{R_E(1+h_{21e})(1-h_{12})}{1+h_{22e}R_E} + \dfrac{|h_e| + h_{22e}R_e}{1+h_{22e}R_E} r_L}$$

With the approximations

$$h_{22e} \ll 1 \; ; h_{21e} \gg 1 \; ; h_{12e} \ll 1 \; ;$$
$$h_{22e}R_E \ll 1 \; ; h_{22e}r_L \ll 1 \; ; |h_e| r_L \ll h_{11e}$$

we have

$$g_v = -\frac{h_{21e} r_L}{h_{11e} + h_{21e}R_E} \qquad \text{Eq. (3)}$$

The current amplification factor, h_{21e}, of a transistor stage in common-emitter connection is always positive. According to the above formula the voltage gain then becomes negative, the minus sign indicating the 180-deg. phase shift between input and output voltages.

For every strong feedback, that is a large emitter resistor R_E, we get $h_{21e}R_E \gg h_{11e}$ and therefore $g_v = -\frac{r_L}{R_E}$.

The voltage gain thus becomes completely independent of transistor parameters.

Feedback Circuit Analysis

Transistor Amplifier Equivalent Circuits.

As stated previously a small-signal transistor amplifier may be considered an active linear four-terminal network with an open-circuit voltage amplification factor μ_o, an input resistance r_i, and an output resistance r_o. *Figure* 8 shows its general representation and the corresponding simplified equivalent network. The reverse voltage transfer ratio is assumed to be negligibly small, that is $h_{12e} = 0$.

The open-circuit voltage gain of the network is $\frac{v_{2o}}{v_1} = \mu_o$ and the short-circuit current gain

$$\frac{i_{2s}}{i_1} = -\mu_o \frac{r_i}{r_o}.$$

When a load is connected across the output terminals of the amplifier, both current and voltage gain decrease, depending upon the value of the load resistance.

The voltage gain of the loaded amplifier shown in (A) of *Fig*. 18 is

$$\frac{v_2}{v_1} = \mu_o \frac{r_L}{r_o + r_L}.$$

Current gain is not of interest for the following considerations.

Since the load resistance, r_L, may be regarded as an internal part of the amplifier (from the viewpoint of a subsequent stage), it may be drawn inside the "black box," as in (B) of *Fig*. 18. The resulting new four-terminal network has an "open-circuit" voltage gain of

$$\frac{v_2}{v_1} = \mu_o \frac{r_L}{r_o + r_L} = \mu$$

and an output resistance

$$r_x = \frac{r_o r_L}{r_o + r_L}.$$

To simplify calculations, this network may be replaced by the equivalent network shown in (C) of *Fig*. 18. It has the form of the network in *Fig*. 17 but now represents the loaded amplifier.

Generally, degenerative feedback is applied to an amplifier for one or more of the following advantages: distortion reduction, improvement of frequency response, changes in input and output impedances, stabilization of performance characteristics. However, each of these has to be traded for the disadvantage of gain reduction.

As already mentioned, a negative voltage series feedback loop around the first two stages of the equalizer is used to realize several of the required performance characteristics. A small fraction of the amplifier's output voltage is fed back and compared with the input signal. The feedback voltage is fed into the input circuit in series with the input signal. For negative feedback, input and feedback voltages have to be 180 deg. out of phase.

Figure 19 shows the block diagram of a loaded amplifier with negative voltage series feedback applied. The voltage amplification factor of the passive linear feedback network shall be called β (β will always be below unity!)

Ideally, the voltage feedback network does not draw current from the amplifier output, nor does it influence the input current. In other words, the input re-

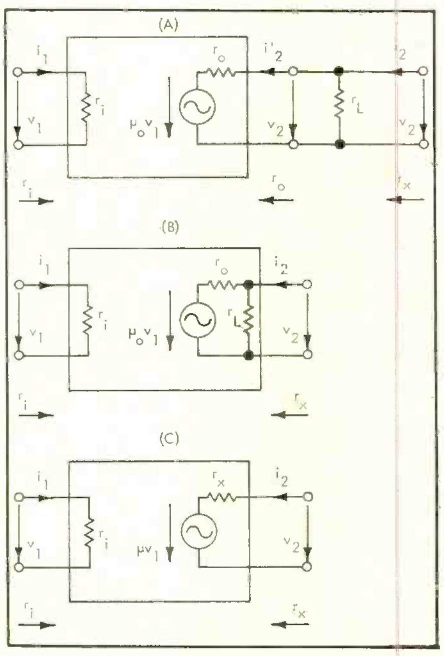

Fig. 18. Loaded four-terminal network.

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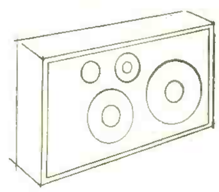

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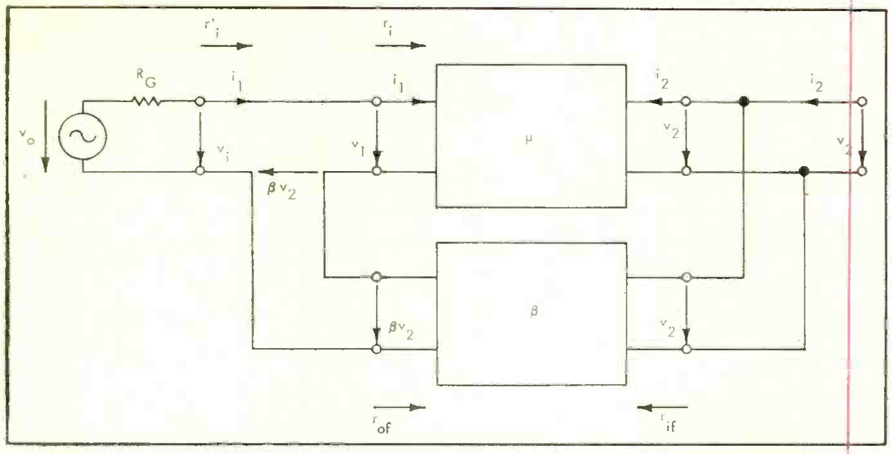


Fig. 19. Block Diagram of amplifier with negative voltage series feedback.

sistance of an ideal β network should be infinite, its output resistance 0.

Practically, the β network will consist of a voltage divider circuit. Its finite input impedance may be considered part of the internal load resistance, r_L, of the amplifier, while its output impedance will have to be made small compared with the input resistance, r_i, of the amplifier and the generator resistance, R_G. Provided that these approximations are valid, all values of interest may now be calculated.

Voltage Gain

According to *Fig.* 19 we may write

$$v_2 = \mu v_1$$
$$v_i = v_1 + \beta v_2 = v_1 + \mu\beta v_1$$
$$v_i = v_1(1 + \mu\beta).$$

the voltage gain of the amplifier with feedback applied will thus be

$$g_v = \frac{v_2}{v_i} = \frac{\mu}{1 + \mu\beta} \qquad \text{Eq. (4)}$$

Frequency Response.

According to the preceding paragraph the voltage gain of feedback amplifier for any desired value of μ/β is

$$g_v = \frac{\mu}{1 + \mu\beta}.$$

For very strong feedback we get $\mu\beta$ much greater than 1 and therefore

$$g_v \approx \frac{1}{\beta} \qquad \text{Eq. (5)}$$

The influence of the amplifier μ and the load resistance, r_L, being completely eliminated, the voltage gain of the feedback amplifier now is entirely dependent on β. Thus, the frequency response of g_v is determined by the frequency response of β only. No requirements at all are put on the frequency response of the amplifier μ, as long as $\mu\beta \gg 1$. Any desired frequency response of the feedback amplifier can easily be obtained by suitable design of the feedback network β.

If the frequency response of the entire amplifier is supposed to be determined by the frequency response of β over the entire frequency range, the equations $g_v = \frac{1}{\beta}$ and therefore $\mu\beta$ is much greater than 1 must hold throughout the entire frequency range. This means that μ has to be several times the highest occurring value of g_v. Unfortunately, this is rather difficult to achieve. However, if it is not necessary to produce a fre-

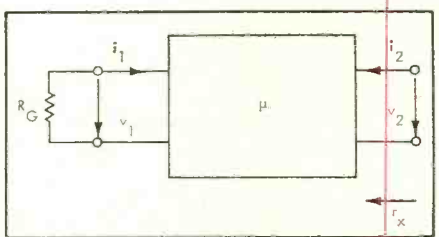


Fig. 20. Output resistance of amplifier without feedback.

quency response exactly corresponding to the $1/\beta$ response, any desired compromise can be made between the necessary value of $\mu\beta$ and the tolerable loss in frequency response.

Normally, μ, β, and g_v will be complex figures. For calculation convenience it may be assumed with sufficient accuracy that at relatively low frequencies these values are real.

If at the highest point of the required frequency response the actually achieved gain

$$g_v = \frac{\mu}{1 + \mu\beta}$$

is allowed to be 3db down with respect to the ideal gain

$$g^*_v = \frac{1}{\beta}$$

we get the minimum permissible value for $\mu\beta$:

$$g^*_v - g_v = 3 \text{ db}$$
$$g^*_v = \frac{1 + \mu\beta}{\mu\beta} = 1.41$$
$$\mu\beta = 2.44$$

This determines the minimum required difference between μ and g^*_v:

$$\frac{\mu}{g^*_v} = \mu\beta = 2.44$$

or $\mu - g^*_v = 7.75$ db.

Thus, if a maximum loss of 3 db at the highest point of the frequency response is allowed, the voltage gain of the amplifier μ has to be at least 7.75 db above the ideal gain figure g^*_v at that frequency. At all other frequencies the difference $\mu - g^*_v$ will be greater, resulting in a higher value for $\mu\beta$ and therefore giving closer adherence to the required $1/\beta$ frequency response.

As already mentioned, a value of $\mu - g^*_v = 9$ db at the highest point of the desired frequency response has been selected for the design of the equalizer. At that frequency (less than 50 cps, according to the RIAA playback curve, *Fig.* 23) the minimum value of $\mu\beta$ is

$$(\mu\beta)_{min} = \frac{\mu}{g^*_v} = 2.82$$

The resulting loss in frequency response then is

$$\frac{g^*_v}{g_v} = \frac{1 + \mu\beta}{\mu\beta} = \frac{3.82}{2.82} = 1.35$$
$$g^*_v - g_e = 2.6 \text{ db.}$$

Input Resistance.

The input resistance of the amplifier without feedback is $r_i = \frac{v_1}{i_1}$.

(*Continued on page 71*)

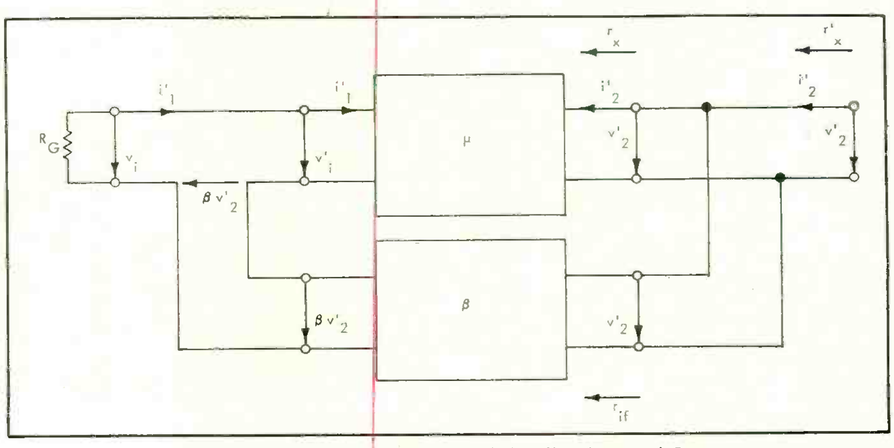
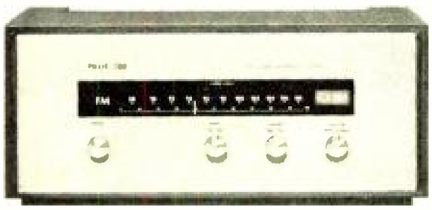


Fig. 21. Output resistance of feedback amplifier.

"The finest FM Stereo Tuner ever built for the home"

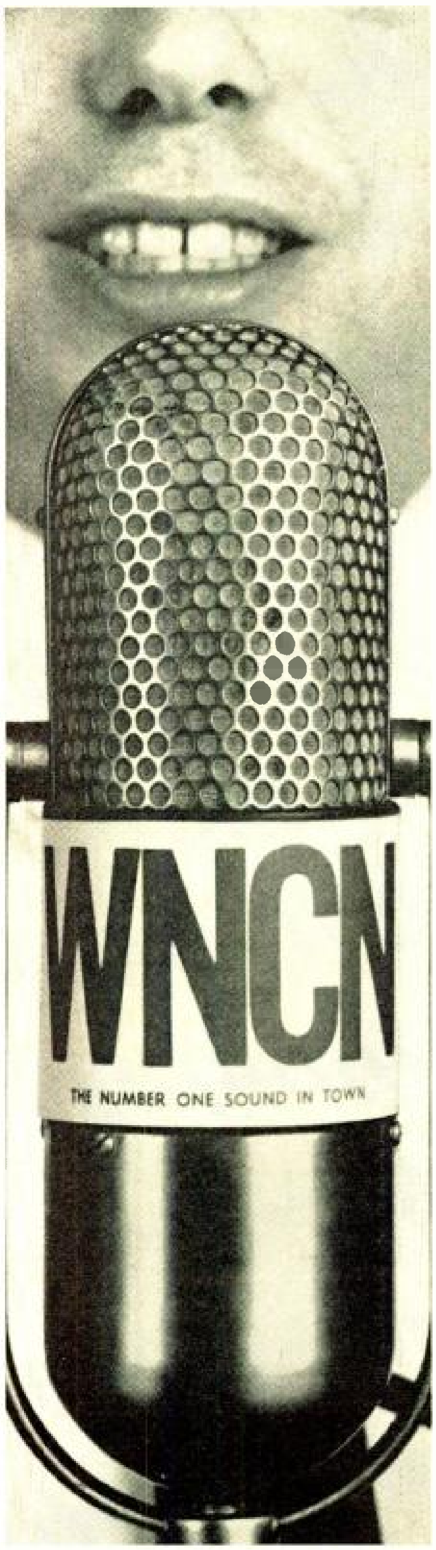
says Martin Gersten, chief engineer of WNCN, The Concert Network

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.



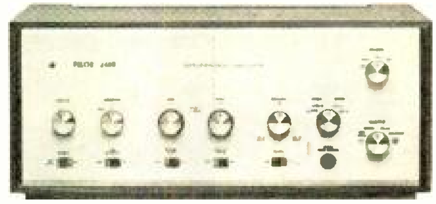
He first heard the PILOT 780 in September, 1962, at the New York High Fidelity Show.

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 signal-sampling 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:

Pilot PILOT RADIO CORPORATION, 37-36 36TH STREET, LONG ISLAND CITY 1, NEW YORK

The Tape Guide

HERMAN BURSTEIN*

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Bias-Oscillator Noise

Q. Over the past several years I have purchased several magnetic tape recorders only to become dissatisfied with their features or performance. Therefore I recently put one together to fill my own particular needs. Inasmuch as I am an electronics engineer, this was not an unreasonable project. I purchased a professional-grade tape transport complete with two-track stereo erase and record heads and both two- and four-track playback heads, and I built the associated record-playback electronics. In the course of designing the electronics, I assembled each of the functional sections as a breadboard in order to optimize and/or troubleshoot them before starting on the final version. As a result I have learned a great deal and have derived considerable pleasure in the process. However, I have a question concerning the bias and erase oscillator section. With the playback gain at a high enough level for tape noise to be clearly audible from blank bulk-erased tape, the oscillator is energized. This results in a considerable increase in tape noise upon playback. By disconnecting the record amplifier from the record head, I have definitely established that this is not due to noise generated in the record amplifier itself. As nearly as I have been able to determine, the oscillator waveform is clean and undistorted. I don't have a harmonic distortion analyzer that will go up to 80 kc, but the waveform is indistinguishable from that of a Hewlett-Packard audio oscillator when the two are superimposed on a Tektronix dual-beam oscilloscope. The oscillator is of push-pull configuration with a balancing pot to ground in the cathode load resistance. I am using separate oscillators for each channel, but the problem is not one of synchronization between the two oscillators. The increase in noise takes place if only one oscillator is energized. I would appreciate your comments as to means of reducing the noise.

A. The recording noise is quite likely due to the imperfect waveform of the bias frequency, even though it seems pure on an oscilloscope. As you know, it is difficult for the eye to detect distortion much below 5 per cent, yet amounts below 1 per cent can produce noise on the tape. To minimize noise due to oscillator waveform means constructing a top-grade oscillator as follows: 1. Use a push-pull design (which you have done). 2. Use the best, most accurate, most stable capacitors and resistors. Mica or silver capacitors and deposited carbon or metal film resistors are recommended. Resistors or capacitors in corresponding stages of the push-pull circuit should match within 1 per cent. 3. Use a very high-grade oscillator coil, having as high a Q as possible. A toroidal powdered molybdenum coil is recommended.

At least one authority with whom I have discussed the problem feels that the use of a cathode balancing pot is to be avoided. While it can help in the case of an oscillator that is of less than the very best design, construction, and materials, in his experience it is more apt to detract from than add to the performance of a really well built oscillator.

Frequent, careful demagnetization of the heads is urged in order to prevent noise being recorded on the tape. Professionals demagnetize the heads as often as after every 4 hours of use; a maximum of 8 hours is recommended. If a sharp transient is fed into the tape recorder—for example, if someone slams a microphone—the heads should be immediately demagnetized if feasible.

D.C. Bias Current

Q. I notice that at least two currently produced professional machines have provision for adjusting both the polarity and amplitude of direct current through the record head. This is in addition to the usual a.c. bias. What are the advantages to this, and what is the adjustment procedure?

A. The purpose of the direct current fed to the record head is to compensate for asymmetry of the oscillator waveform. The amplitude of the current can be varied to correspond with the amount of asymmetry, and the polarity can be changed to correspond with the polarity of asymmetry. These two factors are adjusted while simultaneously recording and playing back, but without an input signal, so as to minimize noise due to the bias oscillator's imperfect waveform.

Optimum Erase Current

Q. I would appreciate some procedure for determining the proper amount of erase current to use for the usual popular brands of 1-mil and 1½-mil tape. My tape heads are of foreign make and I have not had too much success in getting information on the head characteristics.

A. Erase current is adjusted not on the basis of the tape used but on the requirements of the erase head in terms of setting up a powerful enough magnetic field to wipe the tape clean. This may vary from as little as about 10 mA to several times as much, depending on the impedance of the head. The only thing I can suggest is that, starting with a value of about 10 mA (determined by putting a 10-ohm resistor between ground and the ground lead of the head, then measuring voltage across the resistor), you gradually increase the erase current until you get satisfactory erasure on program material (not just single tones) recorded at normal level; material recorded at higher than proper level (resulting in excessive distortion) may require the use of a bulk eraser. Be careful not to increase the erase current to the point where the head becomes hot, for it may burn out.

Furthermore, for a given value of erase current, the head's efficiency will decrease at high oscillator frequencies. Hence for a particular erase head it may not be feasible to use as high an oscillator frequency as you would like to employ for purposes of supplying bias current to the record head.

One more caution. If you draw a very substantial amount of current from the oscillator in order to drive the erase head, the heavy load on the oscillator may impair its waveform, resulting in excessive recording noise.

Selective Flutter

*Q. I have a **** tape recorder. In case you are not familiar with this machine, I shall attempt to describe its tape transport mechanism. The tape passes from the supply reel over a combination alignment guide and tension arm, over the heads, and then between a constant velocity capstan and rubber roller, then around an automatic cutoff arm, and finally onto the take-up reel. The capstan is powered by a hysteresis synchronous motor. Each reel is powered by a torque motor. Both reels are powered during normal operation, with the supply reel being energized in the opposite direction to maintain tape tension. This machine operates superbly, with one exception: very objectionable wow and flutter appear when recording beyond 900–1000 feet on one reel. Any form of therapy, even radical surgery, will be acceptable.*

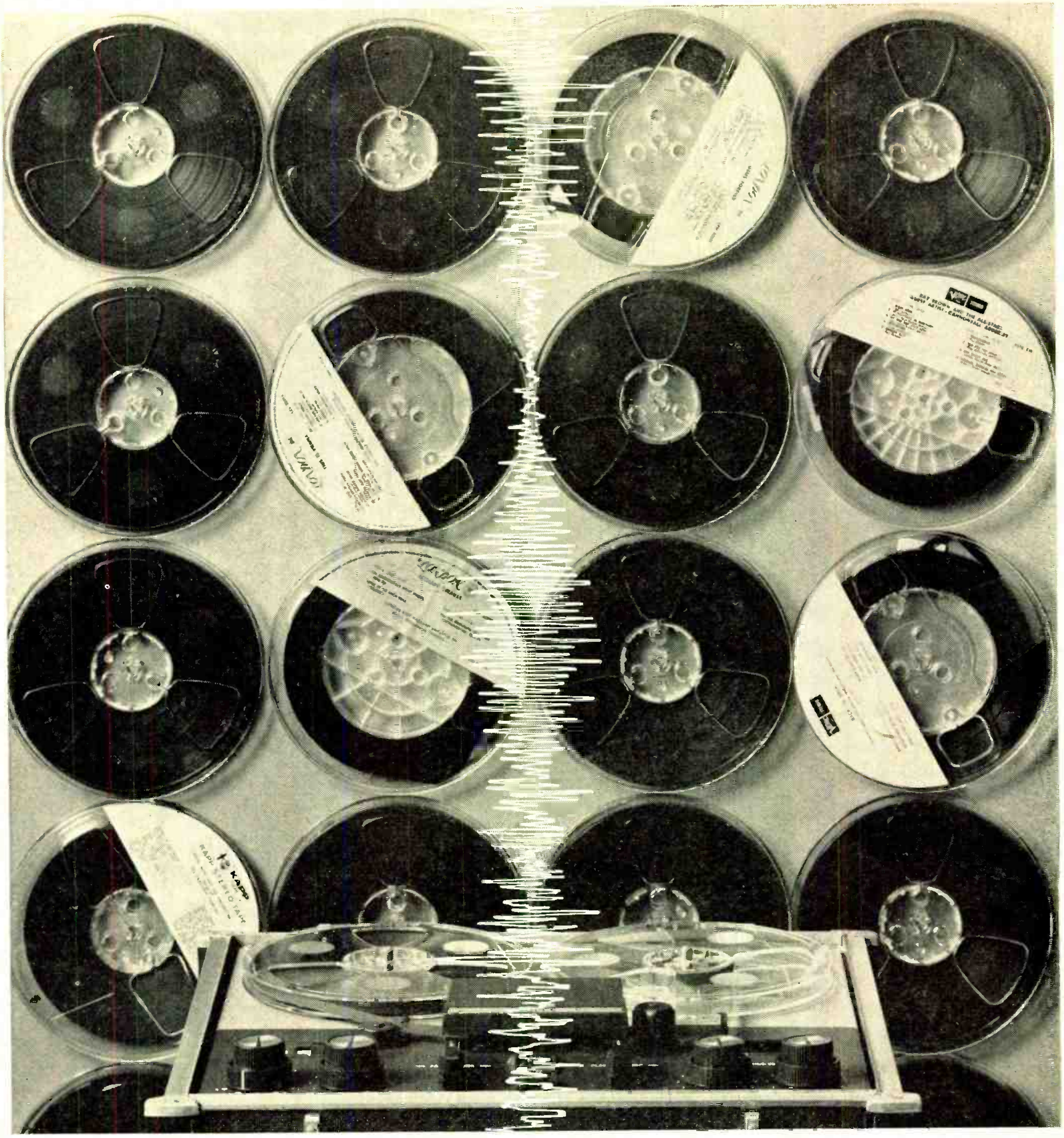
A. I cannot offer specific suggestions for eliminating the wow and flutter you complain of because the possible causes, and corresponding courses of action, are many, sometimes quite technical, and often unique to the machine in question. If normal lubrication and cleaning maintenance in accord with the machine's service manual, do not clear up the trouble, your basic recourse is to an authorized service agency, whose name you can obtain from your dealer or the manufacturer. If the service agency cannot cope with the problem, obviously you must turn to the manufacturer.

Tone Variations

*Q. I own a **** tape recorder and notice that my tapes have a marked variation in tone, especially in the piano passages. Is this a sign that there is a variation in the speed of the tape passing the record head? If so does the trouble lie in the capstan and/or rubber pinch wheel, or should the drive motor be suspect as well? I have cleaned all tape guides and the capstan and pinch wheel as suggested by the manufacturer but with no results. The machine has less than 25 hours running time. Can you suggest any tests that I can make to correct this condition?*

A. Have you also tried cleaning the mechanism beneath the base plate, such as the motor shaft and other parts of the drive mechanism leading to the capstan? If you still do not get improved results, I suggest that you take your machine to an authorized service agency. Æ

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



For a limited time: what tape recorder comes with $116 worth of free tape? **AMPEX 1200**

Now, Ampex will give you $116 worth of tape when you buy any of the Ampex Fine Line 1200 recorder/player series. You get twelve reels of Premium Ampex Tape worth $66—enough tape to record up to 38 hours of stereophonic or 76 hours of monophonic sound. Plus you get your choice of $50 worth of pre-recorded stereo tapes from 13 recording companies. And above all, you get the finest tape recorder in the world: the Ampex Fine Line 1200, the only 4-track home recorder built to professional standards. It features three new precision heads, a die-cast frame and a tracking technique and tape guidance system previously available only in professional recorders. No cross-talk. Just high fidelity sound. You also get the new Ampex "Four Star" One-Year warranty: Ampex will replace any defective part for a full year. Three models: 1250 unmounted, 1260 portable and 1270 portable with built-in amplifier speakers. This offer good only at participating dealers for a limited time only. See your Ampex dealer now. Ampex Corporation, 934 Charter Street, Redwood City, California. The only company providing recorders, tapes and core memory devices for every application. Worldwide sales and service.

AMPEX

VERTICAL TRACKING

(*from page 20*)

interesting implications. For example, it tells us that the vertical-tracking relationship with the available pickups had been worse than previously assumed. Increasing the true modulation slant to the 15-deg. angle adopted by the RIAA improves the stereophonic record and reproduction with *all* the pickups. With those in which the vertical tracking angle does not exceed 23 deg., any distortion that had been heard previously, due to the 20-or-so degree tracking error that had existed, now becomes imperceptible. Moreover, one concludes immediately that the cutters with 0-deg. recording angle produce a *backwardly leaning modulation,* which is, of course, quite incompatible with any of the present

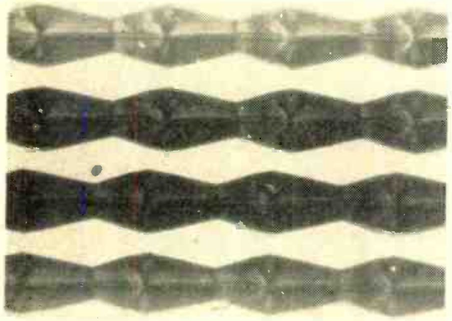


Fig. 5. Photomicrograph of pattern produced by the cutter arrangement in Fig. 4.

day pickups. Measurements have confirmed this prediction. The negative slant of such a wave is between 16 and 18 deg. Thus, the best way to produce records with 0-deg. cutters is from inside-out with the cutter turned around and the record and tape running backwards. Then, when such records are played in the normal manner, a proper modulation slant will be presented to the pickup!

Measurement of Modulation Slant

The measurement of modulation slant of a record is accomplished by using a turntable and adjustable pickup arm combination shown in *Fig.* 6. The arm can be set at any height, and any orientation. The turntable is capable of forward or backward motion by the flip of a switch, and the pickup may be played on either side of the record. The preferred type of modulation for slant measurements is intermodulation in the vertical mode either of the 400/4000- or the 200/4000-cps variety which can be measured directly on an intermodulation meter. The CBS Laboratories Stereophonic Test Records STR-110 and STR-111 contain such test bands which simplified the measurements. Four sets of data are required: With normal mounting, I.M. measurements in the forward and reverse modes, and with added elevation angle of (say) 10 deg., I.M. in the forward and reverse modes. From these four measurements, modulation slant is calculated or obtained by graphical methods. The 2.5-deg. and 15-deg. modulation slants of the STR-110 and the STR-111 records, respectively, have been obtained in the above manner.

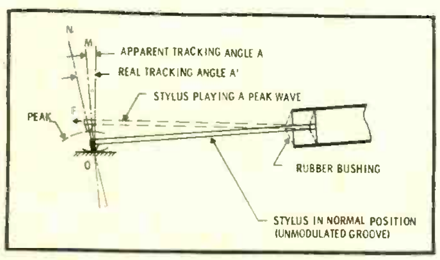


Fig. 7. Increase of vertical tracking angle by longitudinal elasticity of the rubber stylus mount.

Vertical Tracking Angle in Pickups

Once the test record slant has been measured, it is relatively easy to measure the vertical tracking angles of phonograph pickups. In the past this measurement has been performed simply by means of a protractor and a microscope. Sometimes such measurements do not produce a correct result. This is because any longitudinal elasticity of the stylus has an effect upon the real tracking angle of the pickup, thus resulting in an increase of the real vertical tracking angle.

This effect is shown in *Fig. 7.* The stylus in its normal position (as when tracking an unmodulated groove) is shown in solid line. When deflected manually. the stylus moves along the line O-M, defining a rather small tracking angle A. However, when the stylus is playing the peak of a wave, the force between the stylus and the groove rises, and there is an additional force F pulling on the stylus. The rubber bushing on which the stylus sometimes is mounted tends to yield, in which case the stylus might traverse a more slanted line O-N. On the other hand, with those pickups we measured in which the stylus has a wire pivot, the geometrical and electrical measurements give the same vertical tracking angle.

To use either the STR-110 or the STR-111 Test Record for measurement of the real tracking angle, any one of several procedures may be used. The simplest but least accurate method is to measure the I.M. distortion produced by the pickup and calculate the tracking error from the following approximate equations:

(1) $\text{I.M.} = (v/V)D \times 100\%$ (Amplitude Mode)

(2) $\text{I.M.} = 2(v/V)D \times 100\%$ (Velocity Mode)

where v is the peak low-frequency velocity in cm. per sec.

Fig. 6. Adjustable arm for measurement of modulation slant and pickup vertical tracking angles.

V is the groove velocity in cm. per sec.
D is the tracking error in radians (radians = degrees/57.3)

The actual tracking angle is obtained by calculating D, and adding to it the modulation slant of the record, i.e. 2.5 deg. for the STR-110 and 15 deg. for the STR-111. The following precautions should be observed: For pickups with low values of vertical tracking angle, i.e., 10 to 20 deg., the STR-110 is used because it provides sufficiently large tracking error so that any intermodulation measurement is likely to stem from improper vertical tracking and not from inherent pickup distortion. With pickups having high values of vertical tracking angle, i.e 20 to 40 deg., the STR-111 is used to avoid indications outside the range of validity of equations (1) and (2), or outside the range of the I.M. meter.

(*Continued on page 68*)

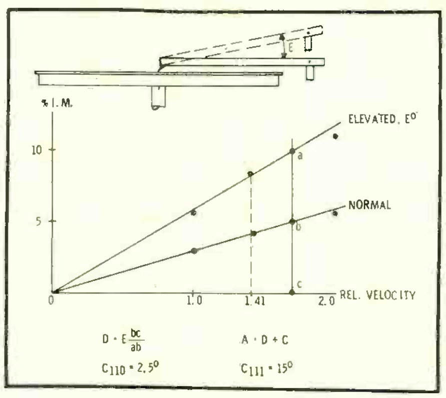
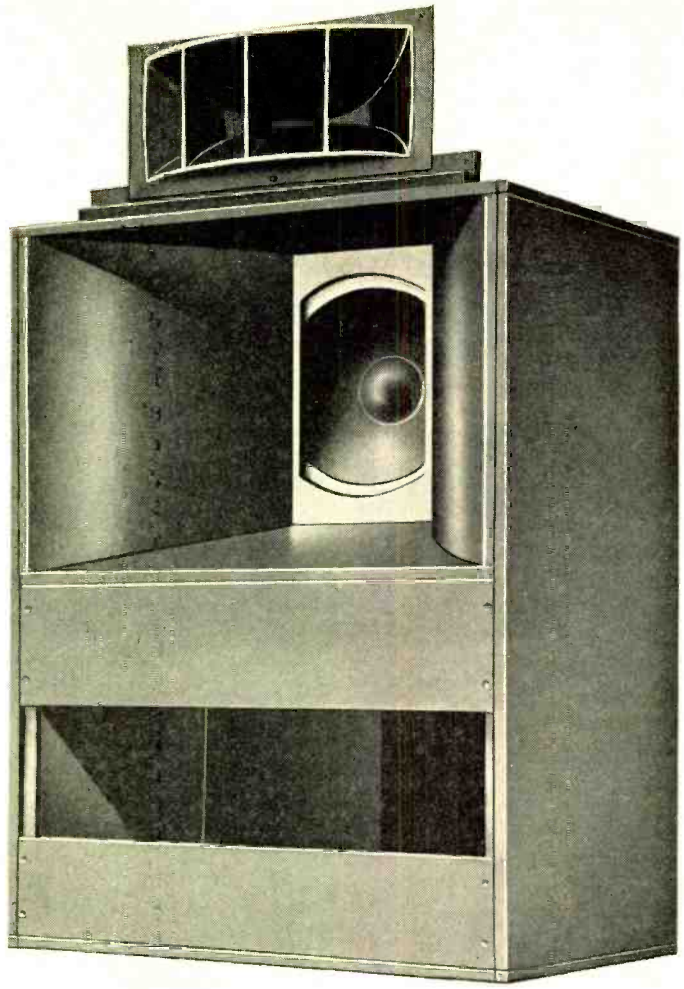


Fig. 8. Method for measurement of vertical tracking angle with STR-110 or STR-111 records.

THIS IS NO COMPACT!

54 inches high
9 feet around the middle



That's a lot of speaker system. Enough for what pleases you. It can whisper or it can bellow. It does both superbly, and anything in between. So much so that Hollywood's famous United Recording Corp. (sound studio for record, tape, film, and tv industries) employs 15 of them. As does Ray Heindorf, musical director of Warner Bros.' production "The Music Man" and holder of 2 Oscars, who has four right in his living room.

No, this is definitely not a compact. It's a giant, this A-7 "Voice of the Theatre" by Altec. A full-size speaker system with quality to match. That's why it belongs in your home. Unless you are willing to settle for a compact "book shelf" speaker . . . and compact sound. Of course if you are a critical listener, you'll want your sound brought to life by Altec; sound so realistically reproduced, you'll find its equal only in the concert hall.

That much the A-7 will give you, and more. Almost in direct proportion to your own desire for perfection. If you insist on hearing the "full sound," the most subtle contribution of each instrument, the effortless reproduction of massive orchestrations at concert-hall listening levels, then the A-7 is for you.

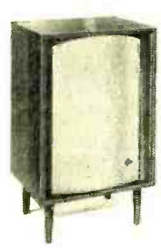
Now here is a hint: you can't make it any smaller, but you can make it a lot prettier. All it takes is a bit of effort, some grille cloth, some veneer or paint and you can transform the A-7 into a custom furniture piece. For built-in installation, there's nothing so perfect. At only $285.00 each, it's a wonderful do-it-yourself project . . . for the critical listener.

However, if you prefer your A-7 sound coming from a more civilized version, we have several solutions, in walnut or mahogany. There's the 831A "Capistrano," a full-size beauty that offers speaker components identical to the A-7 in a classically styled cabinet. It stands 30" high, 47" wide, and is priced at $399.00.

The modern 838A "Carmel" is also a full-size, floor-standing system. It features two 12" low frequency speakers (instead of the one 15-incher in the A-7) and the same high frequency section. It's priced at $324.00 with decorator base (shown) extra; standard model comes with round legs. The "Carmel" is also available with one low frequency speaker in a model called the 837A "Avalon," priced at $261.00.

ALTEC 838A "CARMEL"

ALTEC 831A "CAPISTRANO"



NEW! ALTEC 841A "CORONADO" SPEAKER SYSTEM

Apartment-size version of the full-size Altec speaker systems, the "Coronado" is styled to match a pair of "Carmels" when used as the center speaker in an Altec 3-channel stereo system. Recommended for small apartments where space will not tolerate larger speakers. The "Coronado" is 30" H, 18" W, 14" D and is priced at $199.50.

Go ahead, convince yourself! The A-7 (and its prettier mates) are ready to tantalize you now, at your Altec Distributor's. Or, for latest stereo catalog, write Dept. A-2.

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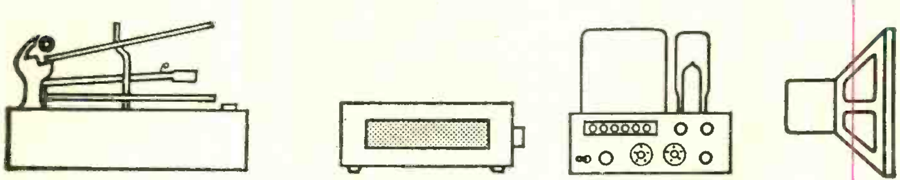
EQUIPMENT



PROFILE

Every now and then we are asked about the availability and adaptability of tape recorders for field use; that is for use in recording interviews, singing, and sounds in locations where the tape recorder cannot be plugged in to a source of a.c. In order to give some answer to those inquiries we are reviewing two completely self-contained recorders this month, both requiring no more than easily available batteries. One of the units is intended for professional use and the other for less rigorous applications, although both are easily portable. ED.

SONY "NEWSCASTER" MODEL EM-1

The Sony EM-1 is a 12-lb. lightweight hung on a sturdy leather strap (with lambs wool shoulder pad for weary strap-bitten professionals) primarily designed for reporters in field or spot interviews. Actually its frequency range and capabilities make it ideal for recording singing (for those who would record the vanishing folk singer) and the many sounds of the city and country. The tape transport is powered by a manually wound spring motor, and the amplifier circuit by six penlight batteries. The EM-1 will record 4½ minutes per wind and a total of 15 minutes per 5-in. reel at 7½ ips. It records and plays back full track.

For its almost $500 price tag, the EM-1 comes complete with an accessory bag, several appropriate wrenches, an earphone, a 125-cps tuning fork for accurately adjusting tape speed, a dynamic microphone, and the usual roll of tape plus an empty reel.

The method for checking speed accuracy is rather interesting and completely mechanical, thus permitting speed checks in the field. Basically it consists of a 125-cps tuning fork which has small plates at the end of the arms. The plates are close enough to make a slit through which the dual-stroboscopic pattern on the pinch roller can be viewed. When the tuning fork is set in motion and half the viewed pattern moves forward at the same rate the other half moves backwards, the speed is correct. The speed can be fine-adjusted by means of a screw on the side of the machine.

Tape Transport System

The drive system consists of the spring motor mentioned before which, when released, drives the capstan. Setting the motor in motion is simply a matter of pushing a lever, and the motor springs into motion *without a sound*. The relative silence of this machine is quite novel to anyone used to the conventional type of tape machine; it certainly eliminates any possibility of machine noise affecting the recording. The motor, its governor, and the necessary gears to drive the take-up reel are all located on the right side of the unit, below the take-up reel. Notice the rectangular window and the triangular pointer above the motor compartment as shown in *Fig.* 1 just above the microphone input. This pointer indicates when the spring needs to be rewound and also when it is in the constant speed portion of the spring.

Since this is a capstan drive system, the motion imparted to the take-up reel is just sufficient to take up the slack in the tape fed to it from the capstan. The motion of the take-up reel is opposite to most recorders so that the tape is wound on it with the recorded surface facing out. The reason for this, according to the company, is that one can tell a recorded tape from an unrecorded tape.

The tape is rewound by means of a hand crank which is normally folded neatly in front of the supply reel.

The entire electronic assembly and controls are mounted on a simple-to-remove chassis as shown in *Fig.* 2. All one has to do to remove the entire works is unscrew the two knurled-head screws on the control panel, slide out the unit, and unplug the head cable. Altogether it takes no more than 10 seconds or so. This includes the battery pack too.

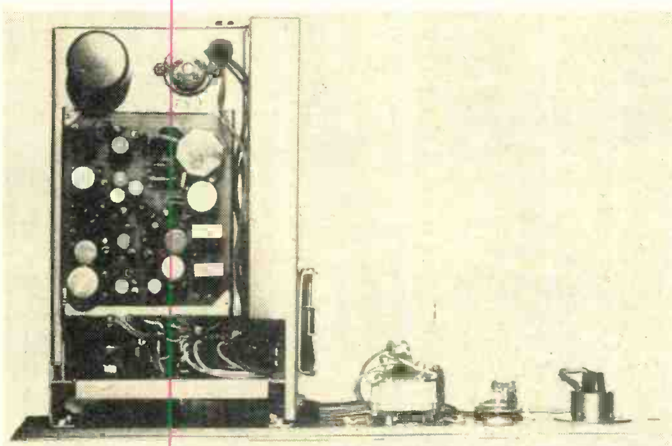


Fig. 2. Entire electronics and control chassis of Sony EM-1.

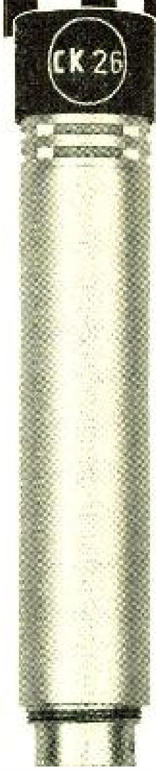
The record amplifier is a three-stage unit employing three Sony transistors, two 2SD65's and a 2SD64. A single transistor stage is provided to feed the monitor headset. By switching to the playback position, the machine will play back the recorded tape through the amplifier circuit.

The bias oscillator uses two transistors in push pull and oscillates at 50,000 cps. The small meter on the control panel indicates when the bias oscillator is operating normally. Actually the meter is also a

Fig. 1. Sony Newscaster, Model EM-1.

THE

BREAKTHROUGH



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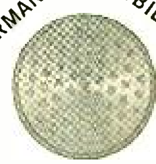

reversing the trend toward higher prices, and offering:

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Transistorized B 60 Power Pack makes the C 60 independent of AC mains. Many hours of remote service without trailing power lines, from a single recharging at any 110/145VAC outlet. C 60 is four inches long, 2 ounces light including internal electronics. The DC Power Supply is miniaturized for use on shoulder strap or as a plug-in stand element.

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C 60 shown actual size

ELECTRONIC APPLICATIONS, Inc.

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battery indicator which indicates the voltage output of the battery when the small button just below the meter is pushed. The battery pack, the loug rectangular object next to the circuit board, is very easy to replace; one merely opens the access door at the rear of the machine, pushes aside a retaining lever, and unsnaps the two fasteners. The batteries can then be removed from the case and replaced.

Performance

The Sony EM-1 is a very fine performer, as one would expect. First of all it should be pointed out that it is not really intended as a playback machine and for that reason the frequency response is better checked on a playback machine. Under those conditions the frequency response extended from 50 cps out to 10,000 cps, falling off 2.5 db at each end of this spectrum. Over-all distortion is 0.7 per cent and the over-all signal-to-noise (recorded and played back tone) is 47 db. Wow and flutter is 0.25 per cent rms and tape-speed accuracy within 1 per cent.

Perhaps the best way to characterize the Sony EM-1 is to say that it is truly a professional machine, in every sense of the word. Our only disappointment with the machine is the relatively short span of recording time per wind. Of course, on the other hand, 4½ minutes is perfectly right for spot news coverage.

Altogether, this machine could be ideal for many field applications if the recording time limitations are not a problem. **B-14**

NORELCO "CONTINENTAL 100" TAPE RECORDER

The Norelco "100" is a self-contained, battery-operated, transistorized, tape recorder which records two tracks on standard ¼-in. tape at 1⅞ ips. It will record a maximum of one hour with 3-in. reels and two hours with 4-in. reels.

The Norelco "100" is an extremely trim package, weighing only 8 lb. with batteries, and comes with a handle (or an optional shoulder strap). The supplied dynamic microphone is shaped so that it fits into a cutout on the side of the machine. Thus everything is in one neat package.

Operation of the "100" is extremely simple too. One merely pushes the forward button simultaneously with the record lock button to start recording. During recording the battery-level meter acts as a recording-level indicator. For playback one merely pushes the play button and the "100" plays back through its built-in speaker. Battery level is indicated continuously during playback. Six "D" cells supply the power to operate the motor and the amplifiers.

As we noted before, the Norelco "100" is battery powered. When the forward button is pressed, the batteries energize the motor which drives the capstan which is mounted on a relatively massive flywheel. The motor is mounted on pivots near its center and its driving puck is held against the flywheel by means of a spring. The supply reel is coupled to the motion by means of a belt which tries to rotate it opposite to the tape motion. Thus tension is applied to the supplied tape. The take-up reel is also connected to the drive motion, but by means of an idler. It operates to take up the tape slack between the take-up reel and the capstan. Motion is imparted to the tape when the pinch roller presses the tape against the capstan.

The tape is kept in contact with the record and erase heads by means of pressure pads. The over-all motion is not quite as smooth and well controlled as we are used to on the larger machines, but nevertheless it is positive and accurate.

Fig. 3. Norelco "Continental 100" tape recorder.

The Circuit

In playback the amplifier consists of four stages of amplification which feed a transformer, and it, in turn, drives the push-pull output stage. The output stage is matched to the built-in loudspeaker by means of an output transformer. A single transistor is used to drive the meter movement. The four amplifier stages contain three OC75 transistors and one OC71, and the output stage contains a pair of OC72's. The meter transistor is an OC70.

The entire amplifier and oscillator is

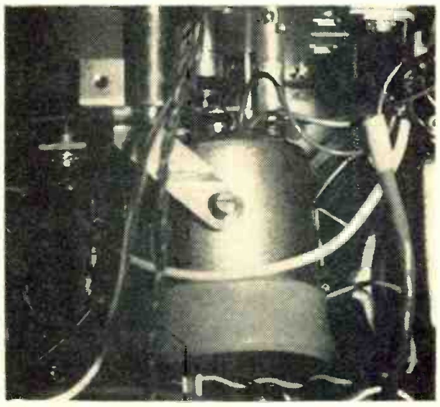


Fig. 4. Motor of Norelco "100." Note pivoted mount and spring which keeps puck in contact with flywheel.

mounted on a printed-circuit board about 4 × 4 inches in size, and is held in place by four screws plus a few wires. It is quite simple to remove or service the amplifier once the outer case is removed.

During recording the push-pull output stage becomes a push-pull oscillator, and the four amplifier stages act as before to amplify the signal but now feeds it to the meter transistor. The oscillator frequency is about 33,000 cps, varying somewhat with the inductance of the individual head and the capacitor value.

The tape speed (1⅞ ips) is maintained by means of a resistor which limits the voltage to the motor and a regulator which adds further resistance when the speed increases. A filter circuit is provided to prevent the motor from interfering electrically with the amplifier circuitry.

Performance

The Norelco "100" is intended for use in general applications where a self-contained recorder is desirable. Although its frequency response of 100 to 6000 cps, plus or minus 3 db, would seem to limit

(Continued on page 63)

AR-2a loudspeakers in the background, a Maillol bronze in the foreground

Even a jazz band isn't loud enough to fill the sculpture garden of the Museum of Modern Art, where a series of concerts was given this summer. An amplifying system was needed that would preserve the natural quality of the live instruments. Mechanical "public address" sound would not do.

AR and DYNAKIT at NEW YORK'S MUSEUM of MODERN ART

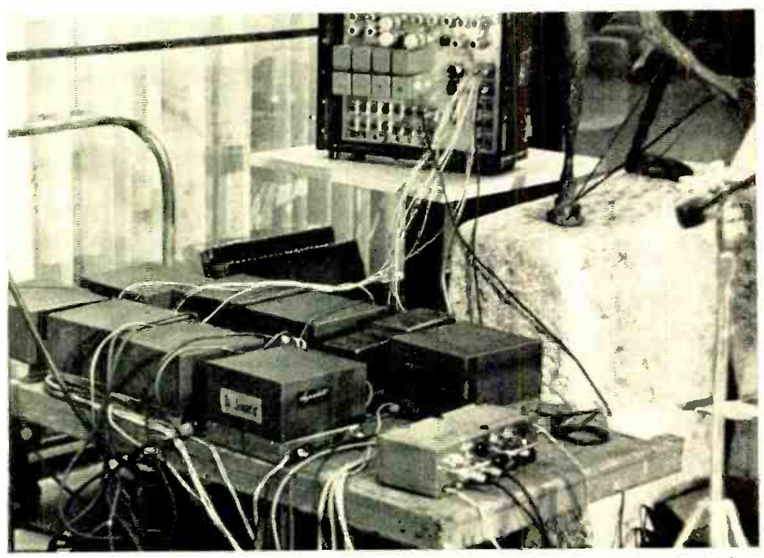
The audio components chosen for the job – eight Dynakit Mark III amplifiers and eight AR-2a loudspeakers – are often used professionally because of their high quality, but they are designed primarily for home high fidelity systems. They are in the low-medium price range.

The Gerry Mulligan quartet

Concert reviews don't usually include references to electronic equipment. A review in the New York Herald Tribune congratulated the Museum on its "superb new sound system."

AR SPEAKERS and DYNAKIT AMPLIFIERS may be heard together at AR Music Rooms, on the west balcony of Grand Central Terminal and at 52 Brattle Street in Cambridge, Massachusetts. No sales are made or initiated at these showrooms.

Literature is available on request from either of the two companies listed below.



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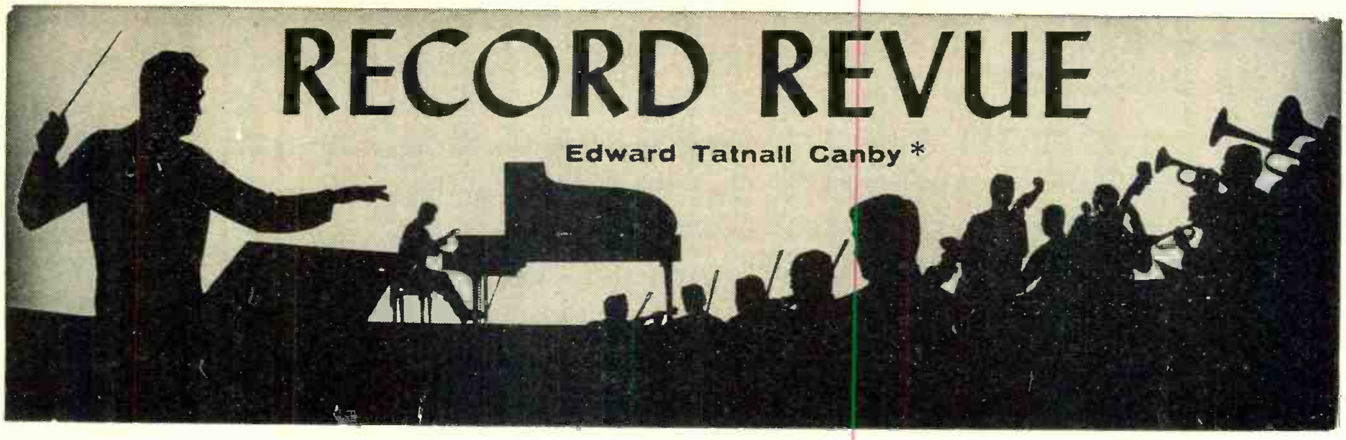
Photos by Jack Bradley



RECORD REVUE

Edward Tatnall Canby *

Bartok: Sonata for Two Pianos and Percussion; Divertimento for Strings. Boston Chamber Ensemble, Farberman.

Cambridge CRS 1803 stereo

Schoenberg: Pierrot Lunaire. Soloists, Alice Howland, sprechstimme.

Concert-Disc CS 232 stereo

Hail two superb modern spectaculars in stereo. both top performances. both guaranteed to intrigue every intelligent owner of top-notch stereo equipment! Find out what stereo can do for *you*—in terms of music that was "made" for the medium, if unknowingly, by both composers.

Cambridge's Bartok recording is no less than breathtaking. In every sense. musical and technical. it beats any recording of these works I've heard to date. from large labels or small. Indeed. I'll rashly predict that this is the hi-fi record of the old year (I received it in December, 1962). Say no more—just get it and put it on your turntable with the volume just as high as you can stand. (You'll never match the intrinsic loudness of *this* score.)

As for "Pierrot," a relatively ancient piece that is my favorite Schoenberg, (maybe because it dates from my own birth-year) it is astonishing how naturally and easily these Chicagoans produce the great experiment in "speech-music," the song that goes up and down but hits no fixed pitches, with its twittering, expressively atonal accompaniment—all to a fetchingly surrealist French clown-poetry text. You will quickly hear, when you note the age of this morsel, that it was the beginning of much, much that has come since, even unto TV and radio commercials, not to mention 12-tone electronics.

Only the relative lack of recorded liveness is any impediment here. If you have a reverb unit, here's a really legitimate use for it.

VOICES FROM THE PAST

Wagner: Die Walküre, Act I. Lotte Lehmann, Lauritz Melchior, Emanuel List, Vienna Philharmonic, Bruno Walter. (recorded 1935)

Angel COLH 133 mono

This is surely one of the greatest Wagnerian recordings ever made. In the middle thirties, this very recording was my own inspired introduction to Wagner's music—I shall never forget it. and this reissue has the excitement for me of a treasure rediscovered.

Many of us remember Lotte Lehmann's extraordinary concert singing. of Schubert and the like, comparable to that of Elizabeth Schumann. though more dramatic. We remember, too. the Lehmann vocal frailties, always forgiven for the greatness of her art. Well—here is the lady before those frailties were thought of, in her very prime wonderfully expressive, vibrant with life, in full, marvelous voice. And with her, Flagstad's later partner in *his* top form, the greatest tenor of our century for the Wagnerian tradition. And what an orchestra! Where Flagstad's recordings with Melchior used the insipid orchestra (see below) conducted by Edwin McArthur, we have here Bruno Walter himself.

Flagstad-Melchior. (Tristan; Love Duet. Lohengrin; Bridal Chamber Scene.)

RCA Victor LM 2618 mono

These two are among the more famous of Wagnerian recordings on 78 and it is a pleasure to have them in LP form, patched for long play. Both singers were in their top prime (though Melchior, as he often did, sounds occasionally strained). The "fi," with a limited top end, is nevertheless remarkably clean and the voices are without unpleasant edginess even in the loudest passages. The recordings were made (on 78 of course) in 1939 and 1940, both conducted by Flagstad's inevitable accompanist Edwin McArthur.

Unfortunately, McArthur was anything but a fiery Wagnerian and the orchestras in these two are merely adequate and neutral, no more than an official backdrop for the great voices. That was not what Wagner intended. Moreover, though RCA says that this was a period when "recording techniques and instruments were approaching the peak of their development," most of us will find ourselves very unhappy as to the mike techniques here used. "Lohengrin" isn't bad at all. The voices are reasonably balanced against the orchestra (in one passage they recede almost to inaudibility) and the room-sound is only fairly dead. But the "Tristan" of a year earlier came at the peak of the fad for close-up solo recording, not to mention that for dead studio sound (shades of Studio 8H and Toscanini). It has been years since I've had to use a phrase I once invented for this sort of thing—tonsil-close. It applies to both singers here. Very interesting, but not very musical.

Gilbert and Sullivan: Iolanthe. D'Oyly Carte Opera Co.

Richmond RS 62005 (2) mono

Tra-la, tra-la, the D'Oyly Cartes are back! Ever since the 1920s this company has been making records; this is the post-war, prestereo recording. featuring Martyn Green (Lord Chancellor) out of the famous casts of before the war. The style is as always *the* only-authentic (you can have the rival Glyndebourne versions, on Angel) and I'll only note that the tenor here sings stylishly out of tune—they always do in good G & S—the soprano is winsome. the contralto is a perfect Buttercup type and the chorus is lousy. Too professional. They sing like the Met. Opera in. say, the Anvil Chorus. The orchestra under the eternal Isidore Godfrey is marvelous. Real bargain, this reissue.

Caruso, the Voice of the Century, 1907–1920

RCA Victor LM 2639 mono

Gigli in His Glorious Prime, 1925–32.

RCA Victor LM 2624 mono

Caruso reissues will go on for ever and the best news concerning this latest is merely that it seems even a better restoration than before of the original frail 78 acoustics, with a more natural, less distorted tone and less surface noise. If you are a Caruso man, go look at the list of contents: it's too long to print here but ranges from a 1907 "Andrea Chenier" to one of the five last discs the tenor made, on September 16, 1920, a few months before his last public appearance.

In the context of the Caruso disc, that of his semi-successor. Beniamino Gigli is especially interesting. Gigli surely had a gloriously perfect voice, as perfect as Caruso's. and the two of them have not since been equalled: but Gigli was a kind of feminine Caruso, more lyric, with less metal—though there was plenty, even so. If Caruso's tones were, to use an anachronism. chrome plated. then Gigli's were nickel plate, beautifully polished.

The Gigli recordings. all electrically made, sound astonishingly old fashioned. It isn't the frequency limitation so much as the style of recording, the oddly dead acoustics, the ploppy bass sounds. almost in the style of the acoustic hepped-up "orchestras." It took awhile before music got accustomed to electricity.

Elizabeth Schumann — Schubert Songs, Vol. II.

Angel COLH 131 mono

Here is the finest lieder singer of her generation (she was active in the twenties and through the war, and died in 1952). The record is a priceless documentary, along with its companion, COLH 130, of her earlier Schubert recordings. Not only was the voice true and beautifully produced but Schumann's character was somehow ideally suited to the fresh, almost naive early Romanticism of Schubert. She felt each song in a personal way that is rarely experienced today by the "sing everything" singers who grace our concert halls.

Beginners will find Schumann a bit old-fashioned in her approach—why not?—and perhaps the concentrated dose of Schubert may prove too much for an evening. But these Schumann recordings are treasures to get at slowly. It should take years, rightly, and well worth it.

The recordings, for our ears, are dull in tone, minus our accustomed big liveness (purely a matter of recording style) and minus the high tones which have become essential for us. There is considerable distortion in the louder passages, often fluctuating along with the singer's natural vibrato. No Schumann fan will allow such trivialities to intrude.

VOICES OF TODAY

Orff: Antigone. Borkh. Hellmann, Borg, etc., Members Bavarian Radio Symphony, Chorus Bavarian Radio, Leitner.

Deutsche Grammophon 18 717-18-19 (3) mono

(stereo: 138 717-18-19)

Phew! This utterly splendid production of a modern German operatic classic is awesome to look at, what with the gorgeously conceived packaging. the complete English libretto and a stunning big booklet in three languages, with the German text in large type. But, I fear. you must have a thoroughly German temperament to survive the opera itself.

Most Americans find Carl Orff's lighter, more humorous works highly intriguing. with their hypnotic rhythms and atavistic sounds out of some primitive world equipped with the fanciest modern percussion ensemble imaginable. Most of us are hypnotized, too, by Orff's radically un-Schoenbergian tonality—most of the music is built on a single chord that goes on and on, over and over, to distraction.

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Fabulous EDDIE ODBORN at the *(new stereophonic)* BALDWIN ORGAN—Hey Look Me Over, Moon River, Ferdinand The Bull, Some Day You'll Want Me To Want You.
AFLP 1968 AFSD 5968

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AFLP 1969/AFSD 5969

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EL DEBKE, Naif Agby & Orch. (New Release) Btestahil (You Deserve It), Mawal (Solo), Rouh, Rouh (Go, Go!), Samra Ya Tamili (Beautiful Brunette).
AFLP 1980 AFSD 5980

JAZZ—

AL HIRT SWINGIN' DIXIE—Deep River, Moonglow, Farewell Blues, Milenburg Joys.
AFLP 1927 AFSD 5927

LOUIE and the DUKES OF DIXIELAND, Louis Armstrong — Bourbon St. Parade, Avalon, New Orleans, Sheik Of Araby.
AFLP 1924 AFSD 5924

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But in unrelieved tragedy of this sort the Germanic urge to heroic extremes is more than most of us can take. This is as stark and horrifying a story as the "Elektra" of Strauss, but the eternal sameness of the key, the persistently hypnotic rhythms, drove me away after two sides—I was by then supremely bored, period. Let 'em shriek, let 'em have their tragedy, *but don't bother me any longer*, was my thought. This was German dogmatism, not Greek tragedy.

Well, there are other viewpoints, as is well indicated by the superb devotion of the splendid cast of performers here, both instrumental and vocal. Try for yourself. But I must warn you that, though Orff calls—again dogmatically, to my taste—for an incredible array of instruments including no less than six grand pianos with their lids taken off, the accompanying sounds are the same old Orff twangs, crashes, zings. The Company notes that this is the first full-scale performance of the work —the six pianos *et al* being impractical for "live" operatic production! Well, maybe so. I'd rather have fewer, and something to look at as well as listen to. We seem to have here a German version of the economy of abundance.

Strauss: "Elektra." Borkh, Schech, Madiera, Fischer-Dieskau; Saxon State Orch., Opera Chorus, Dresden, Karl Boehm.
Deutsche Grammophon 18 690-91 (2) mono
(stereo: 138 690-91)

Carl Orff and Richard Strauss picked similar subjects for their neo-Greek operas. "Elektra" is as German in its feeling as Orff's "Antigone" but musically it is a very different kettle of German Fisch. Strauss, too, back in 1907, composed in his own dogmatic and persistent manner, demanding every bit of your emotional attention, like Wagner himself; but the Strauss emotional palette is infinitely more varied than Orff's, within the then-radical new style of horror, the harmonic patterns are splendidly fluid and, above all, the sung text is projected with the unique musical power that will make Strauss the greatest opera composer of the Twentieth century when all is said and done. There was no boredom for me here, and there was real horror when the ghastly murders are heard offstage in the final section, as well as previously when the almost animal-like passions of the women are relentlessly and skillfully exposed in music. All this, though D-G enclosed no libretto in my copy and I had to flounder along as best I could with the printed synopsis. Not too difficult, at that.

A stunningly beautiful performance—every member here is outstandingly good and powerfully dedicated to the music itself. For those who know our eclectic American way of assembling opera casts from any old country, all over the world, the extraordinary unity of this cast, in performing style, in understanding and even in tonal resources, should be an eye opener. This is the *only* way properly to do a great national opera, out of a single school.

Better try the stereo—MGM has been sending me mono issues. With stereo—this must be absolutely bone-chilling!

Brahms: A German Requiem. Schwarzkopf, Fischer-Dieskau; Philharmonia Orch. and Chorus, Klemperer.
Angel SBL 3624 (2) stereo

Otto Klemperer is turning to the great sidepieces of the classic repertory in his epic survey of the literature which was still young when he was young. This Brahms "Requiem" is perhaps not relatively as outstanding as are his Beethoven symphonies—Fischer-Dieskau has sung its great baritone role marvelously in at least two other recordings of the work—but at least this is a performance of great individuality with some "new ideas" from a very old man that may startle those who know the music comfortably well.

His second movement, for instance, about all flesh being as the grass, moves much faster than usual, and to good effect, and the immense fugues, especially the first, "Worthy are Thou" (as it is sung in English) are sustained without the usual hysterics that cause most choruses to shriek in sheer exhaustion before the end is reached! Schwartzkopf, a great singer, is somewhat miscast here. She is too personal, too dramatic for the distant loveliness of the soprano aria about the mother who comforteth.

Gorgeous stereo, of course, and fine British singing, though it's hard to know whether you're hearing English or German.

Purcell: Dido and Aeneas. St. Anthony Singers, English Chamber Orch., Lewis.
L'Oiseau-Lyre SOL 60047 stereo

Old Queen Dido's famous little opera, the first in English musical history, has been going through a difficult re-appraisal these days, as the new "authentic" movement makes more and more demands for a restoration of at least the outward original format of musical presentation. The last "Dido" I heard out of England featured Flagstad and it was hardly authentic, though beautiful in its own way.

This new version is surely the finest adjustment yet to the new demands—a highly musical, imaginative, communicative performance with the essential elements of the original properly restored—the continuo of harpsichord and cello, for instance, and a recitative style that speaks naturally and fluently without sentimental dragging. Also, the tempi are restored to Baroque credibility, especially the glorious final lament of Dido, one of the towering masterpieces of our art, which has been mercilessly dragged out in Wagnerian style for too many years. It moves, here, with simplicity and enhanced loveliness.

Only the actual voices, understandably, remain wholly modern, the voices of present-day England as heard in other music of varying times. Perhaps it cannot be otherwise; not, at least, until a school of vocal art arises that can produce singers who perform musically and yet with the nasal sound and brilliance, the lack of vibrato and the extreme accuracy and flexibility that are indicated as having been normal in the Baroque period.

PIANISTS

Beethoven: Piano Sonatas Op. 109, 111; Op. 26 81a ("Les Adieux"). Wilhelm Backhaus.

London CS 6246; 6247 stereo

One of the remaining grand old men of the piano, Backhaus plays Beethoven in a style already startlingly unlike what has become the norm today in a fast-moving age. The Backhaus admirers remain legion, for he is almost a last representative of the great dramatic playing of the earlier part of the century. (Who knows what Beethoven sounded like before then? We have no records.)

Backhaus plays for big effect, for high drama. He sees the large emotional shapes, the towering Beethoven—indeed, he is best in the big works, somewhat ponderous in such smaller but lovely sonatas as Op. 28, sometimes called the "Pastoral." (Andor Foldes' recent version is far more persuasive on Deutsche Grammophon, as recently reviewed.) There is an immense bass on the Backhaus piano, rightly exploited by London's engineers, and it comes through in lordly fashion, never percussive, always impressively big. In an older manner, Backhaus uses a great deal of pedaling, for sensuous expression; younger listeners may be disturbed by it though for older ears the effect will seem wholly normal.

At first I found myself (as a still-young ear!) annoyed at the Backhaus dramatics. I've been listening to the newer pianists, Alfred Brendel, Andor Foldes. But in short order, having made a mental readjustment, I fell for the undoubted Backhaus spell. I don't like the dramatics, the pedal; but they swept me along just the same. The old man puts on a tremendous show and no two ways about it.

Which goes to indicate that, as always, the thing about great music is its infinite ability to accede to changes in styles and feelings, from generation to generation. Perhaps for the first time in history we now can fully understand these changes in music, for we can hear them directly for ourselves, AB. We can manipulate time itself to fit our listening convenience.

Everyone who likes Beethoven should have a slice of Backhaus-time on hand for aesthetic reference. A whole age of Beethoven pianism is deep-frozen here for your inspection!

Beethoven: Piano Music, Vol. 1: Variations. Alfred Brendel.

Vox VBX 416 mono

Schubert: Moments Musicaux, Op. 94; Three Pieces, Op. Posth. Alfred Brendel.

Vox PL 12.140 mono

Alfred Brendel Plays Liszt. (solo and with orchestra.

Vox PL 11.030 mono

No doubt about it, this Alfred Brendel is one of the top younger pianists. Born in 1931, he shares the typical pianistic manners of his time, somewhat dry, percussive sounds, little use of the pedal, a driving energy along with an almost ascetic avoidance of high drama; yet these qualities are tempered by an appealing Austrian softness and a superb understanding of the German and, especially, the Austrian musical tradition. Beyond all this is an infallible musical ear, that raises a splendid technique and an intelligent perception to really tremendous levels of communicative power. I enjoyed every minute of all of these varied performances. There should be more Beethoven on the way and it should be outstanding. The Schubert is wonderfully well played and—miracle—so is the Liszt. Brendel can play "big" and "small" with equal perception. The Liszt record is particularly interesting for the seldom-heard late works included, music of almost acid intensity, extraordinary dissonance and virtual atonality.

Evidently Vox doesn't think much of stereo piano. None of these, apparently, is available in the stereo medium. Many engineers agree; but I don't. I find stereo as good for a single piano as for a large orchestra—or a piano and violin duo. Brendel's piano, incidentally, is of the somewhat dry and woody sounding central European type, quite unlike the more grandiloquent Steinways of America. It's good for the music, including the Liszt.

SPECIALTIES

Bach: Complete Harpsichord Concerti. R. Veyron-Lacroix, et al.; Jean-Francois Paillard Chamber Orch.

Westminster-Erato WST 17016-19 stereo

A quick note to mark a superb use of the stereo medium to bring out the best in some excellent French Bach. The last disc, concerti for 3 and 4 harpsichords, takes the stereo cake—without stereo, the sound is almost unintelligible but with stereo separation one can hear each of the four harpsichords, or three, as Bach meant them to be heard. Excellent low-level harpsichord miking—you can turn your volume way up without spoiling the balance and tone of the instruments against the orchestra. Try these in reverse order; the first two contain the six one-harpsichord concerti, the third those for two harpsichords.

Odd note: Westminster's seating diagram shows the harpsichords in reverse—with their flat (bass) sides to the right instead of the left. Somebody's face ought to be pink. (Imagine trying to play on a reversed keyboard, treble notes where bass ought to be!)

Cream Puffs aus Wien. (Dulcet and Delightful Dances from Old Vienna in Original Scoring). The Boskovsky Ensemble.

Vanguard VSD 2129 stereo

"Authentic" and lovely, though to be taken in moderate doses, these Viennese dances are played by an ensemble out of Vienna itself under the solo-violin direction (like Johann Strauss) of Willi Boskovsky. The "original" scoring seems here to call for an odd mixture of solo violin, horns, clarinets ad lib plus fiddles and bass—the latter going *oompah* with a pleasant grunting sound. The range is from Beethoven and Schubert to Johann, Jr. Nothing is said about the reportedly huge orchestras that played later Viennese waltzes; I guess these were for small occasions. Æ

JAZZ and all that

CHARLES A. ROBERTSON

STEREO

Quincy Jones: Bossa Nova
Mercury Stereo SR60751

Stan Getz-Gary McFarland: Big Band Bossa Nova
Verve Stereo V6-8494

The rush to cash in on bossa nova is resulting in a good deal of recorded bossa nada, but in this instance the intense competition almost revives the bad old days of battles of bands. The contest is actually between arrangers, as more than one of the players appear on both stands, a practice which used to be against the rules. And the real measure of the respective skills of Quincy Jones and Gary McFarland lies in a successful transference of the subtle Brazilian rhythms to a larger jazz framework. Small groups won popularity for the new jazz samba, and much of the fragile charm is usually lost as the number of musicians increases. If examples imported to date from the country of origin are any criterion, much of the jazz content also disappears. By proving that the music is sinewy enough to support extra manpower and still swing, both arrangers serve notice of its durability. It should be around longer than any of its detractors think possible.

When Jones tells how the feat was accomplished, he speaks in all probability for his rival as well: "The biggest problem was orchestrating the rhythm, so that it would be compatible with the music going on over it. You have to keep it from sounding too weighty, because it's a floating rhythm. One of the things that makes bossa nova so rich is that it is strong rhythmically and harmonically. I think its influence on jazz will be lasting, rather than temporary."

"It will produce in jazz musicians a greater respect for polyrhythms. It has opened an escape hatch from the 2/4 and 4/4 trap jazz has been in. Jazz musicians have been experimenting with other time figures for the last few years, of course, but bossa nova really provides a fresh new direction."

Borrowing the Dizzy Gillespie rhythm section intact for the date gives Jones the basis for a ready answer to the question of joining suppleness with strength. Lalo Schifrin, Chris White and Rudy Collins are partnered with three Latin percussionists, who assure the required amount of authenticity, and guitarist Jim Hall also helps out. A hearty brass section restores several of the more overworked titles to another lease on life, but of even greater interest is the addition of new tunes to the bossa nova repertoire. Besides a carnival touch on *Serenata,* and *On The Street Where You Live,* Jones introduces his own topical entry *Soul Bossa Nova.* Other originals from above the equator are a sultry blues theme from Schifrin, and an amusing adaptation of boogie beat from Charlie Mingus. While allowing brass and reeds to show plenty of ensemble bite, engineer Phil Ramone keeps the sections from getting out of hand in nicely balanced stereo.

Stan Getz lightens McFarland's burden considerably, as the most plodding rhythm team would pick up its heels in pursuit of the tenor saxist's floating tone. On hearing Getz in his first jazz samba encounter, so many listeners pricked up their ears at the same melodic sound that the recording became a tremendous hit and did much to establish the new import. This sequel is equally satisfying, as Getz retains a warm and personal approach in moving to less intimate surroundings. Sharing solo honors are such fellow romanticists as Clark Terry, Doc Severinsen and Bob Brookmeyer. Jim Hall and Jose Paulo switch bandstands to assist pianist Hank Jones and drummer Johnny Rae.

McFarland freshens the more familiar tunes with a sprinkling of colorful orchestral effects from Ray Alongo on French horn, Eddie Caine on alto flute, and Romeo Penque on bass clarinet. His four originals include the lyrical *Night Sadness,* and the whole band gets a chance to shout on the lively *Street Dance.* Tape enthusiasts should have no regrets about waiting for a four-track stereo version to appear. The only duplication in the two sets is Antonio Jobim's *Chega De Saudade,* but experienced battle veterans will find many points to referee.

Barbara Dane: On My Way
Capitol Stereo ST1758

In spite of all the recent improvement in recording techniques, the life-size Barbara Dane is still too much to be contained in tiny grooves. The sound on her best album to date, with Earl Hines at the keyboard in a pickup group, was through some misfortune barely adequate. Even though this first effort for Capitol receives the finest stereo treatment possible, the results are still something less than when she performs in person. Abetted by a vibrant personality, the blonde beauty has no trouble selling a song to club patrons. Cold studio walls are far from inhibiting in this instance, but they do seem to cause the singer to hasten through a number when a deliberate pace might be pursued to greater effect. Chances are a recorded appearance before an audience would correct slight errors in timing and give her admirers the album they are waiting to hear. Until then, her LP's are too few to pass any by, and the present one will serve to spread her fame and introduce the group regularly employed in her act.

Unlike many of the newer blues singers, Miss Dane is also an entertainer and exhumes such non-ethnic items as *Goodby Daddy Goodby,* and Alex Hill's *Draggin' My Heart Around.* Wellman Braud, veteran Ellington bassist, came out of retirement to join up, but the real find is pianist and cornetist Kenny Whitson. Besides handling both jobs simultaneously, with one hand allotted to each instrument, his bag of tricks includes horn solos that fit right in between Bunk Johnson and the early Louis Armstrong, and he expounds at length on *Good Old Wagon.* The Andrews Sisters, a spirited flock of gospel songsters from Berkeley, California, give an extra lift to the title song and *This Little Light Of Mine.*

Jimmy Smith: Jimmy Smith Plays Fats Waller
Blue Note Stereo ST84100

Fats Waller had so many different sides to his personality that only one or two can be covered adequately at once. In fact, just one aspect of his unlimited talent would burst the confines of a single recording date. In a reading for organ of several titles associated with the master, Jimmy Smith concentrates on a leisurely mood of after-hours playing seldom heard in the studio. Waller showed a liking for slow tempos early in his career, but in later years he found it more profitable to romp and stomp through popular tunes of the day. Smith's reputation was founded on an ability to set a rapid pace, and only recently has he revealed a gentle touch and tendency to relax. Both of these traits are agreeably displayed from the start, as Smith uses the extra space allotted to expound fully on each number and linger over a phrase longer than Waller usually could on records. By way of variety, the organist begins to stride more boldly on *Honeysuckle Rose,* and ends in a blaze of glory on *I've Found A New Baby.* Quentin Warren, a new member of the trio, plays in the tradition of Waller's favorite guitarist Al Casey, and solos strongly on *Squeeze Me.* Only three of the titles selected were composed by Waller, so much material remains for Smith to explore in the future. If anyone can work out an organ transcription of *Numb Fumblin',* or *Handful Of Keys,* Smith is the man.

Dizzy Gillespie: Dizzy On The French Riviera
Philips Stereo PHS600-048

Now that bossa nova has been around awhile, it becomes apparent that not all the bossa is particularly new. One of the fascinating aspects of this recent import is trying to detect whether a tune originated in Brazil or was an old favorite from this country that made the southern trip to return in revised form. *Night And Day,* beating tom-toms and all, can be discovered lurking in *One Note Samba,* and other familar themes often serve as brief interpolations. Anyone fortunate enough to have heard Fletcher Henderson's version of *Panama,* issued in 1926 on the Harmony label under the pseudonym of The Dixie Stompers, will immediately recognize the antecedents of *No More Blues.* Even at the early date, Henderson used in his arrangement some of the modern ideas now incorporated in Antonio Jobim's jazz samba. Described as a shimmy one step in those days, it survived as a dixieland warhorse and was played only by small groups until the current revival.

Not only are big bands featuring the tune again in its new guise, but Dizzy Gillespie took it along to astonish the crowds attending the Third International Jazz Festival at Juan-les-Pins. A ten-minute reading figures most prominently in this recording of the event, and the jaunty samba beat nearly succeeds in turning the trumpeter into a dixielander at last. The ensemble passages with alto-saxist Leo Wright are closer to the fabulous duets between Louis Armstrong and Sidney Bechet than anything in modern jazz. The regular quintet is augmented by Cuban percussionist Pepito Riestra and gypsy guitarist Elek Bacsik, a cousin of Django Reinhardt. The album, which fails to mention bossa nova except for a hastily affixed sticker on the cover, also contains *Desafinado, Pau De Arara,* and Lalo Schifrin's delightful *Long, Long Summer.* The sound effects at the start seem to be a French engineer's stereo panorama of bathers on the Riviera, as the Casino audience is certainly not waterlogged.

Kenny Ball: It's Trad
Kapp KTL41046 (4-Track UST tape)

American slang usually makes a one-way journey to Great Britain, but the word traditional has been imported from New Orleans and shorted to describe a local phenomenon called Trad. The term deserves a return ticket as it is highly appropriate to bands so designated. They invariably display a personality split between strict formality and a carefree joie de vivre. They adhere religiously to the New Orleans style of playing, but their search for new or novel material is unremitting and often follows strange paths. The Kenny Ball Jazzmen, for example, established a reputation for serious reconstruction of early jazz classics before ascending the list of best sellers by spending a *Midnight In Moscow.* This excellent four-track stereo tape comes close on the heels of that success, and the title most likely to achieve the same mark of distinction wanders even further afield. With Paddy Lightfoot's banjo blazing a trail, all levee loungers should be sufficiently aroused to join in on *March Of The Siamese Children.*

The leader's trumpet heads the parade back to the classic period on *Cornet Chop Suey, Arcadia Stomp,* and *Potato Head Blues.* Then the troops break ranks again on sighting

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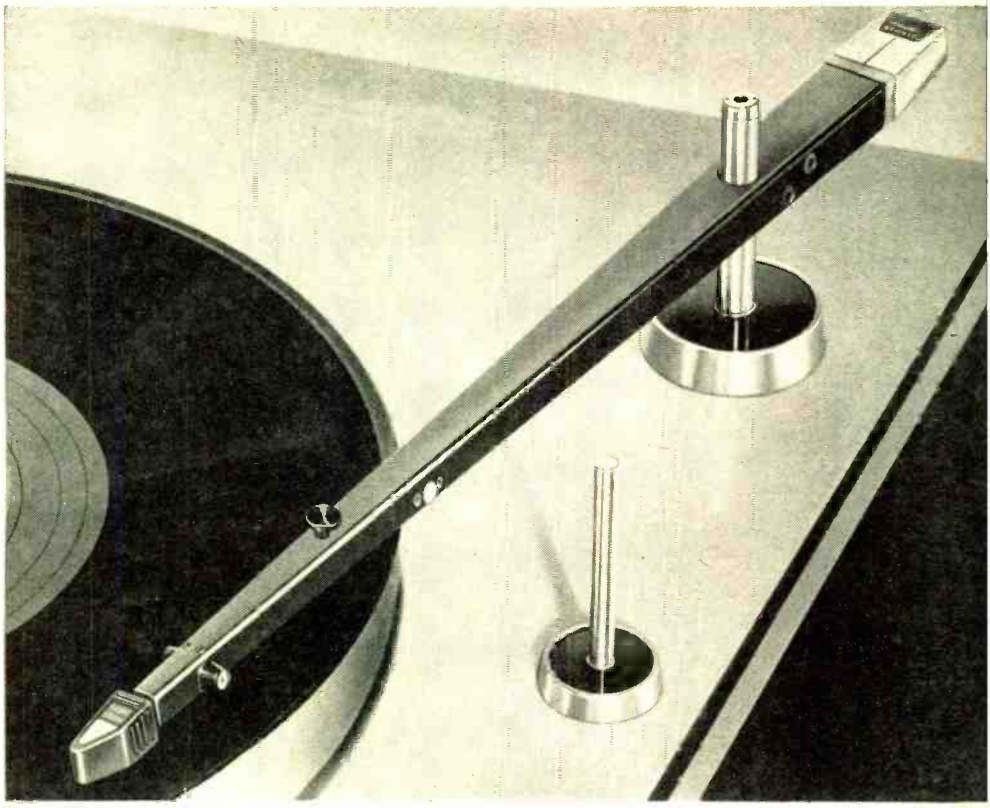

The Shure Studio Dynetic integrated tone arm and cartridge has long been recognized as a unique contribution to highest fidelity coupled with unparalleled record protection. The new Model M222 and M226 Studio Stereo Dynetic arm is significantly improved in many important respects at no increase in price: tracking force has been lowered to an ultra-light ¾ to 1½ grams. Compliance is an astounding 22 x 10^{-6} cm. per dyne! New plug-in cable makes for easy, solderless mounting. Precision .0005″ diamond tip.

The Studio Stereo Dynetic arm's no-scratch feature has been the talk of every hi fi show since its introduction—does away with the major cause of ruined records once and for all. Has actually been artificially stopped in tests to "skip" back and play the same groove over and over many thousands of times without audible damage to the groove.

Out-front needle makes it ideal for music lovers to "index" records. Instantly changeable stylus requires no tools.

Model M222 for 12″ records, Model M226 for 16″ records. Complete assembly includes Arm, Cartridge, Stylus, Plug-in Cable. $89.50 net each.

SPECIFICATIONS FOR MODELS M222 and M226	
TRACKING FORCE	¾ to 1.5 grams
FREQUENCY RESPONSE	20 to 20,000 cps without "break-up"
CHANNEL SEPARATION AT 1000 cps	Over 22.5 db
SENSITIVITY: OUTPUT AT 1000 cps	4.5 mv per channel
RECOMMENDED LOAD IMPEDANCE	47,000 ohms per channel
COMPLIANCE (VERTICAL & LATERAL)	22.0 x 10^{-6} cm per dyne
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Patented and other patents pending

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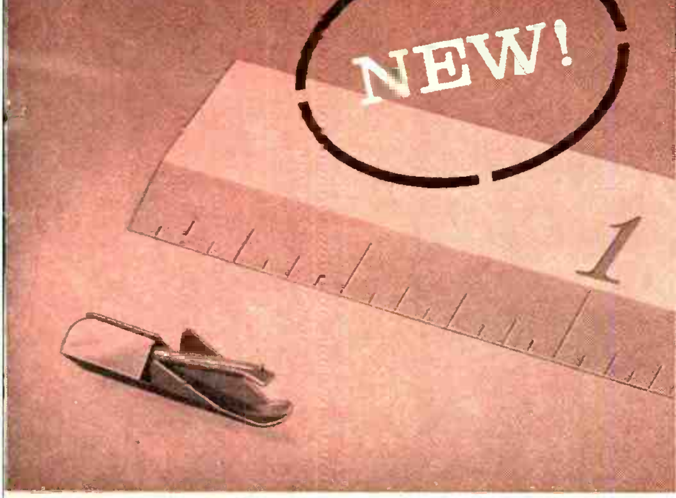

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FOR MODELS M21 • M212 • M216 • M3D • M7D • M3/N21D • M7/N21D

Now, you can upgrade your older model Shure Stereo Dynetic integrated tone arm and cartridge to equal the lighter tracking, higher compliance, improved channel separation, and superior record protection of the new Shure M222 and M226 Studio Stereo Dynetic units. Simply by replacing your old stylus with the N22D, the performance of your Shure integrated arm will be audibly improved.

Because the N22D is interchangeable with the N21D, you may wish to use this stylus as a replacement for the N21D in M7/N21D and M3/N21D Cartridges. This is an ideal means of improving the performance of these cartridges to track at forces of 1½ grams *or less.* (However, the N22D Stylus will *not* function at forces *greater* than 1½ *grams!*)

Compliance becomes 22.0 x 10^{-6} cm/dyne, separation over 22.5 db at 1000 cps, tracking from ¾ to 1.5 grams. With .0005″ diamond. $24.75 net, including counterweight for reducing tracking force of Models M212 and M216.

LITERATURE: SHURE BROTHERS, INC. 222 Hartrey Ave., Evanston, Illinois, DEPT. A-8

Vilia, *Margie*, and *The Green Leaves Of Summer*. As proof that there will always be an England, sample the septet's sturdy group vocalizing on *I Shall Not Be Moved*, and *My Old Man Said Follow The Van*. The last tune sounds as though it originated in the music halls and would be cheap at twice the price.

Arch Oboler: Lights Out, Everyone
Capitol Stereo ST1763

Everyone who remembers the "Lights Out" series from radio needs no reminder that a darkened room adds appreciably to the suspense of Arch Oboler's mad little exercises in horror. The images induced by the spoken word against a curtain of pitch-black were often more fantastic than the flickering shadows on movie screens. Oboler also wrote in almost as many sound effects as he did cues for the principal players, striving always to discover strange and disturbing terrors. The program expired when Hollywood claimed its author, but the frightening frequency response and shattering dynamics of this recorded revival are enough to raise the dead. All the devices invented in the last twenty years to startle listeners are brought into play, along with some eerie skeletons from superheterodyne days. To make the experience more harrowing, the words of advice about dousing the lights are followed by a new request that the audience be seated facing away from the loudspeakers. This devilish trick places everyone at a disadvantage, especially in stereo, when cymbals crash on either side and a huge heart begins an insistent throbbing.

Oboler has tightened his plots for the new medium, cramming examples of seven different types of suspense drama into the pot. Several members of the old radio cast have a hand in concocting a heady witches' brew, and among those stirring the mixture are Mercedes McCambridge, Bea Benadaret, and Hal "Gildersleeve" Peary. After engineer Gene Twombly drops in such items as a dentist's drill, field artillery and the wreck of a deisel engine, no respectable family turntable would serve such a dish except in the dark.

The Wonderful Belgian Band Organ
Audio Fidelity Stereo AFSD5975

One of the main attractions at the recent New York High Fidelity Show made a somewhat incongruous appearance among all the latest developments in audio components and multiplex reception. The brightly painted interloper was constructed in 1885, and even then it could hardly be considered as a likely prospect for home entertainment. It was manufactured in Belgium especially for a beer garden in Detroit, Michigan, and is billed as the world's largest band organ. Located on the first floor near a model of the Tel star exhibited by Bell Laboratories, its inner workings proved to be more of a mystery to many visitors than the well-publicized means of relaying images from continent to continent. Mr. and Mrs. Paul Eakins, the present proprietors of the massive instrument, were on hand to explain the mechanism and describe some of the difficulties of keeping it in good repair in this day and age at their Gay Nineties Village in Sikeston, Missouri. It requires 750 feet per minute of pressurized air, which passes through 1300 feet of rubber tubing, 550 feet of copper tubing, and 496 separate valves to activate 418 pipes, 22 xylophone bars, bass drum, snare drum, cymbal, and double castanets.

Perhaps the most fascinating aspects of the operation in this era of automation are the punched cards bearing the notation. Instead of resembling the continuous paper rolls used in player pianos, they look like a series of IBM cards taped together. This ancestor of the computer in turn is said to be a descendant of a system for weaving patterns and insignia. In any event, cards were being punched recently enough for this recording to include such popular songs of the epoch as *Pennsylvania Polka*, *Rancho Grande*, and *Yes, We Have No Bananas*. Next to melodic aids to beer drinking, the behemoth seems to prefer such martial airs as *Semper Fidelis*, *Washington Post*, and *Anchors Aweigh*. Stereo delivers the whole shebang to any basement rathskeller or rumpus room, but the real test is whether it can teach a computer to march and drink beer.

Ray Brown with the All-Star Big Band
Verve VSTC270 (4-track UST tape)

This session came about through one of the mutual exchanges that record companies occasionally set up to bring contracted stars together in hope of a successful meeting and some incidental financial gain. Everything might have worked out better in this case had Verve forgotten about borrowing Cannonball and Nat Adderley from Riverside and just hired Sam Jones. Not that the Adderley brothers fail to perform as expected, but they have both done as well or better before on much the same material, including Nat's soulpiece *Work Song*. The most rewarding moments occur when their regular bassist supplies his mentor Ray Brown with an apt supporting phrase, or when the two bassists work together all too briefly as a team. Aside from leaving plenty of open space for Brown to fill, the arrangements by Ernie Wilkins and Al Cohn hew closely to conventional big-band lines. More varied instrumentation and a less unwieldy mass to handle could have resulted in a more imaginative showcasing of Brown's poll-winning talent. As it is, his plucked responses to the eighteen-man ensemble must be boosted to unnatural levels, and the louder climaxes contribute one or two instances of tape print-through during quieter bass or cello interludes. Brown solos brilliantly on Oscar Pettiford's *Tricotism*, and his own *Thumbstring*, but the band never adds enough to warrant all the trouble. Featuring Jones and Brown as equal partners on opposite stereo channels, allowing both to alternate on cello or bowed bass, and better writing might turn the tide next time.

MONO

Jim Copp-Ed Brown: A Fidgety Frolic
Playhouse 505

Seasonal greetings from the team of Jim Copp and Ed Brown always receive a ready welcome in the home of any audio-conscious family, as they provide aural enjoyment for young and old alike. They are sent out only once a year by a firm which could easily substantiate a claim to being the sole one-record company in the world. The current frolic is the fifth installment in a continuing volume of tales and fables, told with a great variety of sound effects and lots of tape trickery. If the creators have developed any theories about children over the years, the first and foremost must be that all small fry like trips. A number of fascinating expeditions are planned, and they succeed in making each one a frolicking adventure, including a hen on a train ride, animals on parade, dollies flying to the moon, and a monkey balloonist. A picnic is held on a flat concrete place where a sign says seventy-five miles per hour. Any child knows better than to set up camp on a speedway, but all probably think trying it would be fun.

Besides meeting a zany cast of characters, adults will be treated to an instructive display of multiple recording techniques. The most interesting are designed to face the challenge of stereo by cramming as much space and motion into monophonic grooves as possible. Æ

ORGAN TUNING

(*from page 32*)

7. Set the tuner dial at 3.0. In this case, 48 pattern shifts in 30 seconds equals 1.6 per second, or a 0.200-cps deviation from the original frequency. The frequency at 3.0 on the dial would be 27.300 cps.

8. Recheck 36.0 for stability and repeat Step 7. if stability is questionable.

9. Set the tuner dial at 48.0. Note that the pattern is sliding in a direction opposite to those of Steps 3., 5., and 7. The reason is that the frequency at 48.0

TUNING ORGANS

(*from page 32*)

on the dial is higher than 27.500 cps therefore the deviation frequency must be added rather than subtracted. In this case, 16 pattern shifts per second are equivalent to a 0.067-cps frequency deviation, and thereby establish 27.567 cycles as the frequency for 48.0.

10. Recheck the 36.0 setting.

11. Set the tuner dial at 63.0. Play A3, count the pattern shifts, and calculate the frequency deviation. A count of 36 shifts per 30-second period gives a frequency deviation of 0.150 cps. and a calibration reading of 27.650 cps.

12. Recheck the 36.0 setting.

13. Set the tuner dial at 78.0. Play A3. A count of 56 shifts per 30-second period establishes the point at 27.733 cps.

14. Recheck 36.0 for stability. This step completes the collection of calibration data.

15. Plot all points on a set of graphs, as shown in *Fig*. 6. Two sheets of 8-by-10 inch graph paper provide an expanded scale. Draw a line correcting all points. The line should be almost straight. From the two graphs, all frequencies between 27.300 and 27.700 can be found to the third decimal place for the corresponding divisions on the oscillator dial.

Tabulation of Tuning Data

With the calibration completed, all that remains before organs can be tuned is to compile a table similar to Table 1. Table 1 shows the dial settings which are obtained for each of the twelve tones in the chromatic scale in the calibration of the first test model of the device (*Fig*. 7). Because each tone in the scale has its own dial setting, the table presentation is better than working from a curve each time an instrument is tuned. The dial settings are always the same, and there is less chance for error in taking data from a table than points from a curve. In this table, the column headed "dial settings" is the only one that changes to conform to the calibration curves for a newly constructed tuner.

For correct tuner-dial reading, line "A3" should remain 36.0 because that was the point retained for the 27.500-cps starting point. The dial setting for G$^{\#}$4 is obtained from the calibration curve for the dial reading at 27.687 cps. The dial reading for A$^{\#}$4 is next entered in the table for 27.421 cps. The remainder of the columns of Table 1 help to identify the scope patterns used for tuning. In addition, they show the exact frequency relationships that are used in the process of tuning. In the column headed "patterns" the figure numbers refer to each of the three types of patterns illustrated.

The dial settings for D$^{\#}$5, F5, G5, and D6 represent normal frequencies in the

27.5-cps range, but the pattern on the scope is slightly different from those of the other notes as they are tuned. The table indicates that the multipliers for these four tones are 22.5, 25.5, 28.5, and 42.5 respectively. In the case of D#5, there would be exactly 22.5 sine waves in the scope pattern when the 622.252-cps tone from the organ is synchronized with the 27.656-cps signal from the tuner. The scope traces for the alternate sets of sine waves are 180 degrees out of phase, so the pattern resembles that shown in *Fig.* 8. This pattern is as easily identified as the single sine-wave patterns, and is even more accurate in the determining of synchronization because both starting traces must stand still. Twice the frequencies of each of the four tones (specifically D#6, F6, G6, and D7) can be used because they would produce single sine waves; this calculation, however, doubles the number of sine waves in each pattern and thus makes them more difficult to identify. It also deviates from the principle of accurately tuning one reference octave in the middle of the keyboard as the starting point for tuning the remaining tones.

Tuning Procedure

In the actual tuning of an organ with this system, the 36.0 dial setting should be checked against the A3 tone from the organ after each step or every two or three steps. As previously mentioned, this precaution is taken in case the tuner-oscillator is drifting and resetting of the range knob is necessary. In tuning instruments it is recommended that step-by-step procedures be followed as shown in Table 1. Such practice certifies that no tone is omitted. Individual tones can be rechecked against A3 at any time, which is the reason that this method provides and additional advantage over other tuning systems. The reference octave, as prescribed in the table, can be tuned in a matter of minutes. This last step completes the job for the divider type organs. For other types, the tuning procedure is as follows:

1. Tune A4 by synchronizing the tuner-oscillator with A3. Play A4 and tune it until the scope pattern stands still.
2. Tune D5 from D6 by synchronizing the tuner-oscillator with D6, and then tuning D5 against the tuner; the octave G#4 through G5 is now tuned accurately, and is designated the "reference" octave.
3. Tune each of the A's in the organ one at a time, against the tuner-oscillator; A4 is used as the reference to check or reset the tuner periodically.
4. Tune each of the B's against the tuner; B4 is used as the reference.
5. Tune each of the E's against the tuner; E5 is used as the reference.
6. Tune G#3 and all octaves above it against the tuner; G#4 is used as the reference. G#2 is then tuned by playing it simultaneously with G#3 and watching for a zero beat on the scope. G#1 is then tuned by zero-beating it against G#2.
7. Tune the octave tones above A#3, C4, C#3, D6, D#5, F#5, and G5 with their respective references by use of the tuner-oscillator. The lower octaves of these seven notes are tuned by use of the scope and the zero-beat technique. Æ

Table 1. Tuning Procedure

Tune	Dial Setting	Pattern	Multiplier	Reference Freq. (cps)	Actual Freq. (cps)
A3[1]	—	*Fig.* 4	—	60	220
—[2]	36.0	*Fig.* 5	8	27.500	220
G#4[3]	69.7	*Fig.* 5	15	27.687	415.305
A#4[4]	22.6	*Fig.* 5	17	27.421	466.162
B4	25.5	*Fig.* 5	18	27.438	493.883
C5	43.0	*Fig.* 5	19	27.540	523.251
C#5	75.3	*Fig.* 5	20	27.718	554.365
D#5	64.1	*Fig.* 8	22.5	27.656	622.252
E5	30.8	*Fig.* 5	24	27.469	659.254
F5	17.7	*Fig.* 8	25.5	27.390	698.456
F#5	20.5	*Fig.* 5	27	27.407	739.989
G5	37.5	*Fig.* 8	28.5	27.508	783.991
D6	61.0	*Fig.* 8	42.5	27.639	1174.659

[1] Scope on LINE scan.
[2] Scope on EXT. SYNC., sound A3, set range knob.
[3] Tune G#4 then check 36.0 with A3 tone.
[4] Recheck 36.0 periodically with A3 tone.

The Pro's Nest

Saul J. White
Chief Engr., Audio Div.,
Rek-O-Kut Co.

No. 11 *"DO WE HEAR ENOUGH?"*

Nature has been good to man. A perfect ear can hear roughly 20 to 20,000 cycles per second. About 10 octaves.

Whether primitive man lived in a tree or a cave, his 10 octaves of hearing gave him an instrument for survival whose value is seldom recognized in deserving measure. Who can say if many would have evolved into his present state without the aid of this wide frequency sensitivity?

Such a breadth of sensitivity frightened primitive man by the roll of thunder. The faint snapping of a twig or the scratching of a dried leaf warned him of approaching danger. Within this wide range of frequencies he could selectively identify dangers, he could ensnare his prey. It guarded him against his enemies, it brought him food, and strengthened his cunning and skills. But it made the aural arts and his hi-fi more complex.

Had we been endowed with imperfect hearing or a sharply limited frequency range, our mechano-acoustic equipment would be more than adequate. But could prehistoric man have survived the dangers, the perils and hazards of jungle life with only one or two octave range? Would not the law of tooth and claw have cut man's evolution short? Could he have been warned away from the rumbling volcano without a sensitivity to low frequencies? Could he have known that the friction sounds of dried leaves harbored a serpent, without high frequency acuity?

Consider our sense of sight. Wonderful and versatile as it is, yet our entire vision operates over a drastically restricted spectrum, for visible light covers only *one* octave. Between violet at one limit and red at the other, there exists a visual frequency ratio of only 2 to 1. In the case of audible sound, our hearing covers a frequency ratio of about 1000 to 1.

Suppose we had a yet wider range of hearing. Suppose our ears could respond to one-tenth of a cycle per second at the low end, and up to 2,000,000 cycles at the high end (about 30 octaves). Our heads would be filled with a terrible conglomeration of noise. We could "hear" the bobbing of our heads as we walked because the alternating change of ear altitude of only one inch would have the effect of a sound wave. At these low frequencies, we would hear changes in barometric pressure. We could hear changes in temperature because of the effect on atmospheric pressure. We would hear the wave of a hand, or the descent of a leaf. We would need ear muffs to protect us in elevators.

At the high end of the hearing spectrum, a thousand new sounds would be constantly raining upon us. We would detect the presence of insects and perhaps communicate with bats. We would have totally different musical instruments, possessing harmonics into the megacycle region. We could receive radio energy by a simple conversion process into acoustic waves.

We would have multiplied audio irritations a hundred times. Surely our nervous system would be tortured beyond endurance. And how in the world could we develop our hi-fi equipment to reproduce such a wide frequency range? We could never achieve this in our pickups or speakers.

Somehow our present 10 octaves seem enough and sometimes even that is too much. Let's leave it alone.

ABOUT MUSIC

Harold Lawrence

Storm in a Splicing Block

Magnetic tape replaced disc recording fifteen years ago. Out of this new medium sprang a new worker—the tape editor. Today everyone knows what function the man with the razor blade performs: his activities have been scrutinized in books, magazines, and newspaper articles dealing with recording techniques; and thousands of owners of home tape recorders have mastered the basic methods of tape splicing. Few serious record collectors are unaware that considerable tape editing goes into the making of the finest long playing discs. Yet, despite this knowledge, many artists and discophiles still look askance at the practice of tape editing.

In the days of wax cutting, recording artists had to gear themselves to perform segments of music corresponding to the duration of a record side, which extended approximately from two to four and a half minutes. It was the job of the recording director to organize the session, supervise the placement of microphones, ferret out wrong notes, and produce at least one inspired, relatively blemish-free performance per side. The discs were then processed, test pressings stamped out, and the best overall "take" selected by the artist. Musically speaking, the job was now completed. Everything that could have been done for the recording—sonic quality, balance, interpretation—was caught permanently in the peaks and valleys of the master disc.

Small wonder that veteran record producers look back nostalgically to the 78-rpm era. Not that wax-recording was an easy-going affair. The knowledge that a trivial accident (noise, horn bloop, and so on) could disqualify an otherwise faultless side, plagued both artists and recording directors. Supposedly, magnetic tape was to take the tension out of recording; it didn't. Recording is still an arduous, often exasperating task for the majority of performers, and the flexibility of magnetic tape itself aggravates this condition.

The new medium now offers opportunities which the artist with high technical standards can hardly resist. He believes he can achieve near-ideal performances in which every phrase will be shaped exactly as he wants it, each note not a fraction of a decibel louder or softer than it should be, and the whole conveying the excitement of a "live" concert with an audience of responsive, sophisticated music lovers. Hundreds of takes—some long, some short, and many fragmentary—may go into this dream performance. At least as much time is spent in the control booth listening to playbacks as in the actual performance. The recording director pencils in the preliminary editing instructions: "Use take #5 from A to B . . . best ensemble between flute and solo on take #7. . . . For truest high E at end of cadenza, use take #24." More than half an hour may sometimes be devoted to clearing up a bridge passage lasting only a dozen measures.

After the musicians depart and the engineers have dismantled their equipment, the tapes are sent to the studio where the tedious "audio darkroom" work begins.

Watching the Flags Go By

In the jargon of the recording world, the patches of white splicing tape on a master reel are called "flags." Editors pride themselves in turning out a recording in which none of the splice points are heard. Each flag represents an achievement to them: the elimination of a wrong note, the improvement of a tutti ensemble, the smoothing out of a scale passage, or the replacement of a cracked high note with a perfect, ringing tone.

The critics of tape editing maintain that performances too often are "made" on the concave surface of the splicing block. What the public hears, they say, could be merely a clever montage of takes, technically perfect but musically sterile.

Ban the Blade

The question, "Is editing ethical?", was brought up at a recent meeting of the National Academy of Recording Arts and Sciences. Nobody went so far as to propose a return to the 78-rpm system of recording, but some of the participants were against tape editing in principle when it served to misrepresent a performer's capabilities. "Cannonball" Adderley, the jazz saxophonist, believed that the record buyer was entitled to hear an artist on records "the way he really sounds in person." Furthermore, he went on, it was the critic's job to compare an artist's "live" work with his recorded efforts. In support of this, Bob Rolontz, of *The Billboard* Magazine, observed that the artist whose performances have been spliced together does not reveal himself for what he is, but for what he would like to be. Billy Taylor, the panel's moderator, urged the record companies to print the location of each splice point on the record jacket, along with all the technical data. In short, the anti-edit faction preferred the documentary approach to recording.

Irving Kolodin, music editor of *The Saturday Review*, compared disc-recording with movie-making. In each case, the producer comes up with many takes of the same material, afterwards combining the best elements into an effective unit. The experienced listener, Kolodin contended, accepts the splicing block just as he does the striped "clappers" of the film studio. Similarly, a "live" recording—that is, one made at a concert or at a night club show—may be likened to a stage play insofar as neither contains re-takes.

Nat Hentoff, the jazz critic, disputed Adderley's claim that the record critic ought to familiarize himself with an artist's "live" work before he can evaluate his discs. For one thing, Hentoff explained, it was not always possible to hear the artist in the flesh, for geographic reasons; secondly, the critic was, after all reviewing the disc as a separate entity.

There is no question, of course, that the tape editor can improve on nature. Take the case of a young Viennese pianist whose reputation in the United States was built entirely on his recorded output. His American debut proved that as a recording artist he was years ahead of his "live" abilities. There is a clear distinction between the stamina of the concert hall and that of the studio. The fact that this artist's stage performances failed to match his tapes nevertheless does not diminish the abstract musical values of the latter. Just as it is absolutely fair to line up one against the other, it is equally legitimate to review the recording as a thing apart. For despite the outcries of the opponents of tape editing, a well-turned musical phrase simply cannot be patched together.

When it comes to tonal quality, however, we are dealing with a more basic problem. The microphone can really change things: it can transform a light, lyric tenor into a booming, Wagnerian *heldentenor,* or make a harpsichord resemble a steel band. Fernando Valenti, the harpsichordist, spoke of the audiences who attended his recitals: "You're in a mess of trouble when you play in person. People come to hear me play because they've heard my records. Many of these concertgoers have never heard a "live" harpsichord before. Now, hearing the small sound my instrument produces in a large hall, they wonder whether I haven't been taking my vitamins. I sense this, of course, and try unwittingly at times to play louder. But the harder I hit the harpsichord, the harder it does *not* sound."

The controversy over tape editing is bound to rage for some time to come, with artists and critics taking a variety of positions. Parenthetically, it is interesting to note how often the most outspoken critics among performing artists expect the tape editor to use his blade to extricate them from tight technical spots.

To sum up, what happens to a tape after the recording is perfectly analogous to the work a photographer does to a negative in the darkroom. Which do you prefer; a fine print, or a snapshot? Æ

EQUIPMENT PROFILE

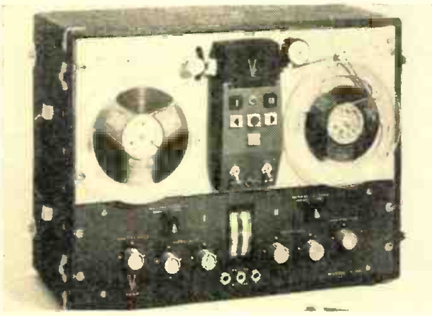
(from page 50)

the type of material this machine can record, it certainly does fill the bill where voice is the main instrument. From our own personal experience we found it excellent to record lengthy lectures and certain types of vocal performance. Also we found it great fun to record a variety of sounds in nearby New York City. We have recorded some ten hours worth on a single set of batteries without any sign of change in speed or other characteristics. We have also used it as a portable background music system when travelling in an automobile. Using the Norelco "100" in this way we could program as we wished and provide sound quality far better than our car radio could provide.

Over-all, the Norelco "100" is a good-quality completely portable tape recorder which is modestly priced (about $130). It certainly should be attractive for those who need a field recorder at a fieldmouse price. B-15

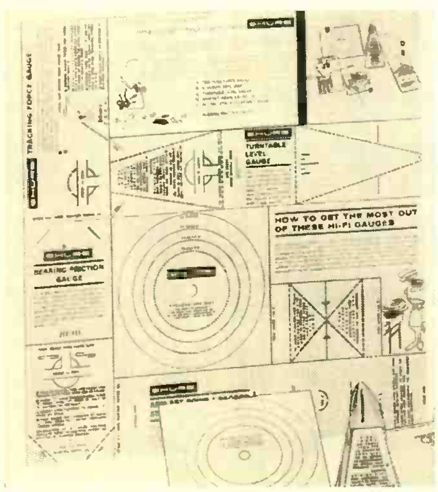
NEW PRODUCTS

• **Transistorized Professional Tape Recorder.** An all-transistorized professional magnetic tape recorder-reproducer has been developed by Vega Electronics. The transport is claimed to have the lowest wow and flutter of any commercial machine, 0.03 per cent wow and 0.08 per cent flutter, equal to 0.09 per cent combined wow and flutter, at 7½ ips. Start-stop action is so fast that it can cleanly split syllables. Priced in the "about $1700" range



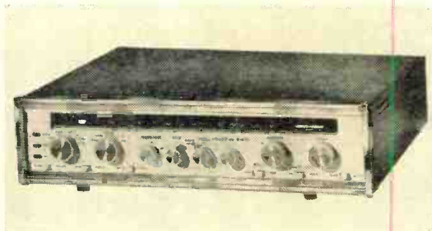
for transport and electronics, the initial version. designated the Vega Model V-30, is a two-speed, two-channel audio frequency recorder-reproducer for quarter-inch width magnetic tape. The two standard speeds are 7½ ips and 3¾ ips, with frequency response at 7½ ips of 50 to 18,000 cps, ±2 db. Other speed combinations can be supplied on special order. Vega Electronics Corporation, 10781 N. Highway 9, Cupertino, California. **B-1**

• **Practical Gauges.** By simply punching and folding a card and inserting ordinary paper clips and pennies, music lovers and audiofans can make a set of surprisingly practical gauges with which to test six functions of their record player. Basically designed for do-it-yourself, the gauges come printed on a perforated card, with full instructions for easy assembly and use. They are produced by Shure Brothers. After constructing the gauges, they can test for: 1. Tracking force; 2. bearing friction; 3. turntable level; 4. arm set-down—whether the tone arm of the automatic record player is dropping properly to engage the first record groove; 5. stack clearance—the correct record stack height



above the turntable for proper tone arm clearance; and 6. stroboscopic disc—to show if your turntable is turning too fast or too slow at any given speed setting. Despite their "home-made" qualities, these Hi-Fi Gadget Gauges are more than accurate enough to indicate whether your record player needs attention. They are available from Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Ill., for 20 cents each for postage and handling, or through your local high fidelity dealers.

• **FM-Stereo Receiver.** The Sherwood S-8000 II FM-Stereo receiver includes essentially the same circuitry as used in Sherwood's S-2100 FM-Stereo tuner and S-5500 II stereo amplifier on one compact chassis and without the usual heat dis-



sipation problems. To accomplish this, Sherwood uses newly-designed cooler-operating Novar output tubes. These tubes are placed at the rear of the chassis, tilted, and surrounded by Sherwood's exclusive air-cooled heat baffle. The receiver features: Sherwood's stereo indicator light, flywheel tuning, FM interchannel-hush circuitry, a tuning dial 20 per cent longer than most, "Acro-beam" tuning indicator. Specifications include: FM Sensitivity, 1.8 μv (IHFM); FM Selectivity, 200 kc at −3 db; FM detector, 1.0 mc peak-to-peak; FM distortion, 1/3 per cent at 100 per cent modulation; power output, each channel 32 watts music power or 30 watts continuous at 1½ per cent IM distortion. Size of the receiver is 16¼ × 4 × 14 inches. A one-year warranty is offered covering both parts and labor. Sherwood Electronics Laboratories, Inc., 4300 North California Ave., Chicago 18, Illinois. **B-2**

• **Tape Deck.** Measuring only 13 × 13 × 6¼ inches, the Knight KN-4400 is a top performance 2-speed tape deck which makes a welcome addition to a home stereo music system, or to school and institutional recording facilities. The unit provides 4-track stereo and monophonic recording and playback. It has laminated 4-track record/play head and a double-gap erase head. A built-in stereo record/play preamplifier includes dual VU meters for precise recording-level adjustment. The deck is styled in matte beige. Another special feature is a built-in multiplex subcarrier filter to assure noise-free recording of stereo FM broadcasts. The tape deck has a single sliding lever that selects rewind, stop, record/play, or fast forward. It can change from 7½ to 3¾ ips at the touch of a button. A digital counter is provided. The

deck can be mounted vertically or horizontally. It requires only a 12½-inch square cutout. The unit operates on standard 110-125 v, 60-cps a.c. Weight is 28 pounds. The KN-4400 is available from Allied at $179.95. (Allied Cat. No. 95 DU 677.) Allied Radio Corp., 100 North Western Ave., Chicago 80, Illinois. **B-3**

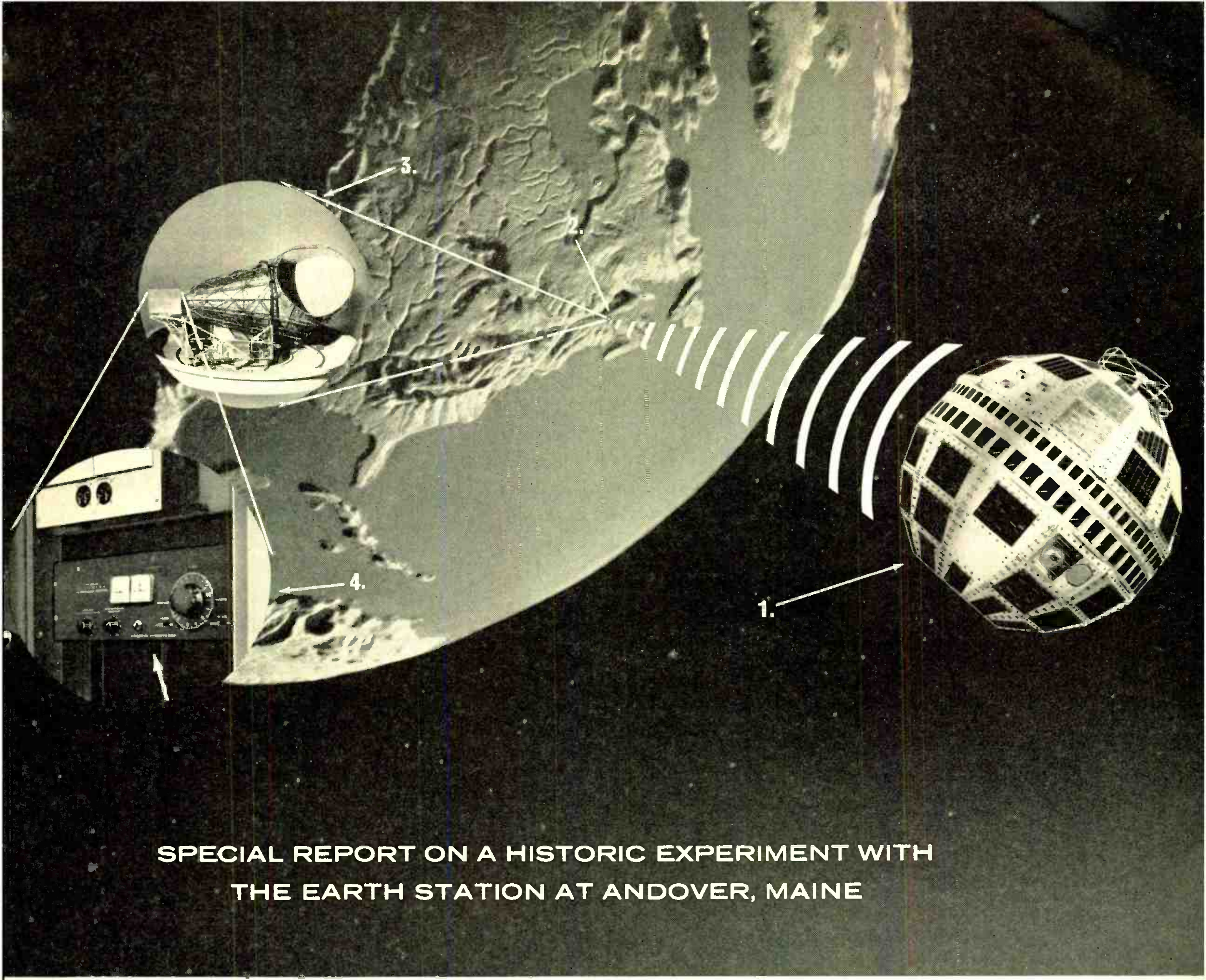
• **Tape Mixer.** A four-channel preamplifier-mixer, transistorized and self-powered, has been developed by Citroen Electronics Corporation for use with its Models 550 and 660 portable tape recorders and other amplifiers and tape recorders. The CEC Model 1400 peamplifier-mixer has four in-

put jacks and will control any combination of four microphones, tuners, phonos or radios, and each of the four can be controlled as to level individually. Priced at just $24.95, the CEC Model 1400 is available now from Citroen Electronics Corporation, 729 N. Highland Avenue, Los Angeles 38, California. **B-4**

• **Speaker System.** Altec Lansing Corporation has added the 841A "Coronado" to its speaker systems line. The new speaker system is an apartment-size version of the full-size Altec speaker system, recommended for small apartments where space will not tolerate large speakers. The "Coronado" is styled to match a pair of Carmels when used as the center speaker in an Altec three-channel stereo system. Versatility of the "Coronado" permits its use as a remote speaker to provide music

in other areas of the home or office. Priced at $199.50, the new speaker system uses an Altec 3000-type sectoral horn and an Altec 414-type bass speaker. The enclosure is finished in walnut and stands at 30-in. high, 18-in. wide, 14-in. deep. Altec Lansing Corp., 1515 S. Manchester Ave., Anaheim, Calif. **B-5**

• **New Series of Receivers.** Two new receivers have been announced by Bell Sound; the 44-watt and 30-watt AM-FM-FM-Stereo tuner-amplifier combinations, dubbed the 2445-S2 and 2425-S2 respectively. The entire face of each unit is finished in brushed gold, including the control knobs. The dial glasses carry black numerals against a brushed gold-finish background panel. Model 2445-S2 (shown) includes such features as the Bell Stereo Sentry indicator light, that automatically lights when the set is tuned to a station that is broadcasting in FM-stereo, and individual signal-strength meters on both

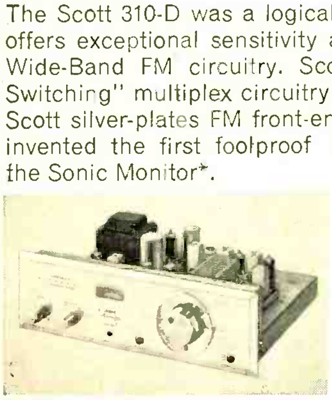


Scott® tuner used for Telstar tests...

Bell System engineers wanted to test FM reception from the Telstar Satellite orbiting in outer space. They used the sensitive Scott 310-D broadcast monitor tuner (rack mounted) for this unique experiment. FM signals were sent to Telstar where they were rebroadcast to the earth station for Communicating by Satellite at Andover, Maine. The Scott FM tuner was successfully used on this project.

Scott congratulates the Bell System on their spectacular achievement and is proud to be part of this historic project.

The Scott 310-D was a logical choice. Like all Scott tuners it offers exceptional sensitivity and selectivity. Scott pioneered Wide-Band FM circuitry. Scott engineers perfected "Time Switching" multiplex circuitry for high fidelity reception. Only Scott silver-plates FM front-ends for highest sensitivity. Scott invented the first foolproof FM Stereo signaling device — the Sonic Monitor*.


350B FM Stereo Tuner

If you want the very best FM Stereo reception choose the tuners selected by professionals . . . choose the tuner most FM stations use for monitoring their own broadcasts off the air . . . choose Scott, America's most reliable name in FM Stereo.

*Patent Pending

These superb Scott FM Stereo Tuners are proud products of the same engineering laboratories that developed the 310-D used in Telstar.

If you seek perfection choose one of these superb Scott tuners: 4310 Broadcast Monitor FM Stereo Tuner, $475*; 350B FM Stereo Tuner, $219.95*; 333 AM/FM Stereo Tuner, $259.95*; 370 FM Stereo Tuner, $169.95*; LT-110 FM Stereo Tuner Kit, $159.95*; 340 FM Stereo Tuner/70 Watt Stereo Amplifier, $379.95*; 355/208 AM/FM Stereo/80 Watt Stereo Tuner Amplifier, $469.90*.

Here's how the "Telstar" experiment worked

1. FM signals were relayed from Bell Telephone System Telstar satellite orbiting the earth at 16,000 M.P.H. at heights varying from 500 to 3,000 nautical miles. **2.** Signals were beamed to the "Earth Station for Communicating by Satellite" at Andover, Maine, where **3.** a giant horn antenna 180-feet long and 95-feet high received the signals. **4.** Installation of Scott 310-D Broadcast Monitor Tuner (Rack Mounted) at Andover, Maine.

35-2

Write today for new 1963 Hi-Fi Guide including complete details on Scott FM Stereo tuners and kits and complete "Telstar" report.

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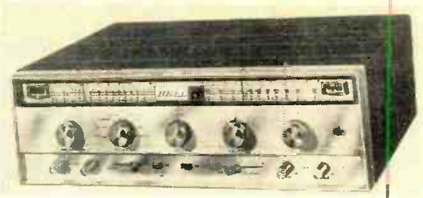
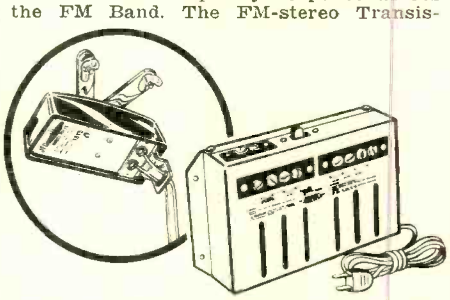
*Slightly higher west of Rockies, subject to change with this notice.



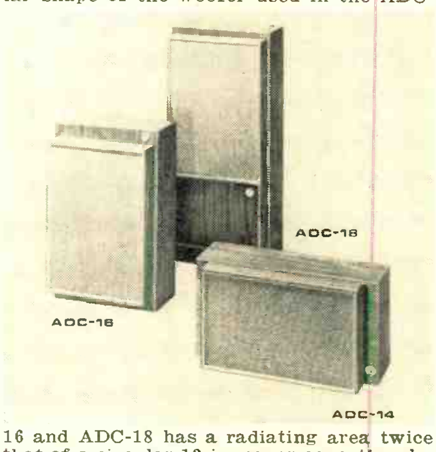
the AM and FM bands for visual tuning. Both bands are tuned by three-gang capacitors. Individual bass and treble controls for both channels, source/tape monitor switch, switched afc, high and low filters, and loudness control are also provided. The model 2425-S2 bears a strong family resemblance to the "45" with an all-gold face and knobs. It, too, provides the Bell Stereo Sentry, switched AFC and source/tape monitor switch as well as individual bass and treble controls. The 2445-S2 is priced at $319.95 and the 2425-S2 lists for $269.95. Bell Sound Division of Thompson Ramo Wooldridge, 6325 Huntley Road, Columbus 24, Ohio. **B-6**

• **FM-Stereo Antenna Amplifier.** The JFD TNT106FM amplifier is attached directly to the terminals of any FM antenna to add up to 25 db gain to that of the antenna with uniform frequency response across the FM Band. The FM-stereo Transis-



tenna converts any FM antenna into an electronically amplified antenna system capable of operating 2, 3, or 4 FM sets. It includes amplifier, 115-v a.c. power supply, and distribution system with 300-ohm jack-type outlets, at a price of $36.95. JFD Electronics Corp., 6101 Sixteenth Avenue, Brooklyn 4, New York. **B-7**

• **New Speaker Line.** Audio Dynamics Corporation announces a new line of loudspeaker systems, the ADC-14, ADC-16, and ADC-18. An accompanying speaker stand, ADC-SS1, which can be used with either ADC-14 or ADC-16 is also available. The features of the ADC line are: 1. The driver units contain a rectangular woofer employing expanded plastic and a 9-lb. ceramic magnet. The treble unit employs a 1½-in. Mylar diaphragm. 2. The rectangular shape of the woofer used in the ADC-



16 and ADC-18 has a radiating area twice that of a circular 12-in. paper cone, thereby resulting in very effective coupling to the air, requiring only small cone excursions for a large output even at very low frequencies. 3. The cabinet design is contemporary. Prices are as follows: the ADC-14 is $175.00, the ADC-16 is $220.00, the ADC-18 is $250.00, and the ADC-SS1 is $6.95. Audio Dynamics Corporation, Pickett District Rd., New Milford, Conn. **B-8**

NEW LITERATURE

• **Bulletin on Columnar Speaker.** The R. T. Bozak Manufacturing Company has released a technical bulletin on the Model CM-109-6 Columnar Speaker System. This is a professional unit for high-quality sound reinforcement over wide and deep indoor and outdoor areas. It employs six weatherproof eight-inch Bozak M-109 loudspeakers in a close-coupled vertical array in a weathertight housing. Its broad horizontal dispersion, wide frequency range, low distortion, and high power-handling capacity have made it extremely successful with voice at indoor conventions and, both in- and outdoors, at symphony concerts. The Bulletin on CM-109-6 is available on request from Bozak, Darien, Connecticut. **B-9**

• **Headphone Products.** Jensen has issued its new Brochure MH covering their new stereo headphones and headphone accessory equipment. The two-color brochure describes and illustrates Jensen's HS-1 Stereo Headphones; the new CC-1 Headphone Remote Control Center which features "Space-Perspective"; and the CFN-1 Cross-Feed Network which provides "Space-Perspective" without the remote control features. Space-Perspective involves new circuitry which makes headphone listening sound like loudspeaker listening, whereby the sound is "out-in-front" of the listener . . . an effect not previously possible in headphone listening. Space-Perspective is licensed exclusively to Jensen by CBS Laboratories Div., Columbia Broadcasting System, Inc. Jensen Manufacturing Co., 6601 South Laramie, Chicago, Illinois. **B-10**

• **"The Trader's Handbook."** Audio Exchange has a remedy for the headaches of buying high fidelity equipment—and keeping it up-to-date. The remedy is a lively new booklet called the "Trader's Handbook." It tells, clearly and simply, the complete story of Audio Exchange's nationwide trading system. The Audio Exchange system includes "trade-in" and "trade-back" of new and used equipment. Both are discussed in detail in the Trader's Handbook." Also discussed are Audio Exchange's service department, custom installations and design, free consultations, and guarantees. Since Audio Exchange has a special trade-by-mail service, it too is fully explained. The "Trader's Handbook" is available from Audio Exchange, 153–21 Hillside Avenue, Jamaica, New York. **B-11**

• **Empire Product Line.** A new brochure from Empire Scientific describes the technical features of their latest line of record playback components. There are details and diagrams of the Empire "Troubador" turntable, the 980 playback arm, the 880p cartridge, and the "Dyna-life" stylus. Also included in the brochure are product prices and a comparison chart enabling readers to compare the specifications of the Empire "Troubador" against any other record playback system. The 4-page brochure is available free of charge from Empire Scientific, 845 Stewart Avenue, Garden City, L. I., N. Y. **B-12**

• **AR Speakers and Turntable.** Catalog describes Acoustic Research speakers, including response and distortion curves of AR-2, AR-2a, and AR-3 speaker systems. Also included is a brief description and order form for two books on high fidelity published by AR, with excerpts from current reviews. Acoustic Research, Inc., 24 Thorndike Street, Cambridge 41, Massachusetts. **B-13**

• **Semiconductor Catalog.** The new Sylvania line of semiconductor devices has been published for the circuit designer by the Semiconductor Division of Sylvania Electric Products Inc. Sylvania is a subsidiary of General Telephone & Electronics Corporation. The catalog includes a numerical index of all Sylvania semiconductors and absolute maximum ratings for each type. The catalog may be obtained for ten cents by writing Sylvania Electric Products Inc., 1100 Main Street, Buffalo 9, N. Y.

VERTICAL TRACKING

(*from page 46*)

An alternative and more accurate method requires the use of an adjustable pickup arm, to allow the cartridge to be played on the record, first normally, and then elevated at a known angle E. With this method, the pickup need not be adjusted to any particular type of response; the RIAA response, for example, may be used. First the measurements of I.M. are taken on the three graduated I.M. bands of the STR-110 or the STR-111, and these are plotted in proper coordinates as shown in *Fig.* 8. It should be noted that the relative modulation velocity is placed on a linear scale, corresponding to relative values of 1.0. 1.41, and 2.0 (3-db steps). If everything is all right, a straight line should go through the three (or at least through the first two) points and the origin. Next, the arm is elevated at a known angle E, say 10 deg., and the measurements are performed again. A new straight line with the increased distortion values is plotted. Then any vertical line *a-b-c* may be drawn, and the segments *a-b* and *b-c* are measured. The pickup tracking angle is calculated as follows:

With the STR-110

$$A = E(bc/ab) + 2.5 \text{ deg.}$$

With the STR-111

$$A = E(bc/ab) + 15 \text{ deg.}$$

Here, E is the angle of added elevation, in degrees. As with the previous method, it is desirable to use the STR-110 for pickups with relatively small vertical tracking angles, and the STR-111 for those with relatively large angles.

The knowledge and instrumentation are now available for the measurement of vertical tracking angles of pickups and for control of the vertical modulation slant in records. Practically all the present-day pickups will sound better with the records embodying the 15-deg. effective modulation slant.

The new Square Wave Tracking, and Intermodulation Test Records, STR-110 and STR-111, provide a convenient means for measuring vertical tracking angles in pickups. Since the STR-111 is recorded with the 15-deg. vertical modulation slant it serves as a useful tool for checking the performance of pickups on records cut in accordance wth the new standard. Present-day pickups with reasonable vertical tracking angles and which otherwise are well designed, exhibit I.M. distortion not in excess of 1 to 3 per cent on the first vertical I.M. band of the STR-111. This statement is not intended to encourage complacency, and it is hoped that future pickups will embody the 15-deg. vertical tracking angles, in conformity with the RIAA standard. The anticipated adoption of the improved methods of modulation that we describe by others will serve further to improve the generally excellent quality of stereophonic record reproduction already obtained with the present-day equipment.

CBS Laboratories plans to offer to the Recording Industry the means for conversion to the 15-deg. modulation slant in the near future.

Acknowledgement

The author is grateful to his Colleagues at CBS Laboratories and Columbia Records: Dr. Peter C. Goldmark and Mr. William S. Bachman for stimulating interchange of ideas and support; Messrs. A. Schwartz and A. Gust for valuable discussion and assistance with the experiments; and Mr. Eric Porterfield for his excellent contributions to the practical application of the new technology to manufacturing processes. Æ

THIS MONTH'S COVER

This month we see the installation of Alan Funk of Brooklyn, N. Y. Here, in his own words, is the reason for that handsome cabinet: "When we were married in 1956, my dear and understanding wife agreed that the first major piece of furniture in our home should be a cabinet to house our newly acquired audio equipment. I knew she would frown on having equipment strewn across the living room as I had previously done as a bachelor. After careful planning with Mr. Henry Cahan of Sound Furniture Associates, we finally decided on the design of the cabinet, taking into consideration room for expansion in the future such as stereo. Naturally, we now have updated to stereo."

Each speaker system uses one wide-range driver unit. The mid and high frequencies are dispersed by reflector panels built into the top of the cabinet, while the bass is channelled down through the horn and out into the room. The speakers are set eighteen feet apart and face inward at a 45-deg. angle. This unusually wide spacing does not create a "hole in the middle" effect because of the excellent dispersion of sound. The tape recorder is in a portable case for added flexibility, but when used with the system, it is completely integrated. An amplifier switching network provides for listening or recording from FM or records using headphones plugged into the stereo amplifier, while the TV (integral) amplifier provides suitable sound through the loudspeakers.

Following is a list of components:

- Fleetwood Television Receiver, Model 810
- Scott 299B Stereo Amplifier
- Fisher 100B Stereo Tuner
- Concertone 505-4 Tape Recorder
- Electro-Voice 664 Dynamic Microphone
- Thorens TD-124 Turntable
- Ortofon RMG-212 Tone Arm
- Ortofon SPU-T Stereo Cartridge
- (2) Brociner Model 4 Corner Horn Loudspeakers (Lowther PM-2 Driver Units)
- Koss SP-3 Headphones
- Finco FM-4 Antenna
- JFD FB500 Hi-Fi Fireball TV Antenna

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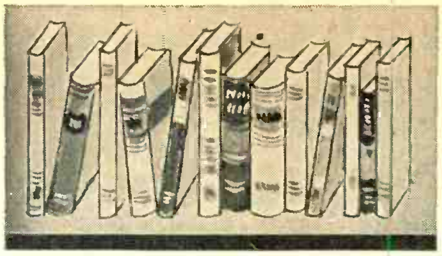

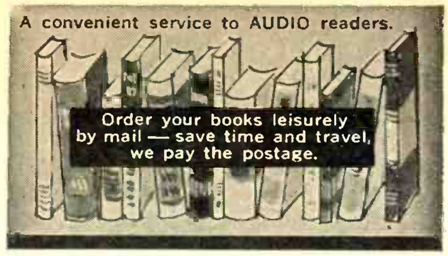

Maintaining Hi-Fi Equipment
Joseph Marshall

A valuable reference for anyone whose living or hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electronic, mechanical and acoustic problems. 224 pages.
No. 58 Paperback $2.90*

Designing and Building Hi-Fi Furniture
Jeff Markel

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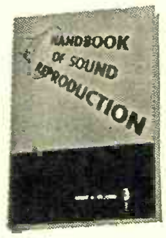
Stereo . . . How It Works
Herman Burstein

A well known authority writes on the exciting technology of stereo. Its theory and operating techniques including recording, playback, broadcasting, simulcasting, multiplexing. Covers stereo discs and tapes with a unique and practical approach. 224 pages.
No. 80 Paperback $2.90*

McProud High Fidelity Omnibook

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable context. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide.
No. 115 $2.50*

Handbook of Sound Reproduction
Edgar M. Villchur



Right up to date, a complete course on sound reproduction. Covers everything from the basic elements to individual chapters of each of the important components of a high fidelity system.
No. 110 $3.75*

Introduction to Hi-Fi
Clement Brown

An original, refreshing approach to hi-fi theory and practice—a typically British thoroughness in the discussion of pick-ups, preamps, amplifiers, speakers, acoustics, etc. — with an interesting prognosis of hi-fi in the future. The author is a renowned British authority. His style contributes a fresh new look at hi-fi. 192 pages.
No. 88 Paperback $3.20*

Tape Recorders and Tape Recording
Harold D. Weiler

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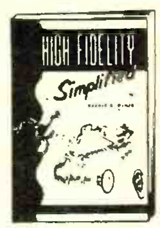

The complete hi-fi story — answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. Lots of ideas for custom installations. Tells how to achieve concert hall reception in your home. 216 pages.
No. 142 $3.30

Getting The Most Out Of Your Tape Recorder
Herman Burstein

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

(from page 42)

Using the equations mentioned previously it can easily be shown that the input resistance of the amplifier with feedback loop closed is

$$r'_i = \frac{v_i}{i_1} = r_i\,(1+\mu\beta) \qquad \text{Eq. (6)}$$

Output Resistance.

Referring to *Fig.* 20, the output resistance of the amplifier without feedback can be expressed in terms of the input as follows:

$$r_x = \frac{v_2}{i_2} \quad ; \quad v_2 = \mu v_1$$

$$v_1 = -\,i_1 R_G$$

$$r_x = -\,\mu R_G \frac{i_1}{i_2}.$$

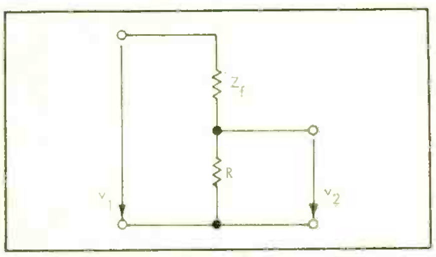

Fig. 22. Voltage-divider network.

With feedback applied to the amplifier (*Fig.* 21) the input impedance r_{if} of the feedback network is treated as a part of the "internal" load resistance of the amplifier. The "rest" of the β network is ideal and does not load the output.

The resulting new output resistance is

$$r'_o = \frac{v'_2}{i'_2}\,; \quad v'_2 = \mu v'_1$$

$$v'_1 = v_i - \beta v_2 = v_i - \mu\beta v_1$$

$$v'_1(1+\mu\beta) = v_i = -\,i' R_G$$

$$v'_2 = -\,\mu R_G \frac{i'_1}{(1+\mu\beta)}$$

$$r'_o = -\,\mu R_G \frac{i'_1}{i'_2}\,\frac{1}{(1+\mu\beta)}.$$

Since the current gain of the amplifier is not affected by voltage feedback, we may write $\frac{i'_1}{i'_2} = \frac{i_1}{i_2}$ and hence

$$r'_o = \frac{r_x}{1+\mu\beta}$$

Distortion Reduction.

In general, the distortion reduction due to feedback cannot be easily correlated with the gain reduction. For small distortion figures of the amplifier, however, a good approximation can be made.

When a pure sinewave signal is applied to the input of the amplifier μ, the output signal will consist of the amplified sine wave plus a small distortion signal v_D. When negative feedback is applied, a small fraction βv_D is fed back to input. Assuming that R_G much smaller than r_i (see *Fig.* 19), the distortion signal at the output will now be

$$v'_D = v_D - \mu\beta v'_D$$

or

$$v'_D = \frac{v_D}{1+\mu\beta}$$

Thus it can be seen that the distortion reduction due to feedback is about equal to the gain reduction. This is only an approximation since the fed-back portion of the distortion signal is again distorted in the amplifier μ, so higher order harmonics are generated. However, when the distortion of the amplifier alone is very small in the first place, these additional terms will be negligibly small.

TO BE CONCLUDED.

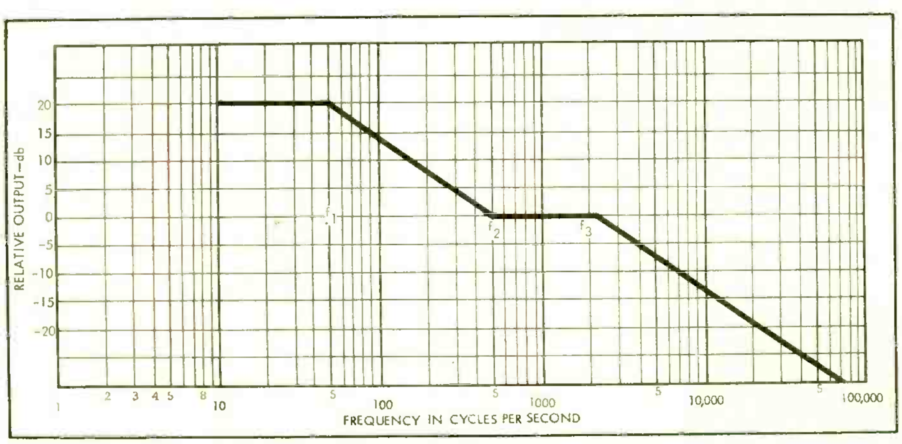

Fig. 23. RIAA playback curve.

AUDIO ETC

(from page 14)

speakers, headphones and the like, that. . . .

Well, anyhow, it didn't seem to me my lack of an E.E. would be a problem at all. I clearly fulfilled that extra little qualification *"or better."* What, I ask, could be better than an M.A., unless a Mus.D.? I was sure, too, that my equivalent experience would be highly acceptable—16 long years at one of audio's nerve centers, located in central Long Island, moments from the doorsteps of dozens of the most highly respected manufacturers, who surround the office of AUDIO in Mineola like bees around honey.

The more I pondered these lovely thoughts, the more excited I got. Ideas rushed pell mell through my head, visions of $12,000 sugar plums dancing madly, as I pored and re-pored through the material spread before you above in order to frame a suitably dignified answer to such an honorable proposal. This was the Executive life, indeed! I would answer in my most searching executive tones.

But alas, after a well-nigh sleepless night and an early-morning cold shower, I tottered to my desk and sadly wrote out the following:

"Director of Executive Search
———, ———, Inc.

Dear Sir,

Much as I would like to accept a $12,000 position, I'm afraid . . . you've got the wrong man. Though I have a large, practical knowledge of audio equipment, especially as related to music, I. . . .

Sincerely,
Edward Tatnall Canby.

Æ

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HARPSICHORD KIT—same authentic instrument as used by Philadelphia Symphony and Columbia Records. For home workshop assembly, $150. Clavichord kit, $100. Free brochure. Write: Zuckermann Harpsichords, Dept. R, 115 Christopher St., New York 14, N. Y.

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McIntosh 30-watt amplifier, $85. McIntosh C-108 monophonic preamplifier, $50. Bogen Presto TT3 turntable, PA1 arm, Pickering 380C cartridge, walnut veneer base, $75. Jensen Imperial speaker system $350. Bill D. Hull, 1905 S. Vine, Urbana, Illinois.

PIPE ORGAN REBUILDS monthly magazine, $2 year. Nostalgia and musical instrument ads. Alden E. Miller, 3212 34th Avenue South, Minneapolis 6, Minnesota.

WANTED: Used condenser microphone; Altec, Neumann, Telefunken, AKG. Charles Hendrickson, U Ark Apartments, Fayetteville, Arkansas.

Industry Notes...

● **Altec Regional Sales Manager.** Altec Lansing Corporation, a subsidiary of Ling-Temco-Vought, Inc., announces the appointment of **Jack Harvey** as Regional Sales Manager for the company's line of stereo high fidelity sound components, commercial and industrial sound system equipment, telephone communication products, microphone and broadcast equipment. Mr. Harvey's territory covers the New England states and metropolitan New York City. Prior to his appointment, Mr. Harvey had been Regional Manager of audio products for **Ampex Corporation** in southeastern United States.

● **EMT Line to Gotham.** EMT Wilhelm Franz GmbH of Wettingen, Switzerland, and its West German parent company, have appointed **Gotham Audio Corporation** their exclusive sales and service representatives for the entire United States and territories effective January 1, 1963. EMT is known in this country for its reverberation unit, studio turntables, the Studer Model C-37 professional tape recorder, and numerous pieces of test equipment and components specifically aimed at the recording and broadcasting industry.

Advertising Manager for the Jerrold Corporation. In a move clearly intended to make the over-all advertising programs more effective, Mr. Selman M. Kremer has been named advertising manager for the Jerrold Corporation. In this position he will direct corporate advertising and coordinate the advertising and promotional programs for the five subsidiary companies of the corporation: Harman-Kardon, Jerrold Electronics, TACO, Pilot Radio, and Analab Instrument Corporation. Mr. Kremer has been associated with the company for nearly 13 years and has been advertising manager of Jerrold Electronics for the past six years.

ADVERTISING INDEX


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