AUDIO

JULY / 1966
60¢

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FM-STEREO ANTENNAS

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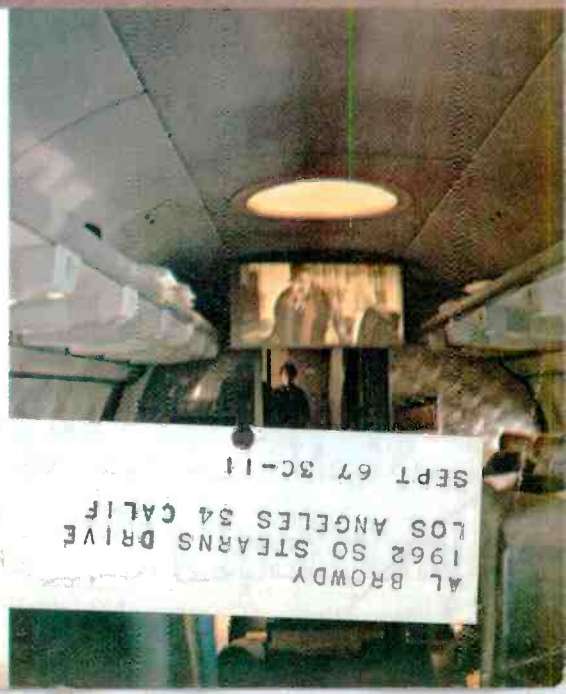
IN-FLIGHT MOVIES

AND STEREO MUSIC



New Scott 382 Receiver lets you hear more stations, more clearly! 65-watts/Space-age FET circuits* in both AM and FM/Only $339.95

Scott engineers are constantly on the search for new developments to continually improve a near-perfect product.

After experiencing the miraculous improvements FET's brought to FM, Scott engineers applied amazing new FET circuitry to Wide-Range AM. The result — the new 382 AM/FM stereo receiver — incorporating, for the first time anywhere, a Field Effect Transistor AM circuit along with Scott's astonishing FET FM front end. Introduction of this new model marks the first real improvement in AM circuitry design in more than a decade.

AM Comes of Age

Recent improvements in AM broadcasting equipment, plus the Federal Communication Commission's decision to split AM and FM programming, have given audiophiles renewed interest in superior AM reception. Introduction of the new 382 now brings Scott FET sound to the exciting news, sports, current events and music broadcasts available only on the AM band.

Scott AM Has Advanced FET Circuits

Advanced Scott 382 circuitry incorporates Automatic Variable Bandwidth, a unique feature which automatically adjusts tuner bandwidth to the quality of the incoming signal. The bandwidth automatically narrows for best reception of weak, distant stations, blocking out noise and interference. When tuned to stronger stations, the bandwidth automatically broadens, providing full frequency wide-range reception. In addition, the new Scott Automatic Gain Control circuit, which increases tuner sensitivity when incoming signal decreases, also increases resistance to cross modulation as the signal gets stronger.

Field Effect Transistor FM Lets You Hear More Stations, More Clearly

The 382 utilizes revolutionary new Field Effect Transistor circuitry for maximum FM sensitivity with virtually no cross modulation, no drift, no more problems caused by changing tube characteristics. Scott led the industry in being first to use this important advance in solid-state design.

Scott's all silicon IF strip provides three stages of true IF amplification for strong as well as weak signals plus three additional stages of IF limiting action, giving optimum selectivity and stereo separation.

Direct-Coupled Silicon Output Amplifier Section

Output and driver transformers, major causes of diminished power and distortion, are eliminated from Scott's radically new direct-coupled solid-state amplifier design . . . allowing more power over a wider frequency range, with virtually no distortion.

The 382 includes these popular features found in the most expensive Scott components: Tape Monitor switching, Speaker switching with provision for remote speaker selection, switched front panel stereo headphone output, front panel stereo balance switch, separate-channel clutched bass, treble, and volume controls, fully automatic stereo switching with indicator, and precision tuning meter.

382 Specifications: Usable sensitivity, 2.5 μv; Harmonic distortion, 0.8%; Drift, 0.02%; Frequency response, 18-25,000 cps ±1 db; Music Power rating per channel (4 ohms), 32½ watts; Cross Modulation Rejection, 85 db; Stereo separation, 35 db; Capture ratio, 6.0 db; Selectivity, 40 db. Price $339.95.

*Patent Pending

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AUDIO

July, 1966 Vol. 50, No. 7

Successor to RADIO, Est. 1917

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AUDIO Reviews

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AUDIO in General

MEMBER INSTITUTE OF HIGH FIDELITY INC.

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COMING

ANNUAL PRODUCT PREVIEW

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

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

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

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

AUDIO CLINIC

Joseph Giovanelli

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

Guitar Amplifier Considerations

Over the past several years I have been trying to discover the secret of designing good guitar amplifiers. I say "secret" because there seems to be some sort of plot to suppress information on this subject. I have thought up brilliantly devious ploys for obtaining this information from the various manufacturers of such amplifiers. I receive even more brilliantly conceived brush-offs in return.

In all of the technical magazines I have read in the past 10 years I have never seen an article of any kind dealing with this subject.

I have tried many different things and have had varying degrees of success. The main difficulty seems to be the tremendous transient peaks which are generated when the guitar strings are plucked. At one time I fed the guitar into the high-level input of my music system. I obtained pretty good results at moderate levels. As I kept increasing the gain, there came a certain point where the sound would begin to break up. This manifested itself primarily as a raucous buzzing noise when the strings were plucked. Yet when I tried a guitar amplifier (push-pull 6L6G's) in an A-B comparison, I could get about twice the apparent sound level before the breakup occurs. I realize that all of this is quite subjective, but I hope that you get the idea.

I obtained a schematic for this particular guitar amplifier from its owner and proceeded to build it. The circuitry was strictly conventional except for the output stage. The manufacturer used 280 volts on the plates and screens and –30 volts bias. Because I was unable to determine the impedance of the output transformer, I used the standard tube-manual configuration for mine, i.e., 360 volts plate, 270 volts screen and –22 volts of bias with 6600 ohm plate-to-plate load for the primary winding of the output transformer. Alas, I stilll have the same problem. I started tracing signals with a 'scope, and found that this buzzing type of distortion was caused by clipping, but not, as I had suspected, in the output stage. It was occurring in the phase splitter which in this

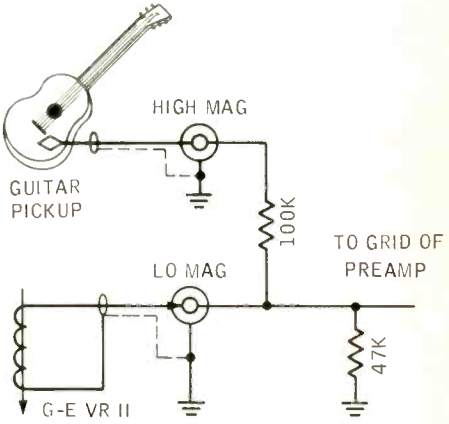


Fig. 1. This system seemed to work.

amplifier is a split-load type. The only conclusion I could draw from this is that the entire problem hinges on efficiency. For a given undistorted signal in the output stage, the sound level depends upon the efficiency of the output stage and the speaker. I once read some place that maximum power transfer and maximum volume level from an output stage were not necessarily one and the same thing. With ordinary program material for an input source —radio or phonograph—this amplifier could be driven until the building shook, with no distortion or breakup whatsoever at an apparent sound level considerably greater than could be obtained with a guitar before breakup occured.

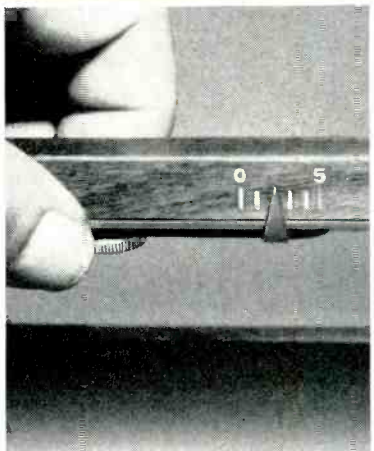
Well, this is all very fine. But there is just one thing that bothers me. Way back when, I had a different music system. I plugged the guitar into the magnetic input of this amplifier and it sounded more like a buzzsaw than a musical instrument. Then one day I wanted to use the guitar and the phono simultaneously. I connected the guitar to the "hi-mag" input and the turntable to the "low-mag" input and as I was playing I began to notice that the guitar sounded suspiciously crisp and clear, I discovered that I could increase the level as much as I could stand it and still get no buzzing or distortion. The "hi-mag" —if I remember correctly—had about a 100 K resistor in series with it and the "low-mag" input. I was using a GE VR-II cartridge. Essentially what I had was a series RL network to ground, with the input to the amplifier being tapped off at the junction of the resistor and the cartridge. (See Fig. 1.)

Grooveless record demonstrates anti-skating on the Garrard Lab 80

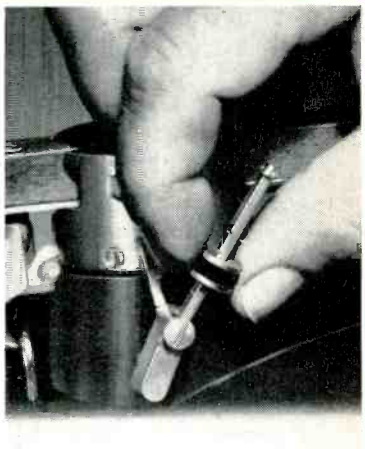
Due to the offset angle of any cartridge, and the rotation of the record, all tone arms have an inherent tendency to move inward toward the center of the record. This skating force, a definite side pressure against the inner wall of the groove, is a major cause of poor tracking, right channel distortion, and uneven record wear.

Your Garrard dealer has been supplied with grooveless records, which make it possible to visualize the skating force and how it is overcome in the Lab 80. With the demonstration below, he can show you how the Lab 80 protects your records and tracks **both** stereo channels more evenly, more perfectly than any other integrated record playing unit.

1 "This is a blank record with no grooves. I place it on the Lab 80."



2 "I set the tracking force at two grams, for example. Since each click of the stylus pressure gauge on the tone arm equals ¼ gram, I turn it for 8 clicks."



3 "I then slide the counterweight on the anti-skating control to the second notch . . . equivalent to the tracking force I have just set on the tone arm."

4 "Now you can actually watch the strength of the skating force. I start the Lab 80, but flip the anti-skating control over and out of operation. Note that as soon as I put the stylus on the grooveless record, the arm moves rapidly . . . with force, toward the center."

TRACKING WITHOUT ANTI-SKATING CONTROL. SINE WAVE FORM SHOWS CONSIDERABLE DISTORTION.

5 "Now watch me neutralize the skating force. I swing the anti-skating control back into position . . . and the arm tracks as perfectly as if there were a groove in the record! If I were playing a regular record—with the side pressure gone and resulting distortion eliminated—the sound would be cleaner."

TRACKING WITH ANTI-SKATING CONTROL. SINE WAVE FORM BECOMES A CLEAN PICTURE OF THE OUTPUT OF THE CARTRIDGE.

(OSCILLOSCOPE READINGS BASED UPON 1000 CYCLE, 30 CM PER SEC TEST RECORD AS SIGNAL SOURCE)

The patented Garrard method of neutralizing skating force is but one of a number of Lab 80 developments. Compare! You'll find this Lab 80 feature is simple and foolproof . . . works perfectly without springs, balancing devices or other delicate mechanisms. Visit your dealer and see it in operation, or send $1.00 to Garrard for your own grooveless demonstration record. For complimentary copy of 32-page illustrated Comparator Guide, write to Garrard, Department GC-16, Westbury, New York 11590.

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This would seem to indicate that the problem could be attacked in the front-end of the amplifier rather than in the output by using some kind of equalizing network. I have tried several different circuits using RC networks but I have not been able to duplicate the same sound that I had with the above circuit. There must be a relatively simple solution, but I have to find it. That is what is so frustrating about the whole business. The guitar amplifier has a straightforward design. There seems to be no hidden bugaboos in it. Why is the company so secretive about it? I must admit, I'm thoroughly confused.

I do not expect that you will give me a flash course in engineering by mail. I would like to know, however, if there is a basic concept that I am missing entirely? It is just the proper arrangement of existing hardware that does the trick? Juel E. Rowden, APO, San Francisco.

A. Guitar amplifiers do not differ very much from high-fidelity amplifiers. Of course, they must cope with the transients of the plucked guitar strings, as you are already aware. The question you need to ask is, "Why does an amplifier fail to come through on peaks?"

The answers are many. First of all, there is the power supply to consider. All too often the power supply is ill-considered in the design of an amplifier. Put your oscilloscope on the power supply B+ output and see what happens to the voltage on transient peaks. Does the voltage drop significantly? If it does, you must lower the impedance of the power supply. This can be done in several ways. First of all, you can use solid-state diodes rather than tube-type rectifiers. You must be cautious here because you will need to be sure the diodes will not provide more voltage than can be handled safely by the associated components in the power supply and the rest of the amplifier. You can use chokes which have a greater current-carrying capacity than those you are now using. This means that the d.c. resistance of the choke will be lower, leading to a reduction in voltage drop across it.

You can take advantage of the high current-carrying capacity of the solid-state diode by using large amounts of capacitance at the input of the filter system. This will provide voltage regulation which is almost as good as that obtained from a choke-input filter.

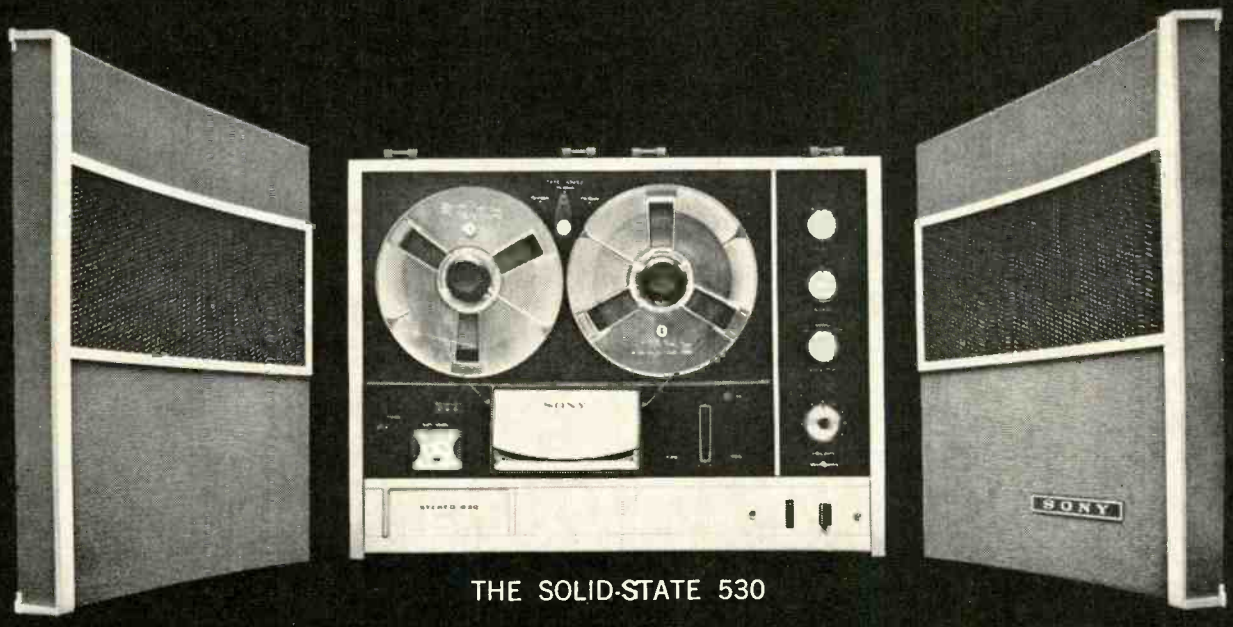
You may wish to use a power transformer which has a higher current rating. This, again, will give you better regulation because of the lower drop in the copper wire making up the winding of the transformer.

Moving to the amplifier proper, you will want to be sure that there is adequate decoupling so there is no tendency toward oscillation at low frequencies. Transient pulses can initiate low-frequency oscillations of at least a cycle or two.

If any stages of the amplifier are not regulated sufficiently as to voltage, you may find it advisable to regulate them. Regulation can be accomplished with tubes or zener diodes. A guitar does not have much in the way of extreme bass tones. If

(*Continued on page 49*)

Surround Yourself with SONY Sound!



THE SOLID-STATE 530

...with XL-4 Quadradial Sound

Imagine yourself at the podium, surrounded by a full symphony orchestra. Hearing everything. Missing nothing. Imagine that, and you will have begun to appreciate the exhilirating experience of the totally enveloping presence of the Sony 530's XL-4 Quadradial Sound System. This four-speaker system, two in the 530's case and two in its detachable split-lid, produces a virtual curtain of stereophonic sound. And only speakers this magnificent could complement a recording and playback instrument as superb as the Sony solid-state 530. Sensitive to virtually the entire audible range, the 530 captures exactly what it hears from 40 to 15,000 cps, and dramatically reproduces it with 20 watts of pure music power. Certainly a performance to please the audiophile. Yet the 530 achieves its remarkable performance with a simplicity that will delight the entire family. From Retractomatic Pinch Roller for almost automatic threading to Automatic Sentinel shut-off, Sony designed the 530 to make professional-quality tape recording and playback a marvelously uncomplicated pleasure. The 530's features include 4-track stereo or mono modes, three speeds, separate bass and treble controls, pause control and two famous F-96 dynamic mikes. Truly, the 530 is a complete stereo entertainment system for the home, any home. It's yours to enjoy for under $399.50.

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AMERICA'S FIRST CHOICE IN TAPE RECORDERS

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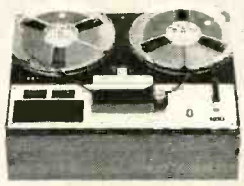

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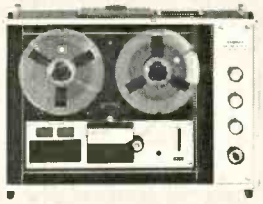
MODEL 660 ESP-REVERSE SOLID-STATE STEREO TAPE SYSTEM. UNDER $575.



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Sound & Sight

HAROLD D. WEILER

We conclude our description of the operation of the vidicon camera which began in the March issue and continued into May. . . .

In addition to the video and blanking signals another pulse must be provided to control and synchronize the movement of the monitor kinescope's electron beam from right to left during the now "blanked out" retrace period. This "horizontal synchronizing pulse" as it is called, begins at the end of each line and causes the kinescope beam to be brought back to the left side until it is in the proper position to begin the next scanning line, at which point the pulse ceases. Since these pulses should not be visible during the intervals the video information is provided they are transmitted during the "blanking period" which occurs between each line and are superimposed on the blanking pulses, as illustrated in *Fig.* 4.

The video, blanking, and horizontal synchronization signals continue as illustrated in *Fig.* 5 until all of the lines in each frame are scanned. The downward motion of the kinescope beam ceases at the end of each frame and it is again "blanked out." It is then necessary to return the beam quickly to the top of the kinescope screen so that the scanning of the following field can begin. Since the vertical retrace requires a longer period of time than the horizontal, the "blanking" interval is also longer. As soon as the vertical blanking period begins, a vertical synchronizing pulse is generated.

This pulse in its basic form would appear as illustrated in *Fig.* 5. However, since the horizontal synchronization pulses must continue at all times, the long vertical synchronizing pulse is separated into appropriate intervals, as shown in *Fig.* 6 making it possible to transmit both horizontal and vertical pulses simultaneously. The two sets of pulses are then accurately separated at the monitor where each then performs its own function.

There is still another problem with vertical synchronization. As explained in March, the first field ends halfway through a line, (point B in *Fig.* 7), the second

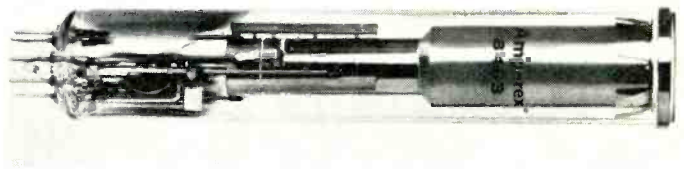


Fig. 6. The new Amperex 8483 Vidicon Tube.

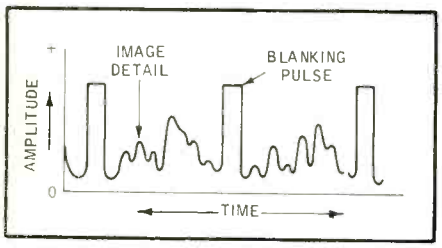


Fig. 1. The video wave form including the blanking pulses.

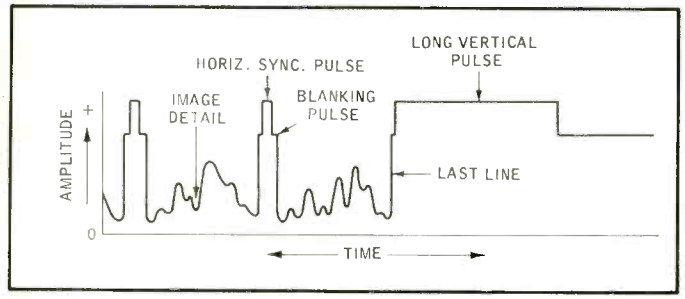


Fig. 2. The video wave form with the horizontal sync. pulse.

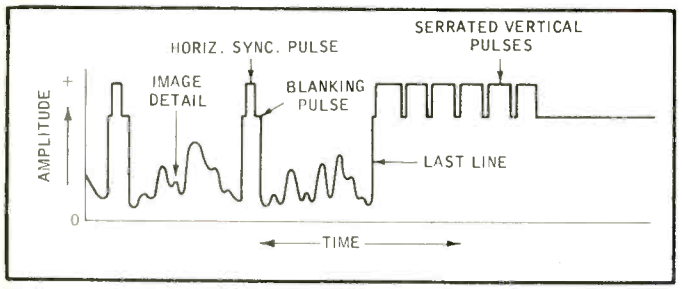


Fig. 3. The video wave form with the serrated vertical sync. pulse.

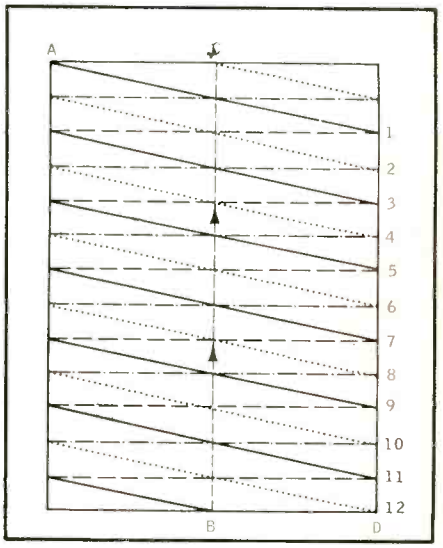


Fig. 4. The over-all scanning pattern showing the two fields in the interlacing scan pattern.

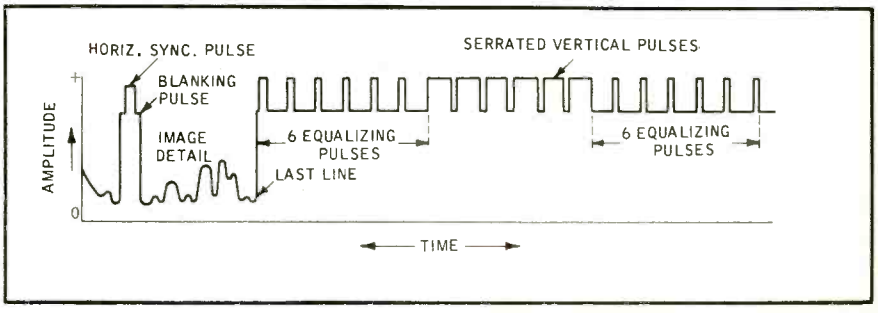
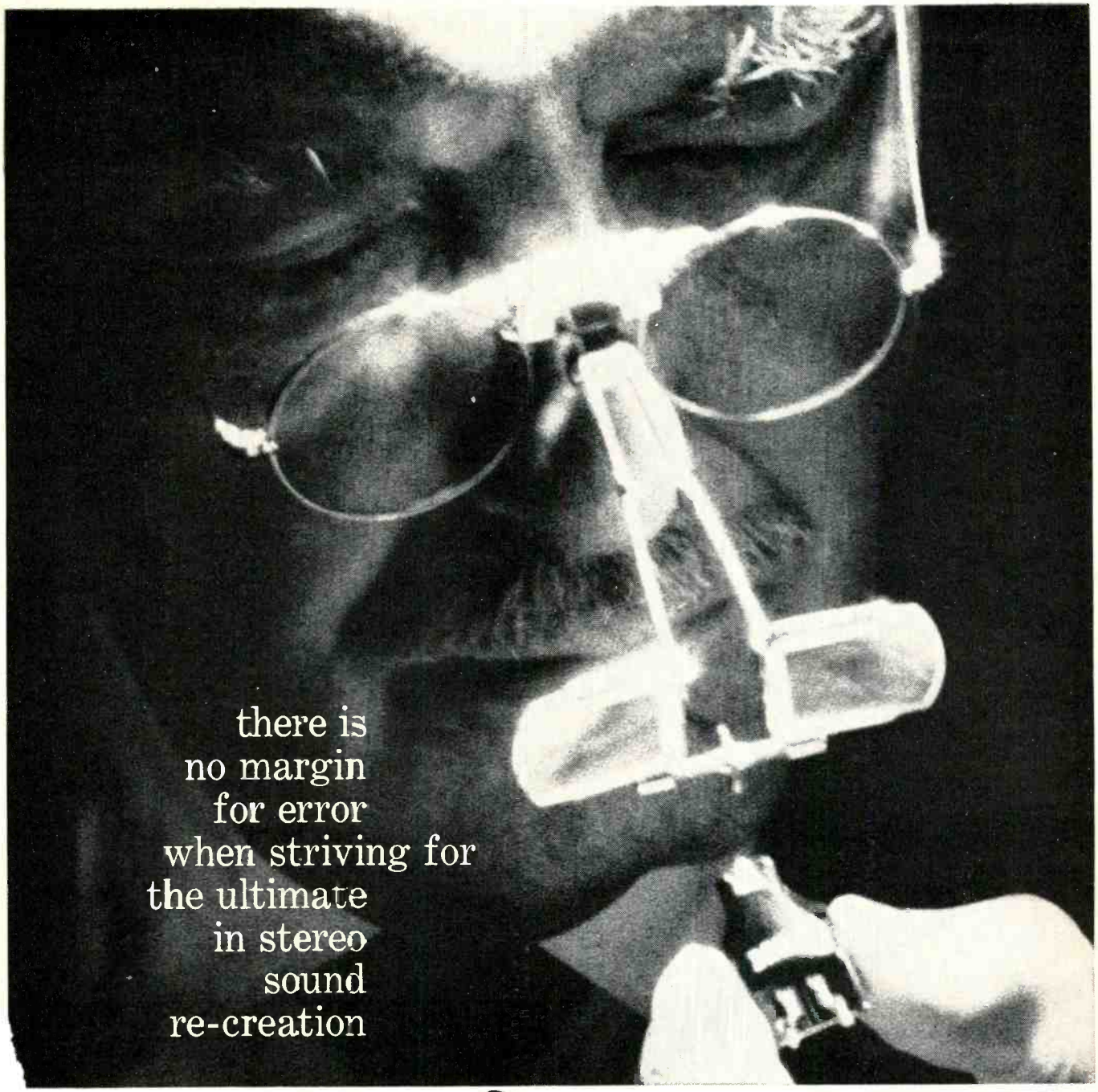


Fig. 5. The equalizing pulses and their relationship to the entire pattern.



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Extremely musical. Tracks at pressure to 6 gms., fits any changer. Only *$15.75*.

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ends on a full line (point D in *Fig.* 7.) This necessitates one additional modification of the video signal.

In order to provide the necessary information at the same time, after each field is completed and to ensure that both vertical synchronization signals are identical, a series of six equalizing pulses are inserted before and after the serrated vertical synchronizing pulses, as illustrated in *Fig.* 8, which shows the waveform of the completed signal.

A New Vidicon

The Amperex 8483 is a modern replacement for the 7038 Vidicon Tube. This high quality vidicon combines the excellent sensitivity with very fine low lag characteristics and high resolution.

An additional feature of the 8483 is its 0.6 watt filament. This low current heater consumes 3.0 watts *less* power than the 7038. In solid-state camera designs, this low power consumption means 3.0 watts less dissipation. With the 8483 circuits run much cooler and in some cases its use has made substantial improvements in component life. Æ

LETTERS

We Made it Feminine

SIR:

Your editing of my letter in the April issue gives the impression that *my* French was wrong, whereas it was *yours*. *Systeme* is masculine, and takes a masculine adjective, which *International* is, and which your *Internationale* is not.

PHILIP N. BRIDGES,
17910 Pond Road,
Ashton, Md. 20702

(*We hope this spelling stays correct.* Ed.)

Demonstration Record

SIR:

I would like to second your proposal in the June issue, "Let's make Comparisons Simpler," in which you suggest that a special demonstration record be prepared and made available to all exhib tors at hi-fi shows.

We agree that music cannot be judged on the basis of only one type of musical soun During a typical half hour at the AR ro at a hi-fi show or at AR's demonstrat room at Grand Central Station (New Yo a visitor will hear full orchestra, pop t pet and band, folk music, pipe organ, c cal and flamenco guitar, small string tra, opera, piano, and jazz; the musi will vary from Baroque to Dixiela

AR would certainly use a st if one were prepared. It wou tor to a hi-fi show a doub could hear varied music in could hear the same m equipment.

GEF
Ac
24
(

SIR:

Your proposal he used by or t room is one of that I have re things are mo show-goer try carry around one room wh bedlam to a ... the ...sted a

page 51)

WHY AR INC. SPEAKERS AND TURNTABLES ARE RELATIVELY INEXPENSIVE *(although many equipment reviews describe them as the best*)*

AR speaker prices range from $51 to $225. Our most expensive model, the AR-3, has been rated by professional equipment reviewers above all other speakers, including those costing more than three times as much.

The $78 AR turntable has been rated above all other turntables, including those costing more than twice as much.

The high quality of materials and workmanship that goes into AR products allows us to guarantee our speakers for 5 years and our turntable for one year, with all repair costs covered. Even freight charges, and the cost of a new carton when necessary, are reimbursed.

What makes this combination of high quality, reliability, and low cost possible?

RATIONAL AND SUPERIOR DESIGN • Ten years ago AR changed the face of the speaker industry with its acoustic suspension system, ending the era of giant speaker cabinets. A few years later AR introduced the dome tweeter, used subsequently by half a dozen speaker manufacturers. The basic design concepts of the AR turntable have now appeared in the turntables of most of the other leading brands.

A catalog of AR products is available for the asking.

**Lists of the top equipment choices of four magazines are available on request . All four chose the AR turntable, and three of the four chose AR-3 speakers.*

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Mrs. Miller's Greatest Hits
Capitol T 2494

Some recent indications to the contrary, it can no longer be said that the recording industry has completely lost its sense of adventure. In some ways, this disc does for popular music what a vocal star of another era, Florence Foster Jenkins, did for classical music. If the name of Madame Jenkins is unfamiliar to you, something more than a perfunctory review will have to be set forth in this space in order to do this unusual recording the justice it so richly deserves. First a word of credit is due. Producer Lex De Azevedo of Capitol Records is the chap with the sense of adventure (and humor) who sold his front office on the somewhat farfetched idea of issuing this recording in the first place. The preliminaries of this project probably took some time. Mrs. Miller's beaming photo on the cover portrays an artist as different from the usual gal vocalist as her devastating delivery is in the grooves of the record. To put the matter as gently as possible, Mrs. Miller is a slightly more than middle-aged housewife from Claremont, California, who could easily be mistaken for a twin sister of Mrs. Nikita Khrushchev who visited these shores not too long ago with her husband, while he was still the Premier. An older and less kind reviewer might be tempted to describe the Miller voice in these ballads and rock and roll tunes as a cross between that of Marie Dressler and Edna May Oliver. Instead, I am tempted to describe the singing style as that of a Mrs. Khrushchev who had had the good fortune to be born and raised in the hep atmosphere of Hollywood before going into show business. Mrs. Miller's diction, when she can get all the words in during a long and bothersome sentence, is a credit to her former standing as executive secretary of the Foothill Drama and Choral Society. The appearance of Mrs. Miller's recording on the market at this time is almost explained in the voluminous liner notes Capitol has graciously provided on the back of the album. It seems that their latest discovery has been traveling from Claremont to nearby Hollywood for the past seven years, there to make recordings for her own pleasure. It was during one of these private sessions that a certain Fred Bock, an organist, arranger and general all-round rascal, heard Mrs. Miller and brought one of her recordings to the attention of the Mr. De Azevedo mentioned earlier. In the disc presently staggering your reviewer, Mrs. Miller is accompanied by a group of male voices and small orchestra. These gentlemen must have been selected in part for their ability to maintain a deadpan expression as Mrs. Miller takes on, and subdues, "Chim Chim Cher-ee," the love theme from "The Sandpiper," "A Hard Day's Night," and "Downtown." The interlude of whistling in the latter item is alone worth the price of the disc. Most listeners will save this record for their next party. If you can't wait for a party and resolve to approach this disc with the right attitude, you may wind up losing your heart to this good-natured artist.

*12 Forest Ave., Hastings-on-Hudson, N.Y. 10706

Sweet Charity (Original Broadway Cast)
Columbia KOS 2900

A tremendous amount of professionalism has been lavished upon Gwen Verdon's latest starring Broadway musical. In every department vital to a show's visual success in the theatre, the staff work has been exemplary—reflecting the producer's willingness to spend freely in hiring creative talent. This fact seems to be paying off at the box office with attendance running well above average. For our purpose, only a small percentage of the show's virtue's trickle down to the record listener. Miss Verdon, after all, is a more talented dancer than she is singer and the whole show rests on her shoulders. The home listener will be hard pressed to believe that the book of "Sweet Charity" is the product of one of the sharpest comedy brains now active on Broadway. Neil Simon is responsible for a remarkably funny series of plays that includes "Barefoot in the Park" and "The Odd Couple." He's off stride here. Cy Coleman (music) and Dorothy Fields (lyrics) are hardly strangers to show fans but there's very little in this score that will be remembered when their respective careers are chronicled. The plot, what little there is, is based upon an original screenplay by Federico Fellini, the noted Italian film director who used it in the film "The Nights of Cabiria," starring his wife Giulietta Masina. It's not enough of a story line in "Sweet Charity" to give the Coleman-Fields team much to do.

Teresa Brewer: Songs for Our Fighting Men
Philips 600-200

This disc is a more palatable way to hear the lyrics of the "Ballad of the Green Berets" than the original Sadler release. The perky style of the ever-young-sounding Miss Brewer is a welcome leavening agent in this collection of war tunes and other songs whose sentiment qualifies them for wartime duty. Instead of attempting big band backing for a small-scale voice, Philips has given Teresa Brewer a small combo made up of electric guitar, organ, harmonica, and fender bass. Market surveys at PX counters apparently indicate that such an instrumental approach sits best with today's military personnel. Æ

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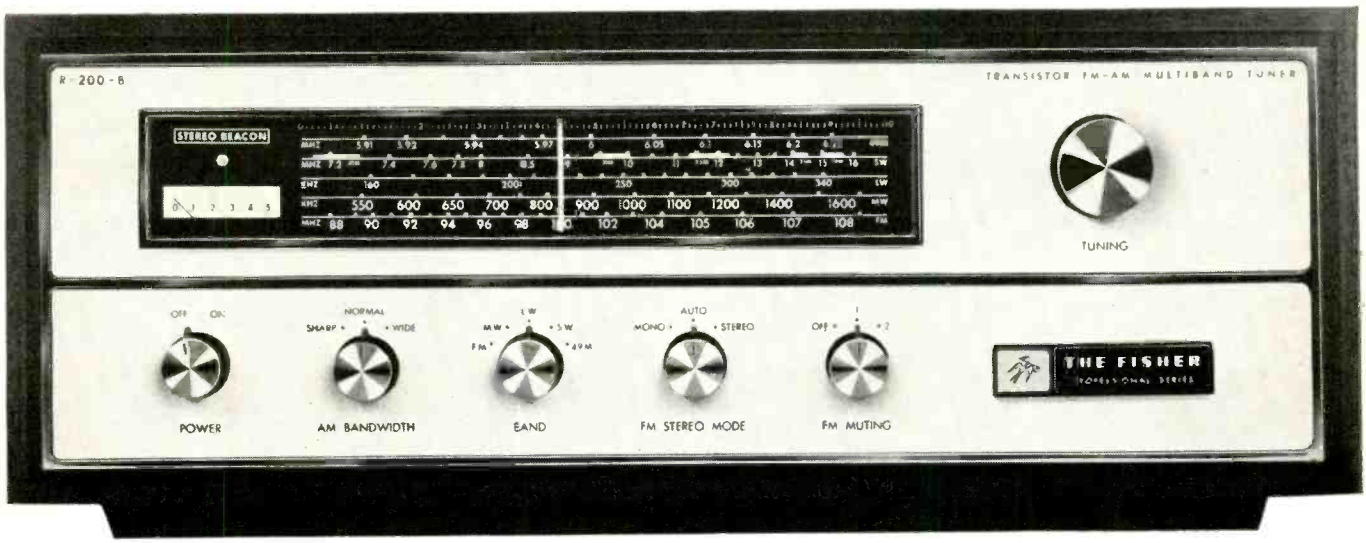

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AUDIO ETC.

Edward Tatnall Canby

The Third LP Revolution—1. The Big Squeeze

My eyes are very much on the seething record business, these days. Classical. There's a big revolution going on and it's hardly started. I call it the Third LP Revolution.

Hi fi is all very well, of course. Audio equipment is still vital. Tape is on the up-and-up thanks to autos and 8-track. Videotape is loping along among the *avant garde*. But what really is front-stage now is that backbone of h fi, the disc record. The most astonishing things are happening in records.

Now how does one write an article on the Record Business (or any other business)? Well, there's an Approved Procedure, all right. First, you go out and get statistics, figures. Some people call 'em the facts. Then you set up interviews, with a heavyweight Captain of Industry or two, to lend weight. Then, having pumped your Captains (who love to talk for publication) you go home and set the whole thing up in the standard Approved Format. An Approved Article outlines like this. It always is the same.

Approved

First paragraph. The SITUATION. Preferably explosive. Make it real dramatic—either pro or con. Things are mighty good. Or things are very bad. Sample:

The record business today is on the verge of its greatest year's profits since 1901. Outlook is rosy. Etcetc.

Paragraph Two. PERCENTAGES. (They always come in the second paragraph. Absolutely required for Approved Articles.)

In 1964 XX per cent of the records sold were classical, etcetc. . . . and in the first three months of 1966 the number of labels showing advances in inventory over Dec. 1965 . . . and so on.

Paragraph Three. The INTERVIEW. The dope from some important horse's mouth, a Captain of Industry.

According to X. Y. Zombie, President of XYZ Records, the company's 1965 gross income was the heaviest in 37½ months . . . Real heavyweight, that man.

Fourth paragraph. WEIGHTY PREDICTIONS. (Not yours—X. Y. Zombie's). *Estimated production 1967 will run XX per cent above 1966 and XYZ Records feels that its market postion will be strengthened to occupy a pre-eminent place in the field.*

Coming straight from the great X. Y. Zombie himself, that statement has the ring of conviction and the weight of truth. Good stuff.

(Now isn't that a fine article on the record business? All you have to do is to clip it and substitute your own statistics. And maybe interview a different distinguished profit—I mean prophet—like, say, A. Gobble Gogo of Agogo Attractions Ltd. or, maybe, Petronius Dastardly Querck of PDQ Discs . . .)

Well, I have my interview all lined up for a couple of days from now, but I can't wait. Things are moving too fast. The Situation is beyond any Approved Article that I could write for you. So I'm going straight ahead.

To put it simply (and now I *am* serious), the record business is in the process of turning inside out. I can't even predict the end, but I know that things are dynamically on the move right now as they haven't been since the early LP days of The First LP Revolution—only now it's more so. What is happening today is the ultimate outcome of the LP changeover more than fifteen years ago, which hit us after the simultaneous appearance (almost) of tape, the plastic disc, and LP itself.

Our present explosion dates back to that time for its technical motive power and its economic potential. But it has much deeper roots. They stretch back a half century, to the beginnings of an exchange of commercial recordings between this country and Europe on an export-import basis.

The Taste for Imports

It was then that the American taste for European culture prompted the first imports of European-made recordings, real novelties of the day. But very soon afterwards a much more potent economic force began to shape up that turned that import trickle into a proper little flood. That was the cost difference between recordings made in Europe and those made over here. It was cheaper to record in Europe. It remained cheaper, and still is cheaper. Now it is *much* cheaper. That difference is at the heart of the whole set-up of today's record business. The enormous present flood of European-made recordings, which we now are buying like crazy, at crazy low prices, is a direct result of it.

There's more. We wouldn't buy these records, even at present prices, if we didn't *like* them—lots of us. Aha! There we head straight into the artistic side of things, which is here inextricably tied to the economic. (That's why I'm so fascinated by it all.) We like these records because for fifty-odd years now we've been getting more and more of them. As record buyers, our very lives and tastes have been significantly altered by the steady stream of these imports over a half century.

It has taken two generations to build up our present tastes. Time marches slowly, and the changes have been gradual, almost unnoticed by most observers (and especially the "live" concert industry, which habitually tries to ignore the influence of records). Nevertheless, the import audience has grown steadily and surely, as tastes spread with the tasting, and as the continuing economic advantages have favored the imported European music. It has been, all this time, a closed "system"—a negative "vicious circle." As audience interest slowly grew, more records were sold, and with more exposure, still more records were demanded. All very quietly, for many decades. But persistently.

For perhaps forty years of that half-century, the new European-music taste spread slowly, like waters accumulating behind a dam. Hardly a splash was ever heard. The taste for imports remained in a minority—as compared, say, to the market for records of "Oklahoma!" or Bing and Frankie. It was seldom taken very seriously in the record business. Yet even as far back as the 1930's the classical record field was already heavily dominated by the *musical influence* of European recording and, hence, by European music-making. That's how economics can affect artistic taste.

LP Revolution

Things could have gone on that way, slowly, for a century—if the 78 disc had persisted. But as we know, tape and LP suddenly brought everything to a head. It knocked the pins out of the abovementioned dam, *wham!*—and down came the waters all over us. That was *LP Flood No. 1*, a real revolution in record-buying, and the beginning of that hugely increased imported market. That was the First LP Revolution, 1949-1955, roughly speaking. Huge quantities of new European music, via LP.

Then came another wave. Stereo. And as a reaction, an even more important factor, the first LP reissues of former mono fare, updated technically to RIAA and much improved in packaging and pressing over the higher-priced originals. Here was *Flood No. 2*—the Second, or Stereo LP Revolution. Now the industry was feeding back into itself—a highly positive feed-back that generated more energy than ever, and more audience, too.

For if the expansion of LP was explosive, so was the growth of the audience—it had to be that way. From its solid pre-LP base, the European-orientated mass of buyers now grew explosively bigger, and each wave of the LP Revolution has spread its influence further.

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The Third Wave

Now we are in *Flood No. 3*, which might be called, tentatively, the Big Price-Break. It is a whopper. This time, it's taking the whole business along with it, topsy-turvy and inside out. This is the biggest upheaval we've had in records since—well, since LP. Or since the great patent exchanges in 1901 that started the record business off on its present course.

Like earthquakes, revolutions usually come in these successive waves. The Third LP Revolution, now upon us, built up its pressures out of the wave of the Second Revolution, stereo, and the reissue feedback. Now, both of these are involved in new ways, all over again.

Like all revolutionary waves, this one is again a letting-out of accumulated tensions and unbalances. This time, though, they are compound, inter-related in many areas to the point of bewilderment. The Third LP Revolution was touched off late in 1964 by that innocent new budget classical label, Nonesuch, a product of Elektra (folk and rock music).

Nonesuch offered a new formula, esoteric, high-quality European music—largely "old" and heavily Baroque—handsomely packaged and produced, first-rate in technical quality and in performance, and at $2.50 list, mono or stereo, half the cost of a regular LP disc.

It seemed impossible — but there they were, on the display shelves. And a very shrewd merchandizing policy soon had them selling in droves. This newest cashing-in on the already-large European-import market made that audience grow once again, explosively, now mainly among young people of high school and college age. (I saw them buying armfuls, last winter, at Yale University.)

Since the Nonesuch debut, numerous other new labels have sprung up to share the newly uncovered market. And, inevitably, discounts, more and more prevalent, have brought the already-low $2.50 price down to unheard-of levels—especially for such very esoteric and utterly special music! The impact of these new records thus has been so great that other major aspects of the record business have been shaken wide open. Hence the major revolution that is now in full swing.

Everything is in a happy turmoil—far beyond a mere price adjustment. For instance, one relatively minor aspect of the Nonesuch debut, the equal price on stereo and mono, has spread to many other labels, even including some higher-priced labels. (Deutsche Grammophon: $5.79 list, mono *or* stereo.) The big U.S. companies still hang onto the $1 price differential and many smaller outfits too. But sooner or later the equal pricing will become the rule. (A sequel to follow later, though not for awhile, is the elimination of tht dual mono-stereo release altogether. But that's another story, when & if.)

Plain-Janes

A more dramatic upheaval is the near-foundering, in the general confusion, of those very useful "plain-Jane" low-priced reissue labels, many of which came out of the Second LP Revolution, after stereo. (Some began earlier, of course.) These helpful labels, modestly packaged and modestly promoted, had a nice old-fashioned look to them, without frills, un-fancy. Just good, solid reissues of valuable older material, and some non-competitive new stuff. But now, the reissue activity has so enormously proliferated, and has taken on so many radically new angles, that the simple plain-Janes are all but lost in the shuffle.

Now, reissues are all tangled up with imports at assorted prices, re-labelings, and in particular, the use of synthetic stereo, which can update a good mono recording into what amounts to a brand new product. So you will now find records that are technically reissues at every price level and in all sorts of categories. It's extremely difficult, these days, to figure out which records are in fact new, or reasonably new, and which are older recordings in newly dressed-up sound. That is *not* a criticism —the general effect is good, decidedly! (Who can complain if an oldie recording comes out fresh, sounding like a newie?) But it is confoosin'. And the prices—that's the crux—are simply wild. Crazy, mixed-up.

First-line and Second-line

Now here is a crucial point to focus this month's installment.

The earlier reissue labels were (except for a few special operations) second lines, put out by the regular companies in the field and priced below the company's new or first-line product. RCA's Camden and Victrola, London's Richmond, the extinct Entré line from Columbia, Vanguard's recent Everyman line. Now a second-line product, at a lower price, no matter how good the contents —*must look like a second-line product and be second-line.* Otherwise why the price difference?? RCA Victor's regular stereo disc is listed at $5.79. RCA Victrola stereo is $3. The bottom-price Camdens are $2.49 for the few (and quite excellent!) stereo discs in that line. A regular price hierarchy, you see—and the looks of the records must be made to correspond.

Thus most of the reissue lines have been purposely clad in plain, matte jackets, in simple colors, without fancy cover art. Sensible, reasonable, and fair, so long as everything held tight in the price structure throughout the industry.

BUT the new Nonesuch-type records, decked out in elaborate and colorful shiny covers, vigorously promoted, equipped with excellent annotations (if I do say so, having written many!), were priced right square in the middle of the reissue labels, plain-Janes all.

The Big Squeeze

So look at what's happening now. If you are a two-line company, what can you do? If you jazz up your second line to compete with the gaudy, potent Nonesuch-type records (Turnabout, Heliodor, etc.), then *what happens to your first-line product?*

(*Continued on page 45*)

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After more than three years of intensive development, we are proud to announce the new DYNACO STEREO 120 power amplifier — a unit which we feel has overcome the problems of solid state devices and can offer the same high level of quality, dependability and economy which has become synonymous with the DYNACO name.

The STEREO 120 delivers 60 watts per channel into an 8 ohm loudspeaker on a continuous basis with both channels driven. Its distortion, frequency response, power response, phase characteristics and transient response are all excellent. Its sound is impeccable, without the unnatural brightness frequently characterized as "transistor sound." We believe that the STEREO 120, alone among solid state amplifiers, demonstrates sonic characteristics that are fully the equal of the best tube equipment, and we are proud of this engineering triumph.

Complete specifications are available on request from DYNACO, but some of its special attributes are:

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No adjustments — ever!

The impedance characteristics and gain of the STEREO 120 are matched to the PAS-3X DYNACO preamplifier, and the superior performance of this perfectionist's preamplifier complements the STEREO 120. The combined distortion of amplifier and preamplifier over the audio frequency range at most useful power levels can be expected to stay below 0.1%—yes, one tenth of one percent! We do not think that further commentary on this combination is required.

The demand for the DYNACO STEREO 120 is very great. Please be patient if your dealer cannot fill your order immediately. The factory assembled amplifier is $199.95, and the coming kit version (requiring less than 5 hours to build) is $159.95: the same price as two 60 watt Mark III amplifiers. For the first time highest quality transistorized equipment costs no more than comparably high quality tube designs which have a 10 year reputation for unsurpassed value.

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EDITOR'S REVIEW

STANDARD DEMONSTRATION RECORD

WE ARE GRATIFIED BY THE RESPONSE engendered by our suggestion in the June issue that some standard demonstration record be prepared under the auspices of the Institute of High Fidelity and made available in every exhibit room so that the visitors would be able to make more-or-less direct comparisons between the various equipments being shown. In the LETTERS column we have included two of the responses, and between the time that page was readied until now we have received still another letter agreeing with our stand. It is interesting to note that all of them came from loudspeaker manufacturers. The first was from Hartley, the second from A-R, and the latest from Altec. The first has long been a strong contender for single-unit quality, and is one of the better full-range speakers available. A-R is certainly one of the most popular loudspeaker systems on the market, and Altec has long been noted for theatre quality, and for its almost universal use for professional monitoring applications. We have not heard the official "line" from the Institute on this subject, but if the plan is to be put into effect for this year's New York Show, it should be started soon. We hope it will be, and we further hope that every exhibitor will get behind the idea and help put it across, and then that they will use the record or tape consistently—if not all the time, then at any visitor's request.

THE FOUR-COLOR COVER

We don't even know right now just how well the cover will turn out—it is our first attempt at a four-color cover in the nineteen-year history of AUDIO, although we have occasionally tried some duotones, which give some life to what are too often dull black-and-white illustrations. At least we intended this to be related to the story about the two London shows, as well as the In-Flight entertainment system described briefly in the story about the two shows in England and one in West Germany. What with the London scene, our own arrival, and the plane's interior with a color movie, it proves that we were there.

Many magazines feature pretty girls on their covers, but in this day of hair-undos, we can't seem to stomach them. It would seem that those who affect the over-the-eyes coiffures have the advantage over us--they can't see us, but we have to look at them. Maybe we're just too old-fashioned for 1966.

VIDEO TAPE STANDARDS

This seems to be a problem which is not yet resolved. But if video tape recorders are to achieve their greatest usefulness—and that is likely to be in the field of education—it should be settled before too many of them are in the field. For the uses to which the average person who buys a video recorder for his home, it doesn't make much difference what tape speed is used, nor how wide the tape should be. He does not expect to exchange tapes with his fellows as he now does with audio tapes. On the other hand, there is a large untapped market for "pre"-recorded video tapes of musical shows, spectaculars, and even movies, particularly after color video recorders are available.

We do not pretend to have sufficient wisdom in this relatively new field to *propose* standards—we only beg for their adoption, and soon. We have already seen the problems created by the introduction of the Super-8 movie equipment which practically obsoletes one's present 8-mm camera and projector. Of course, projectors are now available which will handle both films by the simple expedient of shifting the sprocket-and-gate assembly, but it's not so easy with the camera, to say the least. Then, too, we can remember the hassle between LP's and 45's, to say nothing about the many variations in recording characteristics with which we have been plagued over the last 20 years. Those have been settled, so it is no longer necessary to have a dozen or so types of playback equalization. We still need both the LP and the 45—the latter is ideal for singles. We think it is too bad that the LP didn't utilize the same large center hole as its little brother, but it's too late to worry about that one any more. We shall only worry about video recording standards for the foreseeable future.

THE NEW YORK SHOW

The dates for the New York High Fidelity Music Show this year are September 27 to October 2, with the first day for the trade only. This could be changed, of course, we changed our room. This year we'll be in 445 instead of the old 404 where we have been ever since the first appearance in the Trade Show Building.

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

But the ultimate test of a cartridge is the human ear. Find out for yourself. Listen carefully to a Pickering. You'll hear the difference.

For those who can hear the difference.

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Compare these new Sherwood S-8800 features and specs! *ALL - SILICON* reliability. Noise-threshold-gated automatic FM Stereo/mono switching, FM stereo light, zero-center tuning meter, FM interchannel hush adjustment, Front-panel mono/stereo switch and stereo headphone jack, Rocker-action switches for tape monitor, noise filter, main and remote speakers disconnect. Music power 140 watts (4 ohms) @ 0.6% harm distortion. IM distortion 0.1% @ 10 watts or less. Power bandwidth 12-35,000 cps. Phono sens. 1.8 mv. Hum and noise (phono) —70 db. FM sens. (IHF) 1.6 μv for 30 db quieting. FM signal-to-noise: 70 db. Capture ratio: 2.2 db. Drift ±.01%. 42 Silicon transistors plus 14 Silicon diodes and rectifiers. Size: 16½ x 4½ x 14 in. deep.

Now, look at the *new* Sherwood specs!

Model	V-Vacuum Tube S-*ALL-SILICON* T-Germanium Transistor	Power (IHF) 2 channels 4 ohms Watts	FM Sensitivity Microvolts	Price	Dollars/ Watt
Sherwood S-8800	S	140	1.6	$ 359.50	$ 2.57
Altec 711A	S	100	2.2	378.00	3.78
Bogen RT8000	T	70	2.5	319.95	4.57
Dyna FM-3, PAS-3 & S-70	V	90	4.0	394.85	4.38
Fisher 600T	V&T	120†	1.8	459.50	3.82
Fisher 440T	T	70	2.0	329.50	4.70
Harman-Kardon SR-900B	T	100	1.85	449.00	4.49
McIntosh 1500	V&T	85	2.5	499.00	5.87
Marantz 8B 7, & 10B	V	75*	2.0	1170.00	15.60
Scott 348	V&T	120	1.9	479.95	4.00
Scott 342	T	65	2.5	299.95	4.61

References "T" or "V&T" (above) may include some silicon transistors.
Figures above are manufacturers' published specifications
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The FM-Stereo Antenna Primer

WALTER G. WOHLEKING*

A comprehensive guide to the basic theory behind the design of effective high-frequency antennas and to the practical aspects of their use for FM-Stereo reception.

IF YOU ARE NOW RECEIVING all available stereo broadcasts clearly and noise-free, or if you listen to (gulp) AM radio, or if you mistook this piece for something by Ian Fleming (fat chance), turn to other material between these fine covers. If, on the other hand, you recently, or even not so recently, raced madly home with a newly purchased stereo tuner or receiver, only to find that when it was turned on, stereo broadcasts hissed like air from a holey tire, or if you want to update and improve your antenna system to pick up that marginal but desirable (because it is marginal) stereo broadcaster, then this is the place.

Background

The approval in 1961 by the FCC of a system of multiplex transmission for stereo broadcasting on the FM band had an undeniable impact on portions of the home receiving system. Spirited and healthy discussion centered around various aspects of receiver design for the new stereo-multiplex reception. The result was general agreement on important parameters for satisfactory reception of the stereo signal, and a new generation of receivers evolved.

When one of these marvels of the new stereo broadcast age was purchased, brought eagerly home, and placed into operation receiving a stereo signal, disappointing results were often the rule. Noise levels were higher on stereo broadcasts than on the equivalent mono versions of the same program. Other effects, ultimately attributable to multipath distortion, deteriorated stereo reception and rendered many receivers useful only on certain stations because of geographical location of the station or receiver or both. The fly in the stereo reception ointment was the antenna system. In short, the "piece of wire" often employed in "strong" signal areas as an antenna for mono broadcast reception was impotent for stereo. The greater-than-20-dB deterioration in signal-to-noise ratio that exists with a stereo signal had made necessary the use of a properly designed antenna system, and, because of this, the antenna for FM reception had finally come of age.

Over four years after the FCC's historic (to audio buffs, anyway) decision and subsequent pronouncement, there still seems to exist strong reluctance on the part of the purchasers of FM-Stereo receivers to install an antenna system that will enable all this expensive equipment to perform to the full extent of its capabilities. Similarly, many current users of FM tuners limp along with inadequate antenna installations not realizing the potential of their systems. This situation is particularly prevalent in areas of high FM broadcast station density. With a relatively large number of stereo stations from which to choose, the listener tends to be tolerant of poor reception on one or two of them because he may always tune to a station which does, in spite of his poor or almost nonexistant antenna system, come in with enough signal to give an adequate signal-to-noise ratio on stereo. This often boils down to a search for a stereo broadcast simply for the sake of listening to stereo, rather than a choice of a program on the basis of content.

It is apparent that the collection of pipes, tubing, and wire that is—let's face it, antenna designers—not the most aesthetically pleasing thing to have protruding from the roof of a house. Furthermore, it is probably the least understood and most neglected part of the audio buff's high-fidelity system. Since in most cases it will be necessary to have this aluminum sentinal working for us if we expect to receive stereo broadcasts, a little knowledge of its foibles will be a major asset in choosing the antenna best suited for a particular locale and reception situation. Hence, what follows is an attempt to compile enough information

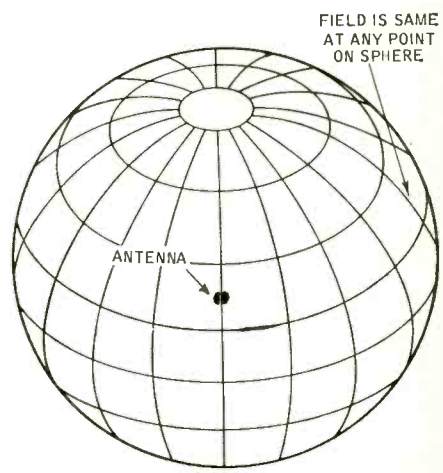

Fig. 1. Three dimensional coverage diagram of a perfect omnidirectional radiator.

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to enable the FM receiver owner to make an intelligent decision when he ventures into the antenna market place. Furthermore, an attempt will also be made *not* to couch this information within the esoteric vocabulary of the antenna designer alone. A strong suspicion exists in one tired mind that a lot of antenna designers don't even understand some of this technically etheric language.

As a start on the road to better understanding of the antenna system you'll have to increase your vocabulary. This can be done in a reasonably painless fashion, and it is necessary to the learning of some basic antenna theory. By the way, through much of this article you will note the words "antenna system" used frequently. This is because the antenna itself is but one link in the chain that captures r.f. energy for use by the receiver. It is important, but can not show to best advantage if any other link, such as transmission line, matching transformer, hybrid, and so on, is weak.

Antenna System Characteristics

An antenna is a passive circuit element. It cannot generate any power of its own, nor can it, like an amplifier, take small amounts of signal power and indiscriminantly make them larger. The term "antenna gain" seems to belie this, but an increase in gain in one direction about the antenna comes at the expense of gain in some other direction, a discriminatory process. The task of the antenna is to transfer information-carrying electrical energy from one medium (air) to another (the lead-in) for introduction to and processing by a receiving system, after the opposite transfer has taken place at the transmitting end of the link. How an antenna accomplishes this transfer is of interest to the prospective antenna purchaser.

To perform this general function, the antenna exhibits two associated properties which can be used as a measure of the worth of an antenna for any particular situation. First, the antenna acts as a device which matches the impedance of the transmission line to that of free space. Second, it allocates radiated energy to certain desired areas while suppressing it in other directions where it is not wanted. This latter property is referred to as the antenna's directional characteristic, and it is of prime importance in selecting an antenna for reception of stereo broadcasts.

Let's stop for a moment and examine something that has just been said. The antennas used by FM receiver owners *receive* energy delivered from a transmitting antenna. But a few lines ago we spoke of allocating radiated energy, and the question that naturally arises is, "What has *radiated* energy got to do with an antenna used for reception?" The answer lies with a characteristic of antennas which is an aid in describing their operation, the fact that antennas are reciprocal devices. The properties of an antenna, whether it is transmitting or receiving, are exactly the same. There is usually only one extra factor that the engineer must consider when designing a transmitting antenna, and that is the power which the antenna will have to handle during its usage. While the antenna for a radio station transmitter receives the entire output of that transmitter and must be constructed to handle this power, receiving antennas, of course, handle minute amounts of signal energy. For our purposes, however, this factor is unimportant, and the only thing to bear in mind throughout what follows is that when reference is made to an antenna characteristic from a *radiation* point of view, the same characteristic applies when the antenna is used to *receive* radio-frequency energy. The reason for even using this at all is convenience. It is often easier to describe the operation of an antenna as a radiator rather than a receiver. If reciprocity is remembered, there should be no problem understanding the meaning of these basic antenna characteristics.

Gain

We have thus arrived at the first important indicator of the performance of an antenna—its gain figure. It is the characteristic that the antennaphile (are there any?) most often quotes as he describes the performance of that "thing" on his roof. He quotes it, that is, when it's available to him, or when he is able, through diligence, to obtain this often elusive figure.

In lieu of an antenna's gain the most prominantly printed "performance" figure is the distance from the transmitter up to which the antenna in question will perform satisfactorily or deliver a useful signal to the receiver. Descriptions of "up to X miles" are used liberally in electronic parts supplier catalogues to describe antenna performance. It is information that is suggestive of television commercials for gasoline mileages achieved with various fuel additives. "The new Super-Blasto gas gives you up to 3 miles more per gallon!" Little study of that statement (guarantee?) is necessary before you realize that "*up to* three miles more per gallon" means never greater than three miles more, but even .01 mpg more fulfills the guarantee. Antenna information presented in this manner is of little actual use and is in many cases inaccurate mainly because the distance up to which an antenna and receiver will operate satisfactorily is a function of the combination of the two.

There are of course exceptions to this distance syndrome. The Winegard Corporation at one time offered a money-back guarantee if one of its antennas in combination with a particular mast-mounted r.f. preamplifier would not give a satisfactory signal level from any station at which it was pointed within a specified range. In this case the mileage characteristic is a good performance barometer, particularly because the one making the claim is, as the saw goes, "putting his money where his mouth is." In the majority of cases such a guarantee is not in evidence, and knowing the gain, beamwidth, impedance, and a few other basic characteristics of an antenna will be of infinitely greater help in evaluating performance than the infamous mileage number.

Gain may not be the single most important antenna characteristic for a particular situation, but it is inexorably linked to other characteristics, all of which serve to make up a complete picture of the antenna. It is for this reason, if for no other, that gain is the first antenna characteristic we will encounter and attempt to slay semantically.

In order to better consider gain, let us construct and place in space, with no nearby obstructions, a hypothetical antenna which, when r.f. energy is fed into it from a transmitter or other source, radiates this energy in all directions equally. The physical appearance of the antenna is of no immediate importance; what it does with the energy fed to it, however, is. If we now went out into space and measured this distribution of energy, we would naturally find the relative amount of radiated

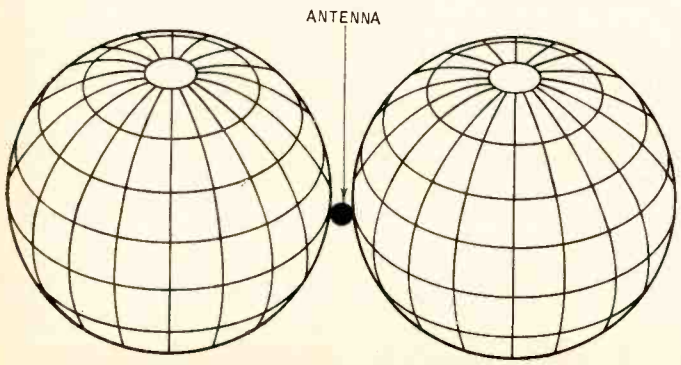


Fig. 2. "Squeezing" the balloon —resulting in two tangentia spheres similar to the radiation pattern of a dipole antenna.

energy in any direction to be the same, regardless of the angle from the antenna at which we make the measurement, providing, that we remain the *same* distance away from the antenna at each angle.

If all these points were plotted graphically, their locus would be a sphere with the antenna at the center as shown in *Fig.* 1. The electric field voltage due to the radiated r.f. energy on any portion of that sphere will be the same as that measured on any other portion, and loci of decreasing field strengths would be defined by spheres of increasing radii, all with centers at our hypothetical antenna.

In reality an antenna as that which we have just hypothesized is impossible to construct practically. Its use, however, is to serve as a standard of comparison, or normal to which we may compare other antennas with the same inputs, further enabling us to compare these antennas against each other. This completely omnidirectional antenna is known as an isotropic radiator. Definition 1 then in our antenna language is of this isotropic antenna, to wit, that it radiates all the energy fed into it in all directions without discrimination.

To better compare antennas and their characteristics we will utilize as a tool the radiation pattern, which is a graphical representation of the radiation of an antenna as a function of angular direction about the antenna. The spherical picture of the isotropic antenna field shown in *Fig.* 1 is a form of three dimensional radiation pattern. But a pattern such as this is, in general, rather unwieldy for use in antenna analysis, because we are usually interested in an antenna's performance in only two planes of reference: vertical, or elevation, and horizontal, or azimuth.

The radiation patterns of our isotropic antenna formed by passing planes through its spherical coverage are both circles. Since the function of these elevation and azimuth patterns is as a reference, we assign to them a value of 1 for their levels. They can now be superimposed on the horizontal and vertical patterns of other antennas we wish to analyze to obtain relative gain figures. For any such gain figures to be meaningful, patterns for both antennas must have been obtained with the same power input to each antenna.[1]

Now, picture our isotropic source radiation sphere of *Fig.* 1 as an inflated balloon, the outer surface of which we assign the arbitrary value of 1 as we did with the isotropic pattern. If we wish to reshape the surface of this balloon we could tie a string around it and draw it up tight, so that the resulting shape of the "squeezed" balloon would be that shown in *Fig.* 2—in effect, two balloons tangent at the center of the old sphere, where our hypothetical antenna is located, and extended at the opposite poles out farther than did the sides of our original sphere. Just how much further does this new shape extend beyond that of the single balloon? Our radiation patterns will readily show this.

If we pass vertical (elevation) and horizontal (azimuth) planes through this squeezed balloon shape, the pattern shown in *Fig.* 3 results. At its extremities it extends 1.6 times as far as does the circle formed by the isotropic antenna, which is superimposed on the figure for convenience. If these balloon patterns were to depict antenna radiation patterns and we were to compare the level of the squeezed balloon pattern to that of the round balloon pattern, we'd refer to the 1.6 times relative increase at the peak as the *gain* of the squeezed balloon relative to isotropic. Obviously if a different direction, such as 60 deg., were selected for comparison, (Point B on *Fig.* 3) the isotropic would show a greater relative-field-strength charactristic, and because we are using the isotropic as a standard, our squeezed-balloon antenna would have a gain of 0.8.

Now what's the point to this balloon squeezing? Well, this is analagous to what we are doing when we try to obtain gain from an antenna. What is implied is that the energy we wish radiated in a greater amount in one direction must come from somewhere, and the somewhere is any of the other directions in which we can afford to suffer a decrease in the amount of radiated energy. This most important principle will be recognized immediately by astute students of human (and now, antenna) nature as the "You can't get something for nothing" law.

When we compare the point of maximum delivered field strength of a particular antenna to the angularly constant field strength of an isotropic radiator, we obtain the directivity or maximum directive gain of the antenna. I.E.E.E. Antenna Standards define this value aptly as the ratio of the maximum to the average radiation intensity. From this it is evident that the antenna has truly behaved as a passive circuit element. No power has originated within the antenna itself. It has rather redirected the energy fed into it, thus concentrating more of it in one or two directions than in any other. To increase directive gain in an antenna we must of necessity give up blanket angular coverage, if the antenna previously provided this. This is not the disadvantage it might at first seem to be as shall be evident when we discuss multipath distortion.

This is the basic principle of antenna gain. The directivity of an antenna can be theoretically determined when its effective length and radiation resistance are known. It can also be measured by comparing the antenna to one with a known directivity. Since the antennas that are of greatest use for stereo broadcast reception have effective length and radiation resistance characteristics in a rather complex fashion, and, since the gain and impedance of the antenna are usually available from the manufacturer who has measured them (we hope), the calculation of these parameters will be left to others more ambitious. Instead we'll examine the general consequences of squeezing the balloon in various ways and the tools which can be used to accomplish this.

We may thus define *Gain* (Maximum Directive Gain) as the ratio of the peak

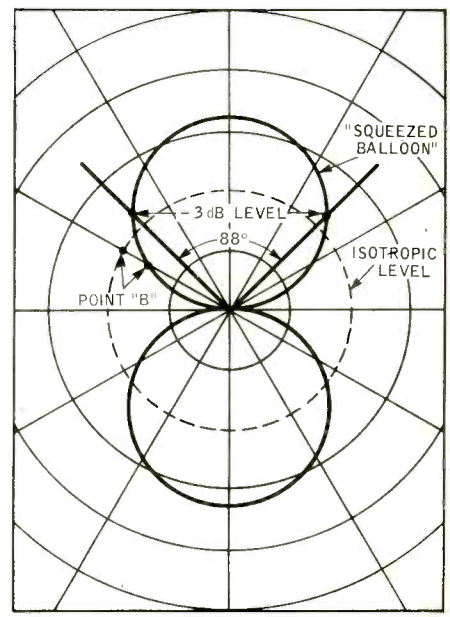
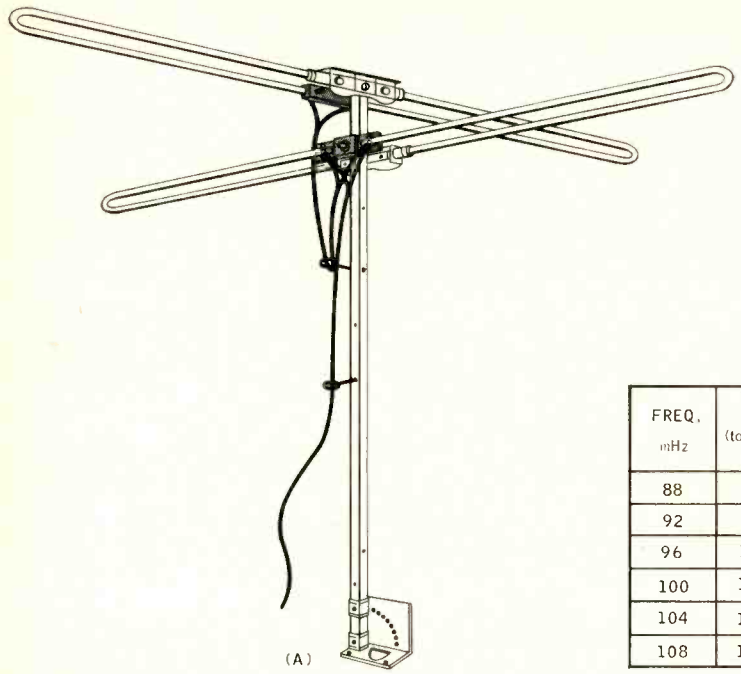


Fig. 3. Radiation pattern of the "squeezed balloon" in any plane through the antenna point.

[1]Those astute observers who are still awake at this point will promptly ask how one can obtain a reference antenna pattern for an isotropic antenna when it's been stated that the animal does not exist. What is actually done to compute gain is that a series of conical patterns is made of the antenna for which the gain is to be determined. A pattern is first made in a great circle in the plane of the antenna. Patterns are then obtained at angles above the plane from 0 deg. to 90 deg. (and below, if the antenna is not symmetrical about the plane) in increments as small as practicable. These plots serve to provide a three-dimensional map of the antenna's radiation pattern, and when each is weighted to take into account the angle at which it was made and all are added, an indication of the total available power radiated by the antenna results. Since the antenna does not manufacture energy itself, the pattern can be obtained of an equivalent isotropic antenna radiating the same energy as the antenna in question. The peak gain of the antenna is compared against this figure.



FREQ. mHz	SWR (to 300-Ω line)	GAIN
88	1.76	< 2 dB (above isotropic)
92	1.96	
96	1.86	
100	1.66	
104	1.66	
108	1.76	

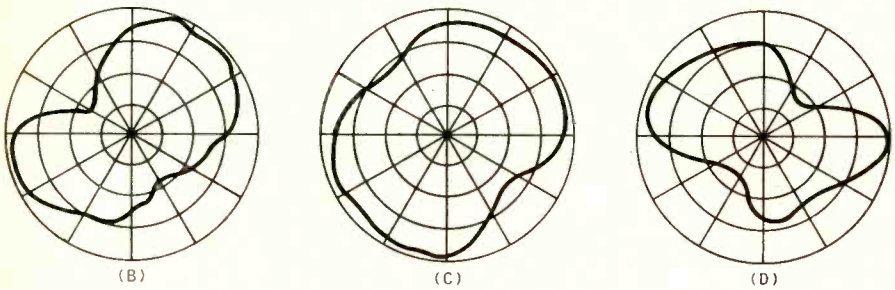


Fig. 4. "Turnstile" antenna and characteristics.

radiation intensity to the average or isotropic value.

One further word about gain figures before they are pushed into the wings to await recall. The published gain figures of antennas are rarely in absolute terms as they have been discussed above. To convert absolute gain numbers to the more common and more widely used dB notation, the familiar equation may be used:

$$G_{dB} = 20 \log_{10} E$$

where E is the ratio of the field strengths of the two antennas being compared. If powers are compared, $20 \log_{10} E$ becomes $10 \log_{10} P$, where P represents the *power* ratio.

If you've remembered reciprocity, what has just been said about the antenna as a radiator is readily applicable to the antenna as a receptor. Increasing its gain enables the antenna to receive a signal more effectively in a given direction and therefore deliver more signal to the transmission line and thence to the receiver at the end of the line.

Beamwidth

Another characteristic which is closely related to gain is the beamwidth, which is arbitrarily taken to be the width in degrees of the antenna pattern main beam at the 3-dB or half-power points. These correspond to the 0.707 E_{max} points on a field-strength pattern. There is nothing which says the beamwidth cannot be measured at the 10-dB points or at any other points on the antenna pattern. Traditionally, however, the 3-dB point has been the place at which beamwidth is defined, and beamwidths measured elsewhere usually are accompanied by the level at which they are measured for identification. All other things being equal (which they often are not), as an antenna's gain is increased, its beamwidth decreases, which can be expected from the redirection-of-energy concept just discussed. As an example of beamwidth read from a pattern, the beamwidth of our squeezed ballon pattern of *Fig.* 3 is 88 deg.

Thus we may define *Beamwidth* as the width in degrees of the antenna radiation pattern at the points which are 3 dB down from the peak of the beam. Beamwidths are given separately for both horizontal and vertical planes, but the beamwidth that most interests us for FM reception is that of the horizontal plane. Unless stated otherwise, references to beamwidth herein will be for the horizontal or azimuth plane.

Impedance

Anyone who has openly exhibited his total contempt of danger by mounting an extension ladder armed with naught but courage and the conglomeration of aluminum tubes and extrusions which pass as an electromagnetic wave radiator (that's an antenna) knows what the physical appearance of an antenna is. Indeed, in the case of an antenna system installation during periods of high wind gusts (a somewhat questionable, but, nonetheless, not unheard of, undertaking) we often get a birdseye view of an antenna which, having foresaken our grasp, is borne on the wings of wind to the middle of the backyard below.

The mechanical interface of an antenna with the wire that connects it ultimately to the receiver below is invariably a couple of screws which clamp the 300-ohm twin lead to one of the antenna elements. What we are immediately concerned with, however, is the *electrical* appearance of the antenna at these screw terminals. We wish to know this because the antenna and receiver should be electrically matched for optimum performance.

If the actual antenna fulfills the promise of its design, it will look, at its design-center frequency, like a resistor, the value of which will depend on the physical parameters of the antenna. This value is called the radiation resistance of the antenna, and it is this hypothetical resistor that would dissipate the power the antenna actually radiates, with a current flowing in it equal to the current on the antenna elements.

This resistance value is important also to the radio-station engineer, because the output stage of his transmitter is designed to deliver maximum power into a specific value of load. The antenna provides this load, and the antenna impedance is an indication of the value of the load on the transmitter output. Similarly the front end of a receiver has a certain impedance characteristic over the FM broadcast band, and for the antenna to deliver the proper signal for optimum input level, it must be matched to this characteristic as closely as possible.

In addition to the impedance or radiation resistance of the antenna at its design center, we're also interested in the degree to which this impedance varies over the bandwidth which the antenna is called upon to cover. If FM antennas were required to operate at but a single frequency, variation would not be a problem, and an almost perfect match could be obtained. When an antenna is used at a number of frequencies, how-

ever, impedance varies, becomes reactive as well as resistive, and mismatch between the antenna and receiver occurs.

Antenna data sheets will rarely, if ever, carry these impedance variations in terms of their actual resistive and reactive values. Rather they will use the term *Standing Wave Ratio* (abbreviated SWR) which is an indication of the degree of variation of the antenna impedance from its design value. A SWR of 1.0 (to 1), for example, indicates no variation from nominal over the band. If the antenna were designed to have an impedance of 300 ohms and its SWR were 1.0, it would exhibit that 300-ohm impedance at all frequencies within the FM band, a very desirable feature albeit an impossible one. Obviously the lower the SWR of any antenna the better it is from an impedance standpoint, (SWR cannot, by definition and measurement, be less than 1.0) since this indicates little deviation in antenna impedance and, therefore, match to the receiver, and delivery of optimum signal over the band. Any FM antenna worth its salt or anyone's money should not have a SWR in excess of 2, and the better antennas are quite capable of covering the band with SWR's of less than 1.5.

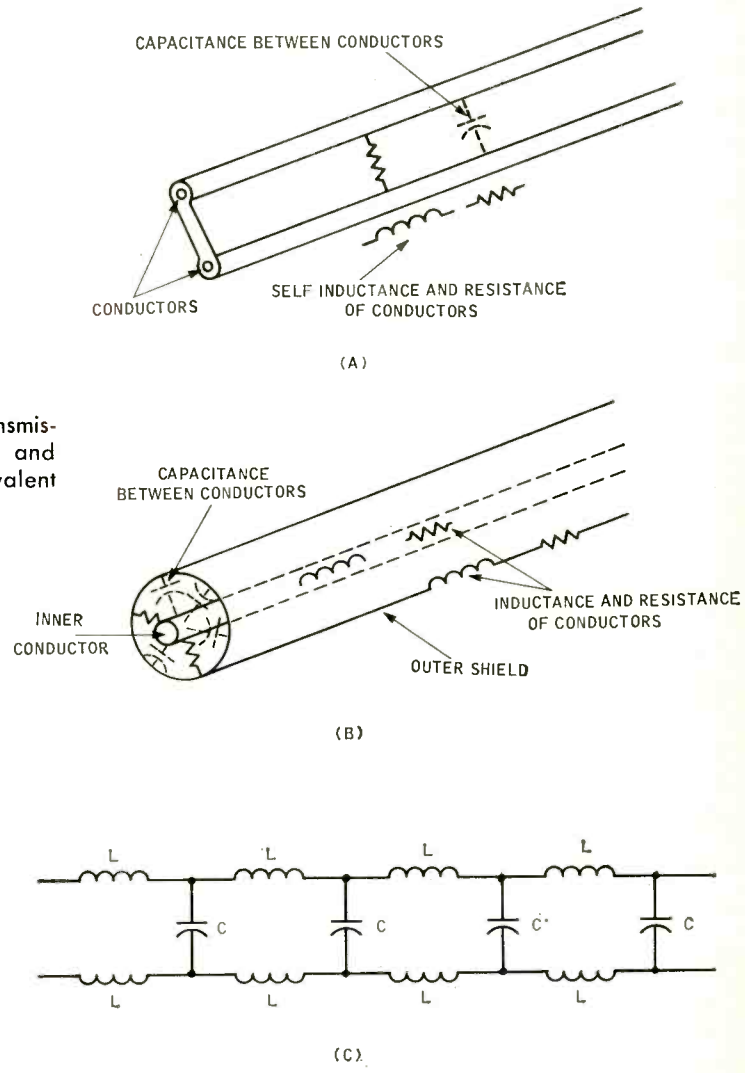


Fig. 5. Transmission lines, and their equivalent circuit.

Bandwidth

Earlier, bandwidth was mentioned in connection with the antenna's impedance characteristics. It might be worthwhile to expand a little on that at this point. The antenna that we use for the FM receiver must naturally be operable over the frequency band that the receiver covers, namely 88 to 108 MHz. Over this range the gain, pattern, and impedance characteristics of the antenna should ideally remain constant at the design values of the antenna for optimum performance. This of course does not occur. In what form does bandwidth-induced variation to these parameters occur?

Figure 4 illustrates a turnstile antenna and gives its pertinent characteristics, including the antenna's radiation patterns at three separate frequencies. This antenna is designed to provide an omnidirectional pattern in the azimuth plane of the antenna and this it does very well at the design-center frequency of 100 MHz. The pattern changes as a function of frequency and approaches a "dog-bone" shape at each end of the FM band, however, due primarily to the phasing line which connects both elements of the turnstile together and to the feed line.

While a cursory look at these patterns might lead you to believe there is considerable variation in pattern over the band, a second look will reveal that the ratio of peaks to depressions in each pattern, a measure of the circularity, is less than 3.5 dB at the ends of the band. This antenna, which is designated the Model FMT-1 by its maker, the Finney Company, actually exhibits omnidirectionality within 2 dB at the center 40 to 50 per cent of the band. Because of the frequency-sensitive phasing line that is part and parcel of all turnstiles, and the pattern variation it causes at the band edges, this antenna is a particularly good illustrator of some of the changes which performance characteristics can undergo as the antenna is operated away from its design-center frequency.

Basically, because of the relatively narrow bandwith that the FM antenna is called upon to cover (in contrast to TV which, with the UHF band, covers a frequency spectrum of 15 to 1) the radiation pattern of a well designed, unidirectional antenna remains fairly constant and under control with some narrowing of the main beam at the higher frequencies of the band. The key words here are "well designed." The bandwidth of a normal, single-driven, yagi antenna, a modification of which a number of commercially available FM antennas are, is no greater than 10 per cent. These antennas can exhibit drastic variations in both their radiation patterns and impedance values at frequencies outside of this range.

Obviously, there must be a way to combat variations such as these if we are to have antennas both high in gain and constant in performance over the band, and designers use twin feeding, element tapering, and judicious choice of element spacing to produce antennas with adequate bandwidths which operate well over the full FM broadcast frequency range.

The keys to determining the bandwidth characteristics of an antenna are consistency of pattern and impedance.

Transmission Line

The wire that connects the antenna with the receiver is technically termed a transmission line, and it is an extremely important part of the antenna system. Many persons experience degraded TV and FM performance because they are

(*Continued on page* 37)

The London Audio Shows— and Bitburg, and Audio In-Flight Entertainment

C. G. McPROUD

A brief resume of the travels overseas to view the U. S. Department of Commerce High Fidelity Show in London, London Audio Fair, and an audio show at an Air Force Base

A typical Trade-Center-furnished display cabinet in the room shared by Fisher and Ampex.

THE NIGHT OF APRIL 12 was only seasonably cool as TWA Flight 700 took off from New York International Airport bound for London and the U.S. Department of Commerce' first hi-fi show in that venerable and delightful city.

The next morning—only six hours later in elapsed time—it was a different story. The temperature was 37, and the wind velocity about the same. But we got off anyway, since we exhibitors at the U.S.D.C. show were to be briefed at 3:00 p.m.

Fighting our way across the breezy tarmac, preceded by the rest of the passengers and a busy photographer (hence the lower left picture on the cover), we entered England officially, got some spendable currency, and continued to our hotel. By that time it was raining, which it continued to do for the next twelve days, varying the pattern only twice—once to let the sun shine for a few hours while the Queen paraded across town to open Parliament, and once to snow for the better part of a day.

Little difference it all made, since the show opened at 10:00 a.m. and closed at either 5:00 p.m. or 9:00, leaving little time for anything but working.

The Show Facility

Entering from St. James Street, just a block off Piccadilly, one first encountered the inevitable "Commissioner," a former Royal Artillery sergeant who, like many of his fellow retired soldiers, serves as a guard primarily, and—in our case, at least—as an uplifter of our spirits secondarily. The reception room was staffed by three young ladies who obtained the names of every visitor in the trade, and there also was AUDIO's counter where every visitor received a complimentary copy—though almost invariably they reached in their pockets for the half crown—two shillings sixpence—indicated on the cover, after being given their free copy. Down a 20-ft. wide corridor were three booths, occupied by such unlikely boothfellows as H. H. Scott and University Sound, Ampex and Fisher, JBL and Stanton/Pickering. Turning the corner one encountered another area flanked by six more booths, with Koss/Acoustech/Rek-O-Kut and Electro-Voice; Dynaco and Empire; Elpa Marketing (showing McIntosh, Bozak, Editall, and Sharpe) and Niles Christensen (showing Crown recorders); Altec and Delrama (showing Marantz, A-R, and Grado); and Sherwood with Royal Sound (showing Trusonic, Midwest Audio, and Frazier). And in the last booth were KLH and Shure Brothers. *High Fidelity* magazine had a counter in this area, also.

A group of visitors concentrates on the Acoustech line of amplifiers and kits.

(Reference to the March issue will show the reader that some changes were made after it went to press.)

The "booths" were constructed for the occasion, and for temporary enclosures were about as soundproof as one could expect, although the low frequencies, in particular, were only slightly deterred from passing through.

Each visitor—whether trade or general public—was given a questionnaire on which he could register his opinion, and indicate what he would like changed or added. These proved most enlightening, since they showed that the average British buff considered the U.S. equipment more elaborate and more "finished" than their European counterparts, and that much more output power was provided than they

Meanwhile, another group of visitors is deep in the insides of a Dynakit amplifier.

Walter Rios, left, assistant to the publisher of *Overseas Weekly*, interviews Stan Neufeld, Bill Cameron, and Haskel Blair of University Sound.

could ever need. (Maybe so, for in general, rooms in British homes and apart—sorry, flats are likely to be smaller than in the U.S.). Typical comments were like these:

. . . Most interesting . . . personnel very co-operative . . . I feel more emphasis should have been placed on equipment for educational purposes . . . far and away the outstanding exhibit . . . finest, cleanest sound I have heard in 10 years . . . would like to see more test-bench equipment . . . over-all standard of equipment very high . . . well laid out, with plenty of information.

While the show was not very well attended by U.S. show standards—nor in comparison with London's Audio Fair—most of the exhibitors were well satisfied with the trade representation, and many excellent contacts were made for distribution in the U.K. and Europe, and after all, this was the principal reason for the show. The exposure to the public was basically incidental, since most of the equipment on display was not yet generally available on the British market.

Nearly 1000 dealers and distributors did attend the show, however, from places as far distant as Athens, Barcelona, and Stockholm, and many new outlets were established by the U.S. manufacturers. In addition, there were about 1650 attendees from the general public.

"Bud" Childs, right, explains the McIntosh line to British dealers.

All of the display booths were fitted with similar cabinets, as shown in several of the illustrations. The first question asked by readers is always, "What did you see that was new?" Actually, very little, since the foreign market is relatively untapped, and consequently the products from the season just ending are *all* new to that market, and, of course, we had seen most of it previously at the Los Angeles Show, and there was not very much there that was actually new.

Before the U.S.D.C. Show ended, we kept hearing about another audio show scheduled for April 30 and May 1 at Bitburg Air Force Base in West Germany. Never having heard of the place, we naturally made plans to go there. First, however, we had to visit the Audio Fair.

International Audio Festival

The London Audio Fair, as it is commonly called, has for a number of years been held at the Russell Hotel in April. This is a solid old structure with walls about two feet thick, and thus admirably suited for such an exhibit. The plan consists of two large exhibition halls on the street floor with static displays, while for the sound demonstrations, some three floors of the hotel are employed, and the usual—and sometimes unusual—crowds flock throughout

L to r: Bill Thomas of JBL, Michael Fountain and Terence Livingstone of Tannoy, in lively discussion with Miles Henslow (back to camera), founder of the British publication, *Hi-Fi News*, and the author.

the ancient halls. Since the London Fair draws around 36 to 40 thousand, and with no entrance fee, the halls are likely to be crowded for the four days of the show. Under the direction of Cyril Rex-Hassan, this show has long been a great success. Exhibit space is relatively costly, particularly since most exhibitors occupy both a booth in the halls on the main floor as well as their demonstration room or rooms.

On the last day of the show, the first stereo multiplex transmission with live artists was broadcast from the Wrotham transmitter. Heretofore, stereo broadcasts have all been pre-recorded. The

Crowds filled the aisles at the London Audio Fair in the ballroom—no demonstrations in this area, only in the upstairs rooms.

In Bitburg, all the exhibits were in a large hall. Exhibitors shared time on 15-minute intervals.

BBC are experimenting steadily with FM-stereo—apparently with the idea of getting all the bugs out of the system *before* they go on the air officially instead of afterward. FM-stereo is almost ready to become a continuing reality in the U.K. This historic broadcast was sponsored by the Festival, in conjunction with the BBC.

As to the equipment on display, it was here that we did see a few new items. One thing did impress itself on us—the British seem to worry overly about tonearms. Maybe we are not hypercritical, since our equipment in general seems to be further advanced than theirs, and we have not felt that arms, *per se*, are all that important. However, it will be remembered that the well-known Shure-SME arm originates in England, and now there is an oriental imitation of it. The striking *new* arm, though, is a product of Audio and Designs, a company composed of several engineers who are experienced in the field, each of whom devotes himself to a particular category of audio equipment. The arm in question has no wires to the arm proper—it can be lifted off its vertical pivot and stored away if its owner wishes. The electrical contact between the arm and the base is made via four pins in the nylon hub of the arm which travel in four "arcuate" (that's what their literature calls them) grooves in the nylon hub of the base,

(*Continued on page* 42)

Tracking Error Determination and Minimization

T. J. CELI*

Although the information presented herein has appeared in other forms throughout the history of audio, this particular exposition is one of the clearest and simplest we have come across. A template is provided to eliminate all calculations completely.

TONE ARMS AND CARTRIDGES have reached a state of development which emphasizes the virtue of exactness. The arms are balanced in every plane with anti-skating forces applied to keep the arm tracking properly with the minimum of record wear. The stylus has been shaped to get the music out of every nook and cranny of the record surface. The audio buff is now shopping for high-quality performance. "O.K., so you just bought the best tonearm. Where are you going to put it?" "No, I don't mean in what room, I mean where relative to the center of the turntable!" Many manufacturers of high-quality tonearms supply a cardboard template with their arms for correctly locating the pivot of the arm relative to the turntable center.

Did you ever stop to think after you have examined this high-quality arm, with the pride of a new father, whether or not the cardboard template was as carefully designed as the arm? Maybe the importance of correct placement has *not* been explained to you.

The main object in locating the arm is to minimize the tracking error. For a given length of arm there is a unique radial distance to the pivot point of the arm which will minimize this error. The angular position of the cartridge must also be set in a unique way to attain the minimum error. This combination is very important. When the cartridge is mounted, it may require a slight rotational adjustment to keep the tracking error at a minimum.

A detailed study of the arm-turntable geometry leads to a simple and interesting conclusion. The arm pivot must lie on the perpendicular bisector of the line AB in *Fig.* 1, where B is on the inner groove and A on the opposite outer one. This geometrical relationship is a necessary requirement for minimizing the total tracking error and the tracking error must be zero at the points C and D. It was also found that when this condition was met the tracking

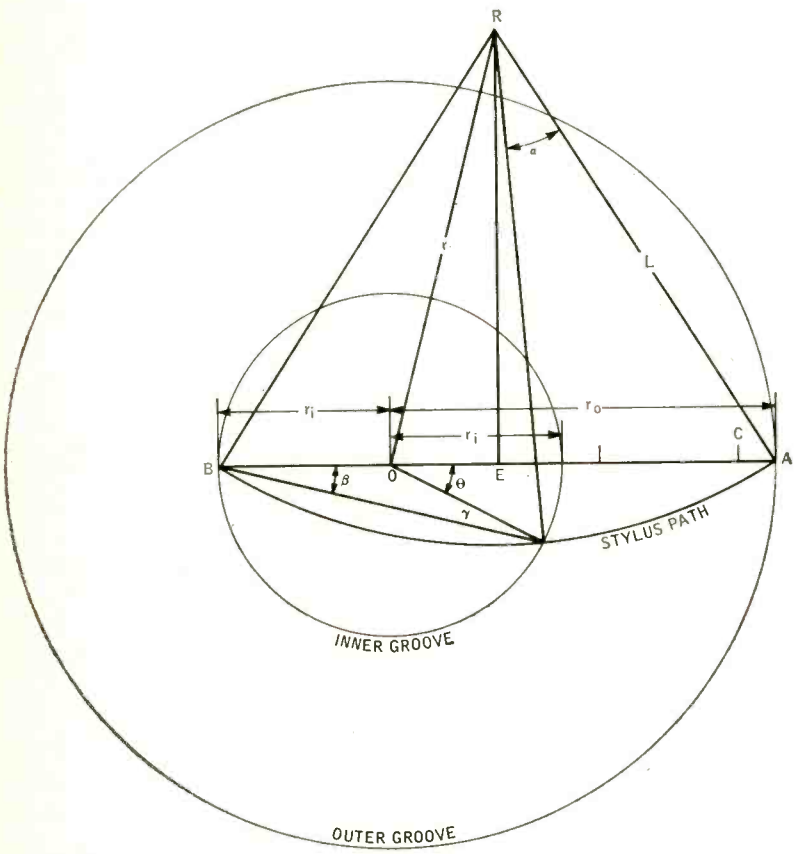


Fig. 1. The basic geometry of the turntable-arm-cartridge combination.

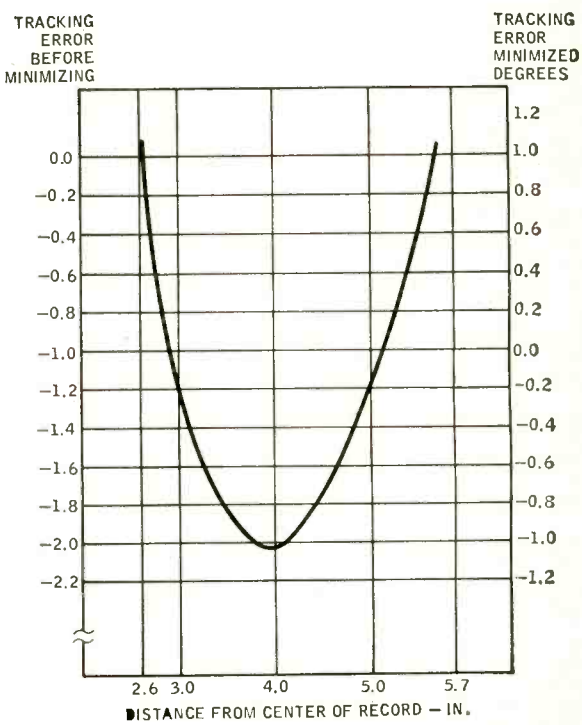


Fig. 2. Plot of the tracking error of a cartridge in a typical arm with respect to the distance of the stylus from the center of the record.

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error increased as the arm moved across the record and then decreased back through zero (*Fig.* 2). The maximum error at the outer and inner grooves is set equal to the maximum error at the center of the groove pattern.

The mathematics which supports these requirements is presented later for those who wish to play with the geometry.

Since the logic and the basic premise are so simple, a template was easily designed to position the arm, set the tracking angle, and measure the tracking error. The template is reproduced full scale (*Fig.* 3) and may be cut out and glued to a stiff piece of paper or cardboard for alignment checks when a new arm is purchased or a cartridge is removed for replacement or stylus inspection. The template can be used with any length or shape of arm and is independent of cartridge characteristics.

The sequence involved in properly placing a tonearm is quite simple. The procedure is summarized under adjustments 1, 2, and 3, but here we will give a few hints to make the jobs a little more foolproof. The basic requirement presented earlier said that the stylus should pass over the outer groove and the opposite inner groove. The template has these two points marked on a radius labeled as points A and B. The pivot of the arm is jockeyed around until the stylus passes over these two points without moving the template.

Later the discussion explained how the minimum error could be obtained by rotating the cartridge to a zero error at points C and D. These points on the template indicate where the tracking error must be set to zero. Lines are drawn on the template which are parallel to the radius of the record; others are drawn perpendicular to the radius. These appear so that the user has a convenient reference for checking that the cartridge is perpendicular to the radius at points C and D. It is quite simple to check the alignment either by lining up the front edge of the cartridge to a line parallel to the radius, or lining up the sides of the cartridge to the lines perpendicular to the radius while the stylus is on the radius line.

The other lines on the template are marked one through four. These are 1-deg. lines. When the cartridge is placed on the template and is tangent to the groove, (perpendicular to the radius) the radial line that the stylus is resting on is the tracking error for that particular distance from the center. As stated before, when making the zero adjustment at point C and D, the stylus should be on the zero error line (the radius).

This little template is a handy gadget to have around a turntable for quick and accurate realignment whenever the cartridge is removed or changed. The three adjustment procedures are listed separately for convenient reference.

Some tone arms have been found to be physically restrained to limit the arc through which they can rotate. Thus it may be physically impossible to place the stylus over points A and B as required. A slight modification to the procedure can be made which will alleviate the problem. In the discussion of the mathematics we show line R-E (*Fig.* 1) as being the perpendicular bisector of the distances A-B. The point E on the figure is also shown on the template. When the template is placed in the turntable one could extend the line perpendicular to the radius at point E. The pivot of the tonearm should lie on this line. Position the arm along this line so that the stylus passes over point A. This procedure is not quite as accurate as the one given in adjustment 1, but will be satisfactory when the arm's rotation is constrained.

Adjustment 1

To Position Tonearm at Correct Radial Distance from Center of Turntable

(a) Place template on turntable with spindle through hole.

(b) Position pivot of arm in general area desired.

(c) Adjust position of pivot and template so that when the arm is rotated the stylus will pass over Points A and B with the template being held stationary.

(*Continued on page 44*)

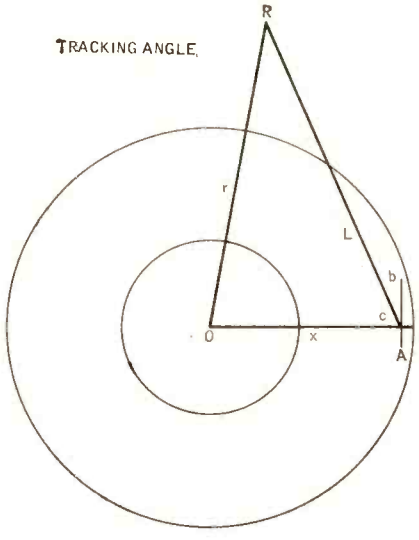

Fig. 4. Angles of the cartridge with respect to the arm are delineated in this diagram which shows the important relations.

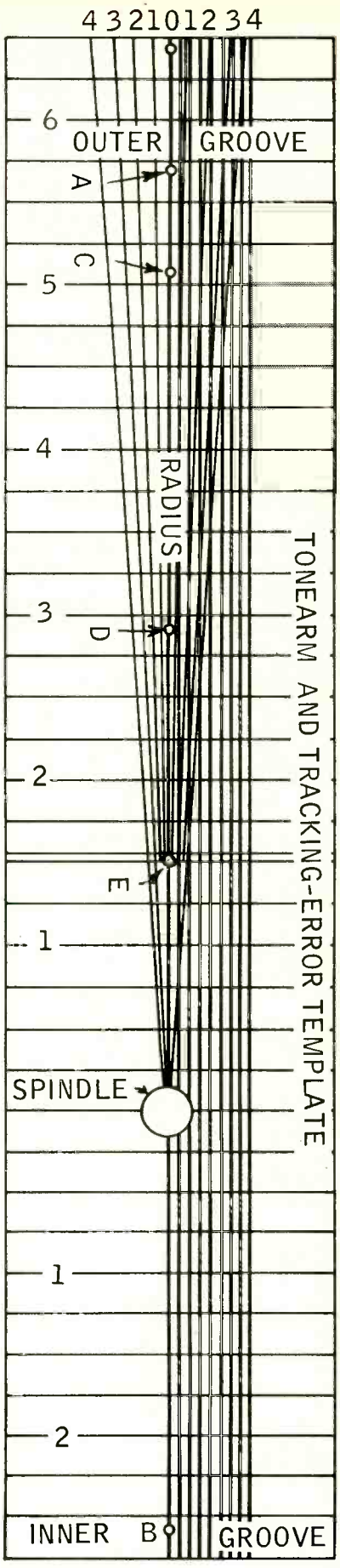

Fig. 3. Template used to determine correct location of the vertical pivot of the arm with respect to the center of the turntable. The template also shows the angle of error at different radii.

Audio Measurements Course

Part 6

NORMAN H. CROWHURST*

Resuming the study of the methods of making measurements on amplifiers and other audio equipment. Having completed the study of basic amplifiers, we now turn to preamplifiers.

When we took a breather, after the first five installments, we had covered most of the measurements basic to amplifiers which are also basic to other items of equipment in audio. We promised to take matters up by considering preamplifiers or control units next.

Two factors complicate taking measurements on preamplifiers or control units: (1) the level at which measurements must be made, which is invariably lower than for power amplifiers; (2) the fact that these units generally contain frequency-selective sections called equalizers.

Problems due to Level

Working at a lower level means that more sensitive equipment is needed to measure noise level and distortion of various kinds. Greater care may also be needed to avoid spurious measurements for various reasons. If the measuring equipment uses amplification to make the results readable, it must not invalidate the result itself.

For example, if the output is amplified before being analyzed, the amplification used must be beyond suspicion and should be so checked before measuring the preamp or control unit to be tested. This means that before use the measurement amplifier must be thoroughly checked out in all characteristics for which it will be relied upon—linearity of amplitude/phase over a satisfactory frequency range, freedom from various forms of distortion and noise, and the amplitude limits between which it will provide reliable measurement.

It is better to use such measurement amplification after any filtering, bridging, or whatever circuit may be used to separate the elements being measured, however good the measurement amplifier is. But then the measurement circuit may be used at such low levels that spurious signals are more readily injected, as noise, at this point. All of this needs careful checking. The rule we gave about looking at what you measure is a useful safeguard.

Problems due to Equalization

The frequency-selective action complicates the specification of level at various frequencies at which tests are made. If the bridging method elaborated in installment 5 is applied to this kind of unit, balance is complicated slightly by the phase shifts that inevitably accompany networks with amplitude selectivity.

A good way to handle this would be to insert corresponding frequency selectivity into the bridging circuit, so the

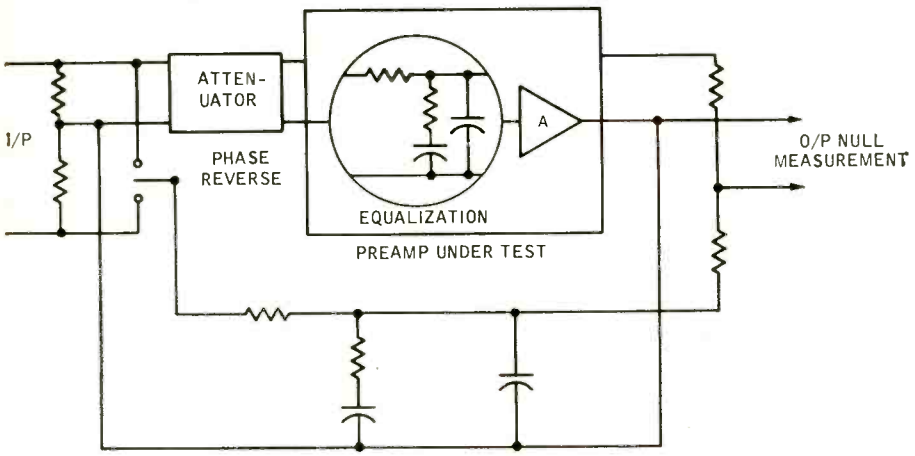

Fig. 6-1. To use the bridge method of measurement with amplifiers including equalization, the easiest way is to insert similar equalization into the bridge network.

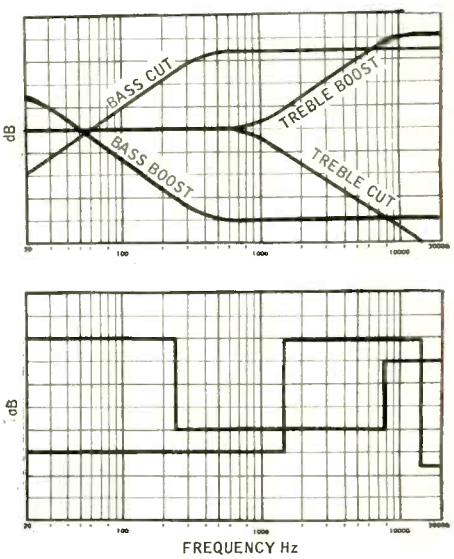

Fig. 6-3. The essential responses of bass boost and cut and treble boost and cut, to show the differences. Fig. 6-4. Idealized concept of tone control type equalization, but this is not how practical circuits work.

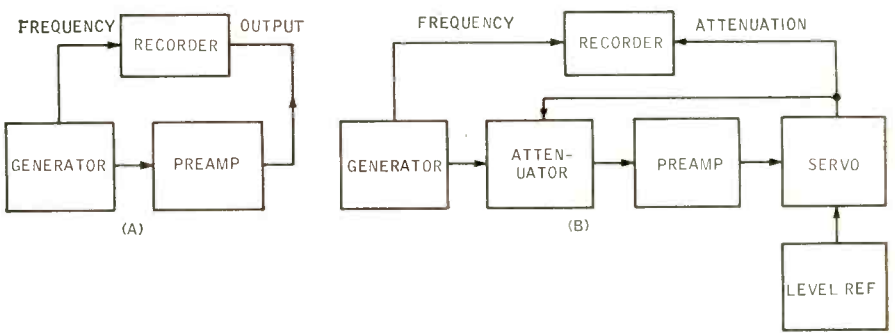

Fig. 6-2. Two ways of taking frequency-response measurements with a recorder: (A) with constant input, recording changes in output, a method that should not be used where a preamplifier includes equalization; (B) with servo-maintained constant output, measuring the attenuation needed at the input to achieve this—the preferred method for the purpose.

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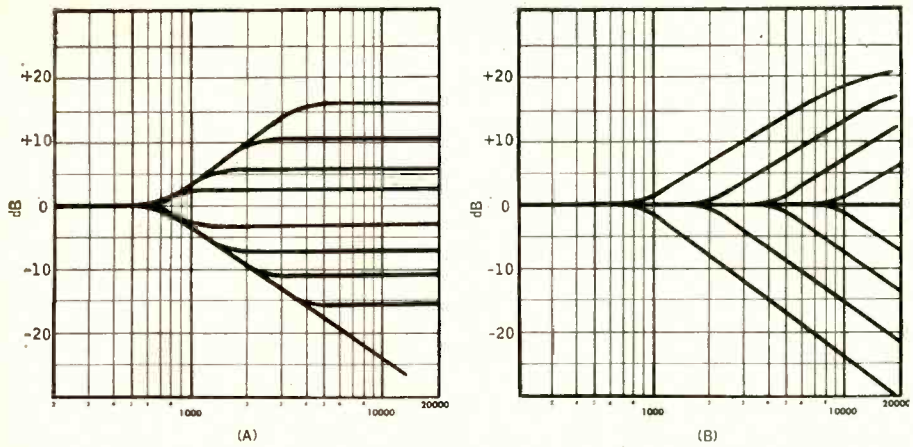

Fig. 6-5. The two basic ways of varying tone control response (only treble control shown, bass would be reversed, left to right): (A) the same basic frequency turnover, with varying depths of change; (B) varying frequency turnover.

amplitude/phase characteristic of the two paths being nulled is similar (Fig. 6-1). In general, all equalizing networks are of the minimum phase type, which means a specific amplitude response is accompanied by a uniquely corresponding phase response, however the response may be achieved in detail.

Being minimum phase does not necessarily mean that the response is the result of a relatively simple network, especially in feedback amplifiers. Interaction caused by feedback can achieve a level response with considerable phase shift, or with very rapid phase shift in the vicinity of cut-off, of a kind that cannot be simulated by passive networks, although it may yet be minimum phase.

If active networks are introduced into the alternate path of the bridge, the possibility must be considered that this path will introduce distortion as well as frequency discrimination. Then comes the question of how any distortions, however small, may interact to invalidate the final result.

So the better plan is to concentrate on simulating the correct balance, in phase and magnitude, at the test frequency, and in doing so allow the imbalance at spurious frequencies to fall where it will.

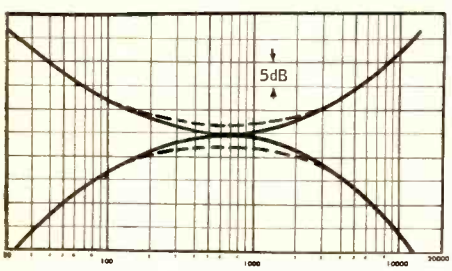

Fig. 6-6. One form of interaction between bass and treble controls: it results in level change in the mid frequencies, when both controls are turned the same way, up or down.

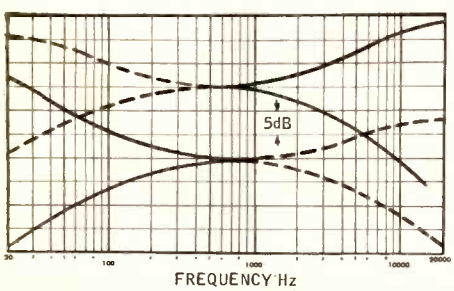

Fig. 6-7. Another form of interaction: top, treble control affects bass response as well (dashed lines); bottom, bass control affects treble response as well.

Level and Frequency Variation

Another aspect of the frequency discrimination is the problem of ensuring correct level relationships at different frequencies. Both phono and tape records are made with pre-emphasis of the higher frequencies. This means the normal input level is higher in the upper frequencies that in the lower frequencies, for the final output to finish up "level." Tests should be made with this correction included.

If frequency-response measurements are taken with equipment that automatically keeps output level constant by adjusting input level as needed to do this, the result will conform with operating conditions (*Fig.* 6-2). But if the input is kept constant, plotting the output magnitude variations as frequency response, the result may be invalidated due to effective level variations different from operational conditions.

This means that measuring the performance of any equipment that includes equalization must either be made with a feedback type of instrumentation that automatically adjusts level to remain constant with varying frequency, and measures the input attenuation changes needed to do this, or else the measurement must be made by hand, using the same reference of constant output level.

An important precaution in measuring equipment of this kind is to be sure that spurious hum, due to measurement connections, does not invalidate the results. With the equalization, maximum sensitivity appears at the lower hum-susceptible frequencies.

Tone Controls

Somewhat similar to measurement of amplifiers including equalization is that where tone-control action is included. In earlier treatments of this subject, we encountered considerable argument about whether treble cut was the same as bass boost, and vice versa. For the record, and for anyone who thinks these effects are the same, *Fig.* 6-3 shows the basic differences.

Manifestly, if you only consider extreme frequencies, such as 50 Hz and 10 kHz, without making any observations between, they could be considered identical. They would have a level differential of (say) 20 dB in each case. But when we take the middle frequencies, which is where the body of sound is, the story is different.

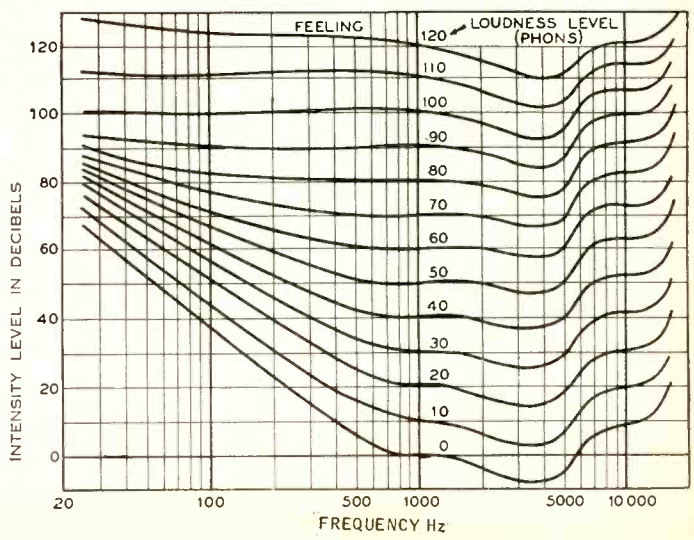

Fig. 6-8. The well-known Fletcher-Munson loudness contours.

In bass boost or cut, the mid frequency has essentially the same level as the higher frequency. In treble boost or cut, the mid frequency has essentially the same level as the lower frequency. Anyone with only a modicum of audio knowledge and experience, it would seem, should detect immediately the difference between bass boost and treble cut, or between bass cut and treble boost.

For the benefit of readers who still do not appreciate the distinctions: bass cut makes the sound "thin," bass boost makes it boomy; treble cut makes it woolly or mushy, which is quite different from boomy, and treble boost makes it "edgy" or sharp, which is quite different from thin.

Having thus discriminated between the coarsest differences distinguishing controls which affect the opposite ends of the response, there are yet finer differences with which measurements will be concerned.

If the control were intended to provide a level differential, and if abrupt separation of frequency bands were achieved by the controls, the action could be visualized as achieving one of the effects shown at *Fig.* 6-4. But these are not practical responses. Practical responses are limited to contours more feasibly obtainable, especially in variable form.

There are two basic ways of varying response (*Fig.* 6-5) for tone control purposes. Which is the better of the two depends to some extent on the purpose of the control. If its purpose is to achieve asthetic balance between the different musical or other frequency discriminative elements of the program material, the variation of level with a constant turnover frequency is probably the better form.

If the purpose is to adjust for deficiency or excess that occurs beyond a point that may be variable in frequency, the other way may be the better form. The really versatile control may include both forms of variation at both ends of the response, or may divide the spectrum into more than the three basic elements here considered, of low, middle, and high frequencies, and vary each band, or elemental section independently.

Interaction

Each form of control must be measured against what it is supposed to do. Particular points to watch for are interaction between controls. For example, simple bass boost and cut, combined with treble boost and cut, may unduly affect the middle when both are turned the same way, so that the total effect is then minimized. When bass and treble are both boosted, the middle goes up as well, making the tone controls act partially as an extra volume control, or when they are both cut, the reverse happens (*Fig.* 6-6). These are points to watch for in combined controls.

Another thing that can happen is a form of cross-coupling. When the treble control is turned to maximum, the bass end may come up, or go down, at the same time, instead of that end remaining flat, assuming it has been so set on its control. The reverse can happen: the treble response may vary with the setting of the bass control (*Fig.* 6-7).

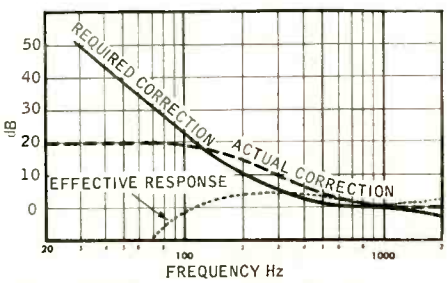

Fig. 6-9. Effect of incorrect loudness correction: one possible combination that produces an effective peak (about 300 Hz) before an early roll-off (about 100 Hz).

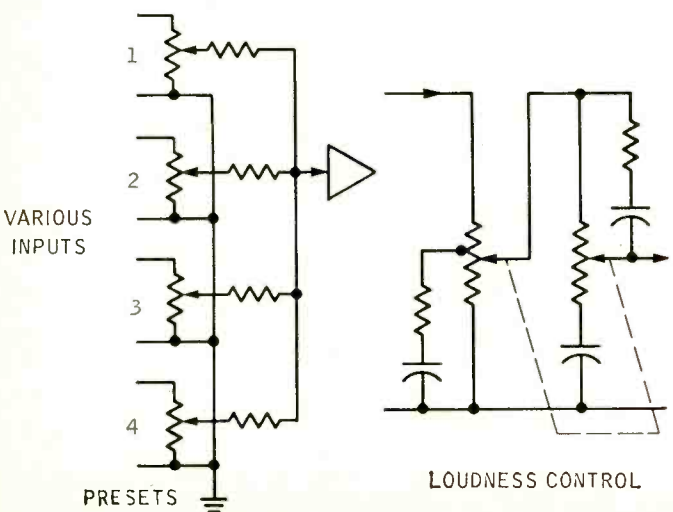

Fig. 6-10. Proper use of gain and loudness controls: each input source has independent preset gain control, while main channel has master loudness contro. Presets are used to let loudness control function over proper level range.

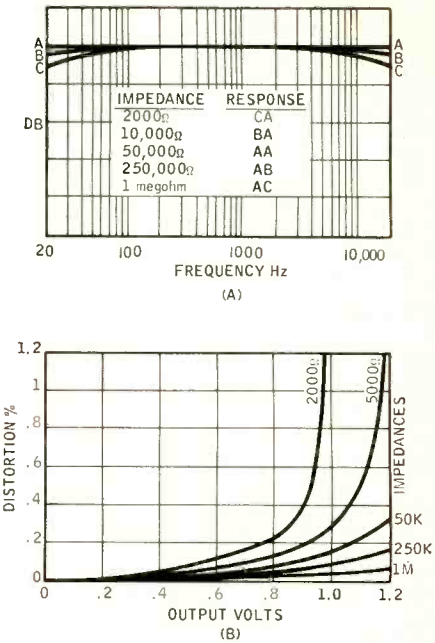

Fig. 6-11. Comparison of performance, frequency response (upper) and distortion (lower) using discrete impedence terminations.

Loudness Controls

Another kind of equalization is used in a control called a loudness control. This differs from a gain or volume control, in providing compensation for the subjective effect of change in sound intensity on apparent loudness.

As the Fletcher-Munson curves (*Fig.* 6-8) show in detail, the average human hearing faculty produces the full range of auditory level change in bass frequencies for a physical level change that is much smaller than that at middle and higher frequencies. If all frequencies have their level changed identically, as by a 'straight' gain or volume control, the lower bass frequencies will apparently disappear at lower levels.

So loudness controls are designed to reduce mid-range and high frequencies much more than the low end, to give the impression of a change of loudness without apparent bass loss.

Such compensation should follow the Fletcher-Munson contours reasonably closely. If they don't, they will produce an unsatisfactory effect, resulting in boom or hollowness. (*Fig.* 6-9).

Setting up Loudness Controls

Just a note on the proper use of loudness controls, which is not strictly within the field of measurements, but may concern the proper evaluation of equipment. For a loudness control to sound correct, even when its contour shaping checks out against the contours, the compensation must coincide with the level at which sound is reproduced in the listening room.

(*Continued on page* 48)

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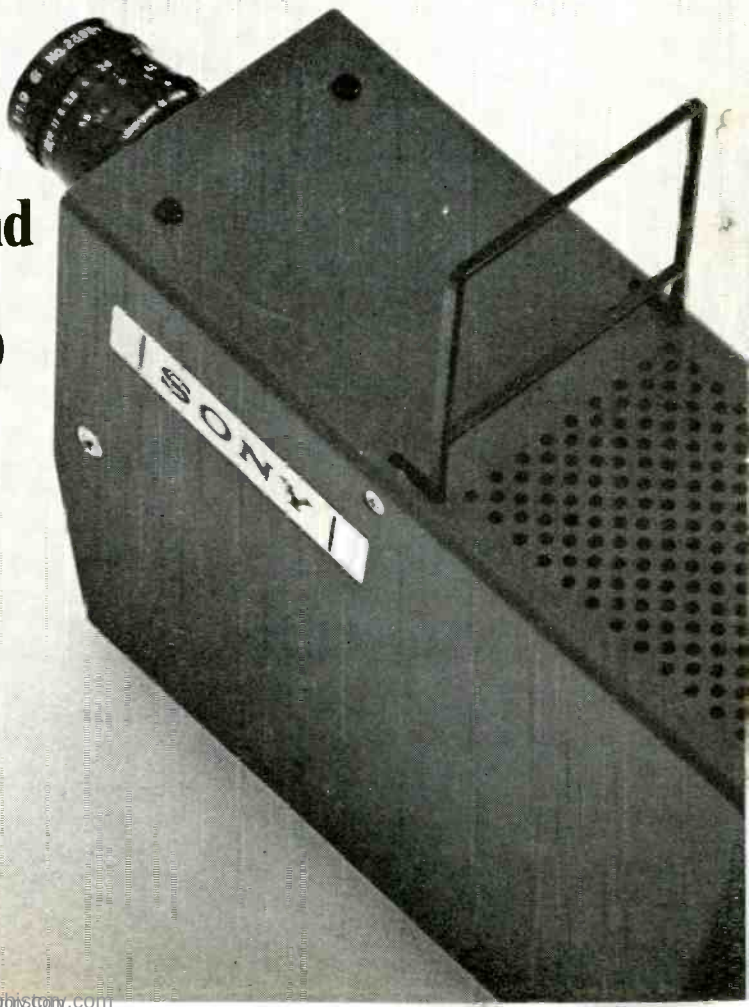


The new Sony Videocorder® is a complete Home TV Studio™: a video tape recorder, built-in monitor, and optional camera outfit. Takes TV pictures and sound right off the air, and puts them on tape. And with the TV camera attached, and microphone plugged in, you can do the same with live action.

When you're done–presto, switcho, rewind, playback! And there, on the TV monitor screen, is the same picture with the same sound, as easy as operating an ordinary tape recorder.

First unit ever designed for the home. There's nothing really new about taping sight and sound. TV stations have been doing it for years. But the equipment costs tens of thousands of dollars. That's a long way from home.

But, when you can bring the complete system—recorder and monitor—down to under $1,000, plus an optional $350 for the camera outfit, you're home. And that's exactly what Sony did. They achieved the most exciting home entertainment concept since television.

How did Sony do it? Know-how, that's how! The same imaginative know-how that has innovated all kinds of new things for people to enjoy: pocket transistor radios, incredibly small, personal TV sets, and high fidelity tape recorders—many of them memorable firsts.

Best known as a pioneer in transistor developments, Sony is also one of the foremost producers of tape heads, tape transports and the tape itself. Sony also manufactures TV picture and vidicon tubes. Sony drew from this specialized experience to create this all-new, all-Sony TV tape system for the home.

New recording/playback technique. It was out of this same resourceful know-how that the ingenious idea of alternate-field recording and repeat-field playback was conceived. Combining it with helical tracking, it made possible the development of a unit that would use standard ½-inch video tape at conventional 7½ ips speed, yet capable of storing more than 60 minutes of program material on a 7-inch reel. The dream of a home TV tape recorder became a reality.

How it works. The Videocorder has a rotating 2-head assembly. Only one head is used for recording. It picks up every other field—30 fields per second. For "playback," both heads are used. As one head completes scanning a recorded field, the second takes over and rescans the same field. This reproduces 60 fields per second on the screen as completely interlaced 525-line pictures.

Similar to movie technique. The principle is very much the same as in movies, where the camera operates at, let us say, 24 frames per second. The movie projector also shows the film at 24 frames per second, but projects each frame twice. Thus, the observer receives 48 image impressions per second.

This is done to minimize "flicker" and enhance the illusion of smooth, uninterrupted motion. The Videocorder records 30 fields per second, and double-scans each field to produce 60 impressions each second.

Complete tape interchangeability. So precise are the sync constants provided by the circuitry and by the mechanical speed controls, that any tape recorded on one Sony Videocorder can be played back on any other Sony Videocorder.

The rotating heads are belt-driven by a hysteresis motor. The head assembly, in turn, is servo controlled to maintain locked-in 30 rps speed accuracy and correct angular orientation with relation to the recorded track.

The same motor also drives the tape capstan via a coupling idler wheel. The combined effects of the capstan-mounted flywheel and the self-speed-regulating characteristics of the motor provide smooth, unvarying 7½ ips tape movement.

Unlimited Applications. The Sony Home Videocorder adds a thrilling new dimension to home entertainment. Want to relive some telecast event? Watch a space launch again? A ball game? A presidential speech? Some selected program? Tape it with your Sony Home Videocorder.

You can even use a timer attachment to record a program while you're out. For, once it's on tape, you can watch it at any time. And you can erase the recorded material, and reuse the tape over and over again.

And with the optional camera outfit, you can also record picture and sound of live events—family functions, social shindigs, community activities—you name it. You can also apply it to your business or profession or your hobby interests.

Playback versatility. Moreover, you're not limited to watching playback on the built-in Sony 9-inch screen monitor. You can connect the Videocorder to any monitor, regardless of size. A competent TV technician can even adapt your Videocorder to work with your TV set.

Now available. Prices start at under $1,000. The basic Sony Home Videocorder (model TCV 2010) is priced at $995 complete with 9-inch screen monitor/receiver. A deluxe version (model TCV 2020) in oiled walnut cabinet, and equipped with built-in timer for taping programs in your absence, is priced at $1150. Optional camera outfit including tripod, microphone and cable, is $350. A 7-inch reel of tape, a full hour of recording, costs only $39.95.

Visit your Sony dealer today for an unforgettable demonstration. For free booklet describing the many uses for your Sony Videocorder, write: Sony Corporation of America, 580 Fifth Ave., N.Y., N.Y. 10036

SONY® VIDEOCORDER®

EQUIPMENT PROFILE

Fig. 1. The Viking 880 Tape System.

VIKING 880 TAPE RECORDER

One of the genuine pleasures available to the audio buff is tape recording—be it from live or electronic program sources. Of course, no pleasure can be any greater than the limitations allowed by the equipment. Which brings us to Viking. They have been making (and we have reported on) recorders and decks for quite a while now.

This new system is a complete tape music center in that it is basic recorder plus stereo power amplifier and dual speakers—all in a portable package.

The transport is the familiar (certainly to AUDIO readers) Viking 87. This is a two motor unit of fine design. It can accommodate up to three separate heads. It is not necessary for us to elaborate on its performance; that was last covered in detail in the report on the Knight KG-415 published in January of this year. Suffice to say, the deck meets or exceeds all its published specifications. And the specs are stiff ones.

There is one addition, however, that we have not seen on earlier transports. Now there is a separate knob that acts as a pause control. It stops the tape motion without affecting any electronic pre-positioning. So you can edit commercials from a radio program while recording.

The housing of the tape motion cut-off switch (activated in case of breakage or runout) seems redesigned in appearance; though no change in function is apparent.

The 880 is equipped with three separate quarter-track heads. A shift mechanism allows you to move them into a position that will center the gaps on half-track tapes. Some limited experimentation with what half-tracks we have seemed to indicate that little difference actually occurred in performance whether the heads were at the half- or quarter-track position.

For quarter-track tapes, of course, the heads must be exactly positioned or you will be playing parts of the wrong tracks. A check with our special track position test tape (discussed in February, 1966) showed that positioning was accurate for the playing and recording of standard quarter-track tapes.

The electronics of the 880 are simple, yet reasonable versatility is not sacrificed. Separate gain controls are provided for record and play functions of each channel. There is a sound-with-sound position that feeds channel one information to channel two. However, you will need a separate mixer if you want stereo microphones at the same time as you want a line feed. (There *are* separate connectors for each source.)

There is a stereo earphone jack that will allow the use of low-impedance phones. Also, there is a gain control for the built-in amplifiers. Thus, you can set playback level, (for the built-in speakers or earphones) to match input level for most convenient A-B testing.

The speakers themselves are detachable wings that can be placed some distance apart from the main section. Toward that end, Viking provides 8 feet of cable for each speaker. Our listening tests of this system through its own speakers was quite satisfactory. If they are really not a replacement for a good wide-range system, no matter. For a portable monitor they are good enough. Sound is certainly listenable, even if it is somewhat tilted in favor of the top end.

And that is about the most severe criticism we can muster. As a record/playback instrument, the 880 is superb. The over-all record/play curves for the two speeds are shown in *Fig.* 2. Only one channel is shown, since both channels were always within one dB of each other. This same statement must be made about response to the standard Ampex 31321-01 test tape. And we must point out that the bass rise seen here is a characteristic of this tape when it is played with quarter-track heads.

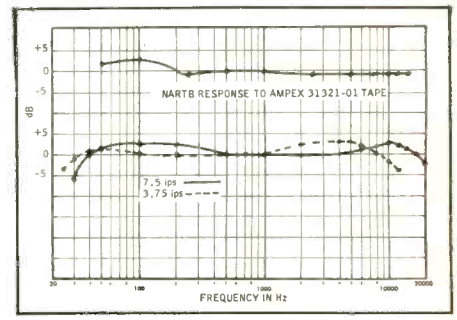


Fig. 2. Standard playback and record/playback response of the Viking 880. The lower curves were made with Scotch 201 tape. The upper curve shows playback response to the test tape played at 7½ ips.

Recording and playback indication is by two separate VU-type meters. These indicated 0 VU within ½ dB of the test-tape standard. Total noise was -49 dB left and -51 dB right channel below 0 VU.

The real pleasure of this Viking is in its use. As a deck or as a portable instrument it never proved inadequate to what we consider our high standards. It is a thoroughly fine system. Its hybrid-transistor electronics seem stable and are likely to stay that way. The transport is a proven winner. With such a combination Viking ought to sell a lot of them. The 880 is the complete system, it is priced at $439.95. The Model 88 is identical except that it lacks the power amplifiers and speakers, its list price is $339.95. In either case we feel these to be worthy of consideration by the most fastidious audio buff.

Circle 201

ACOUSTECH XI-P/M STEREO INTEGRATED AMPLIFIER

It is always a source of gratification to us to complete an amplifier kit that results in a genuinely superior product. Such is the case with this new Acoustech.

Actually we are dealing with two kits here. First, there is the power amplifier section; the Model XI. This is built to completion first. And you can stop right here if you wish. The result is a basic amplifier of more than 35 watts per channel power.

The second part is an option. This is a preamplifier/control center module system

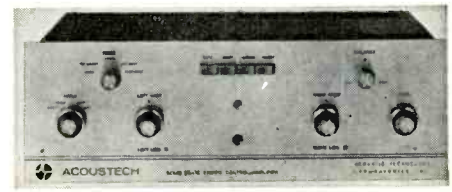


Fig. 3. The Acoustech XI-P/M Integrated Amplifier Kit.

that is added to the chassis to transform the XI basic into an integrated design.

The total system uses four factory assembled plug-in PC boards. Two are involved with the power amplifier portion. These are installed at the time that this section is built. The second two come with the preamp module. (We should state that this is called a *module* because it cannot stand on its own—rather it must be installed within the power amp chassis.)

Construction of the first section is easy —almost too easy for what is to follow. Once past the power amp and through the countdown (more on that presently), you begin the preamp. This first involves the removal of some connections made when you built the power amp. That's not too bad.

Then you plunge into the construction of the preamp. This would be fine except that there is a myriad of wires going to and fro. Many are not soldered to their respective points until later; these are apt to come loose if not securely bound, when you are adding more wires. We didn't count how many there were. But we did fervently wish that a wiring harness had been supplied.

Still we did get through the kit without mishap. Experience does help. This is really not a difficult kit; rather the complexity of wiring increases the possibility of error or soldering iron mishap.

Now we get to the countdown system. This is beautiful. How come nobody else thought of it before? At the end of the power amplifier, and again at the end of the preamp, there are several pages of tables. Each step covers a single connection point, and each one details the quantity and type of connection to be found. For example: Board Jack 2,—(two) green coaxial, green.

With a guide like this, you can't go wrong. If your count doesn't agree with the countdown, *you* are wrong.

We started off this report with the comment that the finished product justified the labor. That deserves emphasis. The quality of components that go into this unit are of the highest. We really cannot fault them at all.

Performance characteristics are equally high. Witness *Fig.* 5. This is full-power response into an 8-ohm load. 4- and 16-ohm loads result in about 3 dB of power reduction. Over-all 1-watt frequency response is not shown. This is +0.5 dB, –2 dB from 8 Hz to 160 kHz. 20-kHz rise time was measured at 2 μsec.

The preamplifier is equally impressive. Noise was 57 dB below a 5-mV input in RIAA phono. Sensitivity was 3.2 mV for 35 watts output in phono *low*. (There is a rear-panel switch that swings the magnetic-phono input to a reduced sensitivity position.) In the *high* position, sensitivity was measured at 40.5 mV.

Equally important is the overload point. In the maximum sensitivity position it is 68 mV; reducing the sensitivity moves the overload to 0.1 volt! No high-output cartridge problems here.

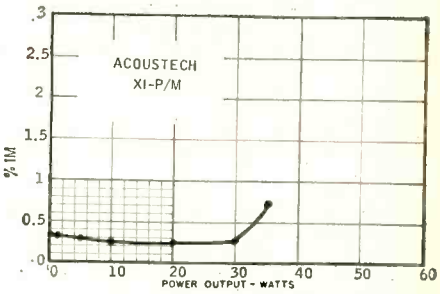


Fig. 6. IM Distortion of the Acoustech XI-P/M at 8 ohms; 60 and 6000 Hz at 4:1.

Figure 6 illustrates the IM distortion characteristic of this unit. We think it excellent. Note that Acoustech rates the amplifier at 30 watts continuous power across 8 ohms. It is this curve, perhaps more than all else, that is responsible, we feel, for the clean, effortless sound of this system. This Acoustech does to music what should be done—it passes it through without alteration.

The XI basic amplifier kit lists at $129.50. The preamp module is an additional $89.50. Compare this against the wired Acoustech V (a similar unit) at $349 and you come up with quite a bargain. In any case this kit represents value. We most earnestly recommend it.

Circle 202

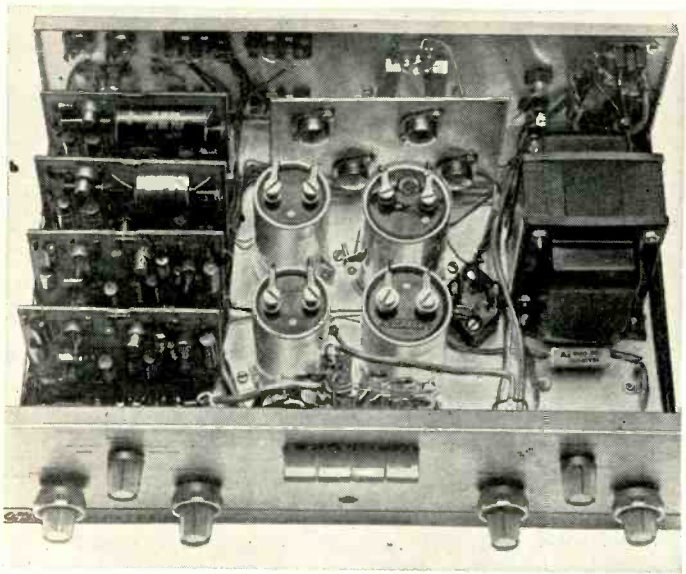


Fig. 4. This is how the Acoustech looked when it was completed.

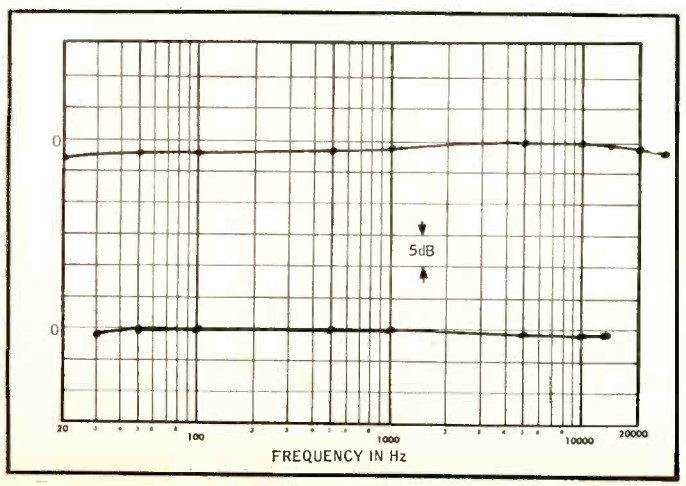


Fig. 5. Frequency response of the Acoustech XI-P/M. The upper tracing represents 8-ohm power response with a reference of 35 watts = 0 dB. The lower tracing is the accuracy of the Acoustech to the standard RIAA playback curve.

UNIVERSITY MEDITERRANEAN LOUDSPEAKER SYSTEM

Every so often it becomes our privilege to observe a new and interesting loudspeaker system. All too often loudspeakers fall in a broad category of "just another bookshelf system." The University Mediterranean is different.

In the first place, it looks different. We have seen decorator cabinets of similar design, but heretofore, not loudspeakers. Physically it is 24¾ inches in diameter on the top, with heptagonal sides in the type of cabinet known as commode. Over-all height is 22½ in. Two doors, with grille-cloth backing, provide the opening for sound radiation. Finished in either grained Butternut or lacquered and hand-rubbed antique white, the unit can fit into many decors with finesse. Also available in similar styling are equipment cabinets and other pieces which could be integrated into the home.

Internally, the system consists of a highly compliant 12-in. woofer with University's Radiation Resistance Loading, which results from the extra strong cabinet structure, combined with a 4-in. lining of damping material to eliminate resonance. The mid range is accommodated by an

8-in. unit with a closed-back basket designed to provide presence and clarity. The solid basket serves to control cone motion, as well as to isolate the mid-range unit from the high pressures created by the woofer sections. The tweeter is of the reciprocating-flare type, and operates above the crossover frequency of 5000 Hz. The crossover between woofer and mid range is at 500 Hz. Continuously variable controls provide for optimum adjustment of mid and high units, and a three-position switch gives similar flexibility for the low end. The theory of the controls is that the speaker itself can be tailored to the acoustic requirements of the room, rather than the amplifier, which is, in theory at least, the ideal way to operate. The only question lies in the education of the listener—he must be cautioned to set the controls to what he considers the optimum and then leave them alone as long as the speaker remains in the same location. We have never been in favor of visible controls that invite "fiddling," but when they are relatively inaccessible, they can be ideal.

We found the Mediterranean to have good definition, with the production model better balanced than the protoype which we had seen in Oklahoma City a year ago with admonitions not to talk about it. Certainly the over-all range encompasses anything available on records or radio. If your decor calls for a cabinet of this design, the Mediterranean should be your dish of tea.

Circle 203

Fig. 7. University Mediterranean Loudspeaker system.

ANTENNAS

(*from page 23*)

using ancient, weatherbeaten transmission line, the losses of which have increased in proportion to the line's exposure to the elements. The transmission line is the means by which the signal power that the antenna captures is transported to the receiver where it can be processed to yield the information it carries. The line is merely another medium of transmission, and as such, the lower its losses the more desirable the medium.

At radio frequencies this transmission line behaves differently than it does at lower frequencies, such as those in the audio band. This is because the two wires that make up the line actually look electrically like (A) and (B) of *Fig.* 5. A capacitance, the value of which depends on the spacing of the conductors and the dielectric constant of the material which separates them, exists between each conductor of the transmission line in the same way a capacitance exists between any two conductive surfaces that are situated parallel to each other. In addition, each conductor of the line has self-inductance which, in combination with the capacitance, forms the LC networks shown at (C) in *Fig.* 5.

To an electrical impulse applied at the end of the transmission line, the inductive-capacitive combination appears to present an impedance approximately equal to $\sqrt{L/C}$ where L and C are the inductance and capacitance per unit length. This is termed the surge or, more commonly, the characteristic impedance of the line.

These capacitors and inductors are assumed to be ideal, with no inherent resistance, and therefore no power losses, (I^2R) occur in them or the surrounding medium.

This, of course, is practically not so, and the amount of power that is dissipated in this medium is a measure of the insertion loss or attenuation of the particular transmission line.

A combination of inductors and capacitors such as these have the following property: If they are terminated at any point with their characteristic impedance, all the power delivered to one end of the line will be available in the terminating load. The transmission line is then said to be "matched." An antenna system for FM-stereo reception should always have the line and the loads at each end of the line matched. This requires that the receiver at one end of the line and the antenna at the other have the same impedance as that of the line characteristic impedance. But what if either, or both, do not?

(*Conitnued next month*)

The Tape Guide

HERMAN BURSTEIN

Tape Abrasion

Q. Which kind of tape has the least abrasive action, Mylar or acetate? Is there some kind of lubricant that I should apply to my tapes at certain intervals? What brand of tape results in least head wear?*

A. I don't know that there is any appreciable difference between Mylar and acetate where head wear is concerned. I can't recommend a specific brand if only for the reason that I don't know if there is one best brand. I only know that the premium quality tapes at premium prices give you the best of present technology and therefore the highest protection against excessive head wear. You can find in most audio stores lubricants specifically made for application to the tape heads and/or the tape.

Microphone Transformers

Q. I am having microphone trouble, the problem being that the microphone doesn't seem to have enough sensitivity. It is a low-impedance microphone, and I am using it in conjunction with a transformer with a primary impedance of 150 ohms and a secondary of 40,000 ohms.

A. Are you using the microphone transformer specifically recommended by the microphone manufacturer? If not, this may be the answer to your problem. To step up the signal coming out of your present microphone transformer, you might employ a microphone mixer with gain. Or you might purchase a simple phono preamp (the kind costing in the vicinity of $15 to $20), remove the phono equalization, and use the unit for amplification. Or you might use one of the regular audio preamps with an input specifically intended for microphones. In all or some of these cases the output signal may be sufficiently large to require that you feed it into your tape recorder's high-level input; feeding it into the low-level input might result in overloading.

Polished Capstan

Q. My foreign-amde tape recorder has a highly polished capstan which tends to pick up oxide from the tape and hence need frequent cleaning. Even though I am using top quality tape I have to clean the capstan after every reel or two. I have noticed that the capstan of most American recorders have a satiny finish to which the oxide doesn't adhere. Would you recommend having a satin finish put on the capstan as a solution to the problem; if yes, where and how? Also, do you think the satin finish would have a higher coefficient of friction that would tend to reduce wow and flutter?

A. If you attempt to put a new finish on the capstan, this may result in grinding down the capstan sufficiently to cause an appreciable reduction in tape speed. And if the capstan does not remain truly round, you may introduce additional wow and flutter. I think you had best refer your problem to the manufacturer of your machine, or to his representative in this country. In any case I don't know of any place that will undertake to refinish a capstan. I suggest that you try more than one high quality brand of tape to see which rubs off least.

*Reg. T.M., Dupont polyester base.

Half-Track vs Quarter-Track Heads

Q. Is there any loss of fidelity when playing a half-track tape with a quarter-track head?

A. When playing half-track tape with quarter-track head, you will have the following adverse effects: (1), a loss in signal-to-noise ratio because the playback head is not picking up all the signal on the track; (2), somewhat greater dropout effect because the narrower the track the less chance there is for tape imperfections to average out.

On the whole the above effects are slight enough so that the reduction in high fidelity is minimal—often nearly unnoticeable. On the other hand, the use of a quarter-track head may have an advantage in that there is less treble loss due to azimuth misalignment than in the case of a half-track head.

Slitting

Q. I have been able to obtain a quantity of ½ inch tape which, judging from a sample strip, will work fine in my recorder. My problem is splitting the stuff—and I have quite a lot—to ¼ inch width. Do you have any ideas on tape splitting?

A. You have me stumped. I can't recall having come across any device that would assist you in precisely splitting a ½ inch tape into ¼ inch tape. Frankly, I am skeptical about using anything but sophisticated industrial equipment to perform such a job. Unless a tape is precisely split under proper conditions, you are apt to run into problems such as the tape weaving as it passes through the guides during use, resulting in high frequency loss; the tape sticking in the guides; cupping or curling of the tape; etc. Æ

Slippage

Q. In the fast-forward mode the takeup reel of my tape recorder practically comes to a halt when the reel is nearly full. What is the cause?

A. Low line voltage may be the cause. A slipping belt, a slipping clutch, a clogged motor, an underpowered motor, and so on. Any one could be responsible.

Print Through

Q. What are the relative rates of print-through for ¼-mil, 1-mil, and 1½-mil tapes? The problem is to store as much information as possible on a reel of tape with minimum print-through.

A. I gather that the signal/print-through ratio deteriorates about 3 dB as one goes from conventional 1½-mil tape to 1-mil tape; and as much again in going from 1-mil to ¼-mil tape. To minimize print-through you can purchase special low-print tape, which is about 3 to 4 dB better than conventional tape. This is generally made in 1½-mil thickness, although some companies offer low-print tapes in other thicknesses as well.

To minimize print-through, do not rewind the tape immediately after recording, but store it as is (tail out) for at least 4 hours. The greatest amount of print through occurs in the few hours immediately after recording. By following this course you can achieve as much as 6 dB improvement in the *apparent* print-through. Furthermore, avoid storing recorded tape where temperature is excessively high.

Lubricants

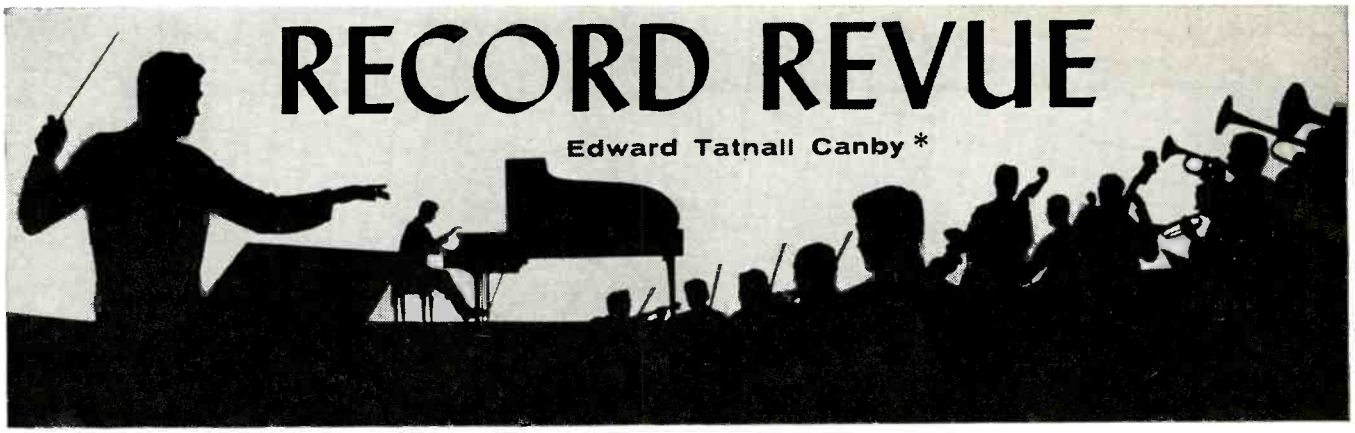
Q. I applied a special tape lubricant to two of my tapes, and now they reel through the tape recorder like a snake. The tape seems like crepe paper that has had both sides thumbed to produce a wavy edge. What can I do to salvage these tapes?

A. Nothing, I'm afraid. I would suggest that you describe your experience to the store that sold you the lubricant. In the future you should be careful to use such lubricant sparingly. I have had no problem similar to yours in the use of tape lubricants.

Reviews

*Q. The **** tape recorder was reviewed by* AUDIO *magazine, and the test report brought out that the machine's signal-to-noise ratio was very close to the manufacturer's specifications. But the test report in another magazine resulted in signal-to-noise figures far below those of the manufacturer. How come?*

A. AUDIO's test report was based on a recording level that produces 3% harmonic distortion on the tape, while the other organization uses a level that produces 1% distortion. The difference in level is about 6 to 8 dB, and the measured signal-to-noise ratios differ by the same amount. Furthermore, one has to make allowance for variations from one unit to another of a given brand and model of tape recorder; hence identical testing methods will result in some reported differences. However, a really good machine will be adjusted at the factory so that it *at least* meets specifications. Æ



RECORD REVUE

Edward Tatnall Canby *

HELIODOR

Telemann: Concerto for 4 Violins in D; Concerto for Trumpet, 2 Oboes and continuo; Sonata for Gamba and continuo (lute); Quartet for Flute, Oboe, Violin and continuo. Hamburg Camerata Instrumentale.

Heliodor HS 25006 stereo

This splendidly varied Baroque disc points up the present upheaval in the record business. Heliodor, a new label from M-G-M in the Nonesuch price range, derives most of its material from the top-priced European Deutsche Grammophon label, the high-quality earlier D.G.G. mono recordings updated via an anstonishingly effective "enhanced" stereo treatment called *Breitklang*. (The four violins in the first piece, above, playing all alone, precisely equal in tonal range, are somehow spread out neatly from left to right before you! How you do *that* in pseudo stereo I don't know—though part of it is via a brighter left channel.)

So hastily are the catalogues now being rearranged that the music on this disc is still listed as available in the original mono D.G.G. Archive release—at not far from $6 a disc, more than twice the new Heliodor price! (There were two discs, from about 1958; this combines material from both.) The Heliodor record, on direct comparison, is clearly preferable. Only about one in 100 people could spot it as other than a brand new, top-quality stereo recording. If you don't believe me, go out and buy the Archive mono ($5.79 list) and compare it with the Heliodor stereo ($2.49 list). Some price adjustment!

KEYBOARD

Artur Rubinstein. Liszt: Sonata in B Minor/Schubert: "Wanderer" Fantasy.

RCA Victor LSC 2871 stereo

In his recorded tour of the important landmarks of Nineteenth century music, old Artur Rubinstein has turned out some stunningly fine discs in recent years. This one is a bit less satisfactory, though it knowingly combines two significantly related pieces, the exploratory "Wanderer" Fantasy of Schubert and the almost equally exploratory B Minor Sonata of Liszt, so clearly derived from the Schubert. Both are mammoth pieces, of full "symphonic" length but in a single continuous movement.

The trouble here is mainly with the Liszt, one of the most profoundly Germanic pieces by that pianistic thunderer. Af first I thought maybe Rubinstein, at last, was beginning to show signs of old age's weakness. But on second thought, it occurs to me that the problem is simpler—Rubinstein is not a German pianist but one of those fiery Poles—like Wanda Landowska and Chopin himself. Somehow, the Polish temperament is not proper for the weighty architecture of drama found in the Liszt B Minor Sonata. At any rate, it seems to me flighty, thin and lacking in over-all architectural feeling here. Schubert is something else again; Rubinstein plays its varying moods with a good deal of beauty.

Hindemith-Ludus Tonolis. Käbi Laretei, piano.

Philips PHS 900-096 stereo

This is a monumental big piano work, of many separate movements, a kind of modern "Art of the Fugue," summing up Hindemith's own special language and his modernization of older contrapuntal techniques. Though officially an exercise, or a "demonstration" work, it is of course very real music. And if you have the slightest liking for the easy Hindemith sort of Romantic modernism, you'll find this lady's piano playing quite superb. She understands Hindemith beautifully—and so will you as you listen.

It's beside the point to remark that she is the wife of a famous Swedish film director, no less than Ingmar Bergman. She looks like one of his top actresses. But what counts is her playing and it is good.

Wanda Landowska. Handel: Suites for Harpsichord Nos. 2, 5, 7, 10, 14.

Angel COLH 310 mono

Wanda Landowska/Dances of Ancient Poland.

RCA Victor LM 2830 mono

Here is the First of Harpsichordists, the lady who brought the instrument back, in an early and a late recording. The Handel suites date from the pre-war period and her long stay in Paris. They were recorded in 1935 and, of course, originally issued in a fat, fancy 78-rpm album. The Polish Dances were made in her last days, at Lakeville, Conn. (a few miles from where I sit writing this review), when RCA Victor was taking her down on tape in her own study at home. Neither record is a "modern" recording, but both are entirely adequate for listening, the Handel Suites tending to a massive, enormous sound, the new RCA recordings a bit close and stringy in comparison.

The Handel Suites speak for themselves—even unto the familiar "Harmonious Blacksmith" variations, one of the many movements. The Polish music is not quite what it seems; some is genuine Baroque music out of the far side of Europe; a number of pieces are Landowska's own settings of traditional Polish tunes. They are musical, if old fashioned. And—what else!—the final number is a Chopin Mazurka. Why not?

Oud Nederlandse Klaviermuziek. Marijke Smit Sibinga.

Odeon 33 CHX 5 mono

(Via London)

If the title makes you want to sneeze, be reassured! It's just a Dutch import. Old Netherlands Keyboard Music, played on several interestingly different types of harpsichord.

Marijke Smit Sibinga is an excellent young harpsichordist, confident, absorbed in the musical meaning, expressive. She plays, as far as I can figure out from the notes—all in Dutch—three different instruments, maybe including the cover picture of one of those "giraffe" affairs, the body of the harpsichord zooming vertically up the wall of the room. The change in tone color is subtle and very interesting, and it helps to make the collection of old dances (sounding, by the way, very much like English Elizabethan music) a very good bet for listening.

ALL OVER THE LOT

Bernstein Conducts Ives. (Symphony No. 3; Central Park in the Dark; Decoration Day; The Unanswered Question. New York Philharmonic.

Columbia MS 6843 stereo

In case you didn't know, Ives is "in" — if not actually camp. The ancient American prophet of violent modernism wrote most of his works in the very earliest years of the century and so they were even more startling than they might seem. That is, if anybody had heard them, then. But at the same time, they are also very pleasantly old-fashioned, which is only to be expected as of now, a half-century later. The combination of corny, semi-Civil-War-period revivalism, the gospel hymns and the marching bands, and the most outrageous dissonance, is unique. And today it is really quite enjoyable.

I still think that most Ives pieces are stylistically and constructionally about as well coordinated as a half-grown puppy. The music flops around all over the place, one minute juicily tearful, the next excruciating. But it was a legitimate sort of music for a vigorous "loner" like Ives, who made his living off insurance and wrote whatever he felt like. It is saved for us because, crazy as it is, the stuff *is* very definitely playable. It sounds.

Bernstein's own somewhat juicy and occasionally loose-jointed approach is perfect for Ives! He really weeps over it all, which is nice.

Leonard Bernstein N.Y. Philharmonic Debussy: Clarinet Rhapsody; Saxophone Rhapsody. Honegger: Rugby; Pacific 231; Pastorale d'Eté.

Columbia MS 6659 stereo

Leonard Bernstein's recorded programs (this one listed exactly as per the above) are always imaginative, if sometimes corny. This is good listening, though the two seldom-heard rhapsodies are not Debussy's finest work and Honegger's once-shocking modernism (as of the 1920's) now sounds like big-time movie music.

It's always pleasant to hear that the sax was around before jazz took it over, and that the clarinet adapts to so many

different syles of music—from Goodman and Russell all the way to Mozart and Debussy. The Clarinet piece is much the best of the two Debussy works; the sax piece is listenable as a curiosity, filled with tired Debussy clichés. (It was commissioned by a Boston lady in 1895; she paid in advance—she should have known better. She got the piece, still incomplete, in 1911. ("Pacific 231" is, of course, a steam locomotive, more or less. "Rugby" isn't even recognizably a ball game. But both are orchestrally impressive, with much skillful sound-effect noise. Honegger knew his big orchestra, all right.

The Baroque Harp (Purcell, Pachelbel, Seixas, Hotteterre, Dandriue). Elena Polonska; R. Cotte, G. Durand, recorders.
Turnabout TV 34069S stereo

Four Centuries of Music for the Harp (C.P.E. Bach, Handel, Dussek, Naderman, Cabezon, Palero, de Ribayaz). Marie-Claie Jamet.
Nonesuch H 71098 stereo

French Music for the Harp (Debussy, Ravel, Pierne, Faure). Annie Challan; Paris Cons. Orch., Cluytens.
Angel 36290 stereo

Three harp records, two of them collections of older works, the third (with orchestral instruments) out of the late-Romantic and Impressionist France of the turn of the 20th century.

Most old music on the harp is transcribed—there is precious little real harp music. Turnabout's Elena Polonska plays a program, mostly 17th- and 18th-century music, of works which *might*, some of them, have been for harp but probably weren't. In any case, she is of the watery harp-playing school and her rhythms are too vague, her blurrings too pronounced, to get over much specific musical continuity. Very good for background music.

Nonesuch's similar record of old music, with Marie-Claire Jamet is 'way ahead on many points. The playing here in contrast, is forceful, rhythmic, melodic, and very clear in the harmony—this is a splendidly musical harpist! In addition, there are several valuable works here, specifically composed for harp, and of real musical value. On the first side, the C. P. E. Bach sonata, late-Baroque already tinged with Mozart, and the little Dussek, out of the early Beethoven period (sounding like a modest "Appassionata") are worth twice the cost of the whole disc; the Naderman, early 19th-century French, is also a dramatic and listenable little work. The disc is rounded out by Handel Variations and some transcribed items of lesser interest. If you want to hear the harp making *sense* in older music—try this.

Angel's disc is altogether different—out of the days of the harp's Romantic glory in recent times. Debussy and Ravel on Side 1, with respectively, orchestra and chamber group, nicely played, with the harp miked too prominently for the music. Side 2 offers a pair of minor but mellifluous harp masterpieces by Frenchmen of the school of César Franck, not very important and yet extremely easy to listen to, if you like corny late-Romanticism on a high level.

David Diamond: String Quartet No. 4 (1951). Samuel Barber: String Quartet Op. 11 (1936). Beaux-Arts String Quartet.
Epic BC 1307 stereo

Two quartets by America's two leading modern-conservatives, both well along in middle age; and your reaction will depend on your own sensibilities. They are modern, but not *very* modern.

This is the sort of record that commonly gets issued by foundations and is bought mainly by composers and a few dedicated and determined supporters of

(*Continued on page 43*)

LONDON SHOW

(*from page 25*)

these grooves being filled with mercury, and the contact to the mercury puddles is made by four more pins in the bottoms of the grooves. Even the anti-skating force is provided by a magnet arrangement which is so unique we didn't understand it at first (or yet).

The usual crop of new loudspeaker designs was shown, along with a growing list of solid-state equipments. Nothing impressed us so much, however, as the arm just described.

Bitburg Amateur Radio Club

Originally started as a club for "hams," the Bitburg Amateur Radio Club is more like a hi-fi "club." It's primary purpose is apparently to provide a source of supply for the service personnel in the area. Actually it is only one of five audio clubs in the military establishment, others being located in Darmstadt, Oberammergau, Kitzingen, and Lenggries. During the time of our visit, however, there was a two-day Audio Show at Bitburg, which is a large Air Force base with some 8000 people living in quarters provided by the Air Force, and a few more thousand "on the economy," which is the service term for living in housing not provided by the government.

The club provides a means for these people to obtain U.S. (and other) hi-fi products at somewhat less than they would have to pay here at home, even at discount prices. Bitburg offers the best prices of any of the clubs, and servicemen come from miles away just to take advantage of them.

With rather less to do than would be available at more populated cities, many of the service people have begun to develop a great interest in hi-fi as a hobby, and to provide themselves with entertainment in their off-duty hours. Many of these men have their families with them, of course, and even if there were other activities with which they could occupy their time, it is not likely that they would have the freedom needed to engage in them. In any case, the entire high-fidelity industry should be grateful for these clubs for their part in promoting hi-fi—when these servicemen return to their U.S. homes, they will undoubtedly continue their interest.

The Bitburg show was held in the recreation hall—a room of about 80 by 100 feet for the hall itself, and with a cafeteria and game room attached. The hall is often used for dances and other forms of group entertainment, and has a stage at one end. As there were no "booths" or separate rooms, each exhibitor was allotted an area for his display, and aside from this difference, it resembled a stateside show, in that all the familiar names were present—Fisher, Scott, University, Sherwood, Acoustech, A-R, Altec, Stephens, Marantz, J. B. Lansing, Kenwood, Koss/Acoustech, Frazier, Dynaco, Electro-Voice, to name a few, along with some less-known names as Audioson—a German-made line long made under the direction of Per Kirksaeter. It was here that we saw the "world's most powerful solid-state receiver," with 200 watts output, and feeding four large speaker systems to provide band music rather louder than the same band would have been if it had been in the room.

Peter Dyke of H. H. Scott patiently awaits his turn on the demonstration schedule.

To avoid the certain bedlam which would have resulted from all of the exhibitors playing at once, each was assigned a schedule which allotted 15-minute periods during which he could demonstrate his equipment. The first day, the show was open from 10:00 a.m. to 10:00 p.m., and the second day, Sunday, from 10:00 to 8:00 p.m. Several hundred people attended, with, in many instances, their families.

We also visited the club's showroom, where the equipment available is on display, and where we saw literally hundreds of cartons of equipment. In one area we counted 28 well known receivers of one manufacturer, 25 expensive automatic record players, and dozens upon dozens of loudspeakers of many types. The inventory of equipment, we were told, was in the range from $150,000 to $200,000 at all times, and also that on a Saturday after a payday, sales run to as much as $15,000. Quite an operation, to say the least! And the bonus to industry is that each of these purchasers has become an audio buff, and should continue to be an enthusiast when he returns to civilian life again.

Following the show, we returned to Frankfort, loafed a day, and left on TWA Flight 741 for New York, arriving 8 hrs and 2 minutes later, even though the pilot had announced that flying time would be 8 hours and 1 minute.

In-Flight Entertainment

Now that entertainment is provided for practically every minute of our flights, we naturally took more than casual interest in the equipment, which varies with the airline. On TWA, two types of entertainment are provided—eight channels of sound, some of them in stereo, and moving pictures. The channels available include sound for the movie, classical, popular, theatre and movie music, children's programs, the spoken word, jazz, and so on. The choice is made by the passenger with a simple switch. The sound transducer is built into the seat arm support, and sound is conducted to the listener by a twin acoustic tubing terminating in stethoscope-like ear plugs. The sound is surprisingly good, particularly when one considers that it is conducted for some four feet in this fashion.

Before the movie is to start, a screen is lowered at the front of each cabin. The projector is mounted above the aisle in a housing only about 8 in. deep, up against the ceiling. Entirely remote controlled, it requires no attention during the flight.

The sound tapes are endless loops, each 150 feet long, and each with four tracks, running at a speed of 1⅞ ips. Two quarter-track heads are employed, and using selection actuated by transparent "windows" in the tape. Track change requires less than ¼ second, and thus each tape cartridge can provide one hour of monaural entertainment, or one-half hour of stereo. There are no reels—the tape is simply fed from the capstan into the open space in the cartridge, much as is done in some types of transports used in computers. The cartridge itself is ¾-in. thick, and measures 6 x 12¾ in. Ten of these fit into the reproducer cabinet, which has 12 preamps integral with it, each amplifier providing an output adjustable from −20 to ±10 dBm. A second cabinet accommodates as many as thirteen 30-watt amplifiers, each of which measures only 1⅝ x 4 x 4⅞ in.

The entire system is powered from the plane's 28-V. d.c. supply, except for the drive motor, which operates from the 40-Hz, 115-volt supply. The Airborne Passenger Audio Entertainment System is a product of the Data Division of United Control, which manufactures and services the equipment, and which also furnishes program material for the system.

Thus, having described three audio shows and the audio entertainment system en route, we feel we have covered the entire junket in capsule form. Now we await patiently the opportunity of making another such trip, to wherever.

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RECORD REVUE

(*from page 41*)

the contemporary. But, like all such, it should be considered on its own merits as home listening fare. For those who like to explore and to hear what's going on in music, who are ready to listen to good composers who may not quite match up to Bach or Beethoven and, above all, who have some mild experience, at least, of the modern—this kind of record is easily worth its price.

By the way, one movement of the Barber is the famous Adagio for strings, very well known for its Romantic persuasiveness in many an orchestral performance, including Toscanini's. This is the original format.

Brahms: Deutsche Volkslieder. (42 German Folk Song Settings). Elizabeth Schwarzkopf, Dietrich Fischer-Dieskau; Gerald Moore, piano.

Angel B-3675 (2) stereo

For a special taste, but this album is unique and superb of its sort. Here are most of Brahms' late-in-life settings of tunes which then rated as folk songs, done up with marvelous piano accompaniments — the very best Brahms there is.

The tunes weren't too "authentic" (they are far removed from the folkish "originals" we like today) but they are absolutely beautiful tunes, any way you listen. Angel has combined a baritone and a soprano singing sometimes alone, sometimes alternating within the same song (as boy and girl), for the necessary variety. Both are absolutely tops—and interestingly different in their approach, too.

Fischer-Dieskau, Germany's most famous young baritone, sings in a modern style, powerful, expressive, but without frills. Schwarzkopf, on the other hand, adopts the old traditional German *Lied* style of singing, all tremulous and agitated, wonderfully moving at its best. This makes for an interesting contrast; for both singers are superb musicians and both make the musical sense absolutely clear.

The trio would not be complete without the piano accompaniments of one of the real greats in the field, Gerald Moore.

Heifetz-Piatigorsky Concerts with Leonard Pennario and Guests. (Arensky: Trio in D minor; Vivaldi: Violin and Cello Concerto. Martinu, Duo for Violin and Cello.)

RCA Victor LSC 2867 stereo

How quaint and old fashioned (for the most part) RCA goes sailing along with its now-elderly top virtuosi, who play splendidly in the old-fashioned music which is their preference. (I say this from the point of view of many younger record buyers.) The Arensky is sugar-sweet late Romanticism and the Martinu, for two players alone, is Romantic early modern. Both are good pieces of their sort and, of course, wonderfully played by these old pros.

The Vivaldi, a concession to the new "Baroque" taste, is rather surprisingly good, considering. It has a real, live harpsichord and a more or less "authentic" small orchestra. The great Heifetz, moreover, somehow manages to make his unctuously Romantic violin sound *almost* pure Baroque, as does Piatigorsky his usually lush cello — a double miracle, if you ask me!

Pennario is apt to be a bit chill and hard on his own but in the Arensky his piano is lovely and warm, no doubt sparked to action by his two impressive cohorts. Æ

TRACKING ERROR

(*from page 27*)

Adjustment 2

To Set Correct Cartridge Angular Position

(a) Place template on turntable with spindle through hole.
(b) Place stylus on C.
(c) Rotate the cartridge about a vertical axis until its center line is perpendicular to the line marked RADIUS. (zero error line)
(d) Move stylus to point D. Center line of cartridge should be perpendicular to RADIUS at D. If an error exists at point D, adjustment *1* is in error.
(e) If adjustment *2* changes the distance between the stylus and the tonearm pivot, repeat adjustment *1*, and then check adjustment *2*. Adjustments *1* and *2* assure tonearm position and cartridge angular position corresponding to the absolute minimum tracking error.

Adjustment 3

To Measure Tracking Error

(a) Place template on turntable with spindle through hole.
(b) Place stylus at desired distance from center.
(c) Rotate template until cartridge is perpendicular to RADIUS.
(d) Determine the radial line that passes directly under stylus.
(e) Read error where radial line terminates at outer edge of template.

Mathematics Behind Template Design

The establishment of the relationship of the arm length to the positioning of the arm was done from a geometric analysis of the arm-turntable picture shown in *Fig.* 1. The line R-A is the distance from the pivot of the tone arm to the stylus and is called "L." The radius to the outer groove of the record, O-A, is "r_o" and the radius to the inner groove, O-B, is "r_i." "r" is the distance from the center of the turntable (point O) to the pivot point of the arm (point R).

Consider what happens when the arm is rotated from the outer groove to the inner groove, passing through angle $\propto$. The record must then rotate through angle θ in order that the tangent at the outer groove be tangent to the inner groove at point F. This requirement that angle $\propto$ equal angle θ minimizes the tracking error to the smallest value an arm of given length can provide. In order for angle θ to equal angle $\propto$ the stylus path created by the rotation of the arm must pass through point B. The proof of this statement is clearly seen from the following logic:

Angle $\propto$ is a central angle spanning the arc A-F. Angle β is the peripheral angle spanning the same arc A-F. Thus Angle β is half the size of angle $\propto$*

In triangle O-B-F angle β equals angle γ, and angle θ equals γ plus β and also equals twice β.

Therefore Angle θ must equal angle $\propto$ thus proving that the path of the stylus must pass over point A and B in order that angle θ equals angle $\propto$.

Computing the radial distance r for the correct placement of the tonearm becomes a simple process now that this basic premise has been proved.

Let line R-E be the perpendicular bisector of line A-B.
The length of line R-E equals.

$$\sqrt{L^2 - \left(\frac{r_i + r_o}{2}\right)^2}$$

It also equals.

$$\sqrt{r^2 - \left(\frac{r_i - r_o}{2}\right)^2}$$

From these two equations an expression for r can be found

$$r^2 = L^2 - r_o r_i$$

This distance r is a function of the length of the arm and the radius to the inner and the outer groove. Normal values of r_i and r_o are 2.6 in. and 5.7 in. respectively. Since most "12-in." arms are 9⅝ in. measured from the pivot to the stylus, the distance r becomes 8.273 in.

The Tracking Angle

In Fig. 4, b is the angle between the straight line connecting the pivot of the tone arm and the stylus and the tangent to the radius. The tracking angle is completely independent of the tonearm shape.

The angle b is found from:

$$\sin b = \frac{r_i + r_o}{2L}$$

For the normal 12-in arm (which is really 9⅝ in.), b becomes 25.4 deg.

Computing tracking error at any distance from the center of record is an extension of the same logic.

From *Fig.* 2, the angle c is defined by the law of cosines in the following equation:

$$\cos c = \frac{r^2 - L^2 - x^2}{-2Lx}$$

The tracking error is then E which is given by:

$$E = 90^\circ - d - b$$

To minimize tracking error, the maximum error is found and then the error is equally divided over the inner and outer groove. A typical tracking error is plotted in *Fig.* 2 as a function of the distance from the center of the record. Notice that the error is zero at the outer and inner grooves, and is a maximum at the 3.9 in. from the center of the record (using the left scale). The maximum tracking error can be reduced to half of the amount shown in *Fig.* 2 by shifting the zero point. The right-side scale shows the same plot with the axis shifted so that half the error is above the zero line at the inner and outer groove and the other half is below the zero line at 3.9 in. from the middle of the record. The maximum error is thus reduced by half. The cartridge must now be placed at the angle a as previously computed, plus half the maximum error. The corrected tracking angle is now 26 deg.

The template of *Fig.* 3 eliminates the need to compute the distances and angles presented in the mathematics. It also eliminates the need to measure these distances and angles on your turntable. The template is usable with any 12- or 16-in. arm and any cartridge. The accuracy of the template is limited only by the user and his ability to check for proper alignment with the guide lines. It is not recommended that you take this template to your best friend and check his arm for tracking error or mis-positioning, because you may embarrass him.

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*Theorem in plane geometry states the central angle formed by two radii is equal to twice the angle formed by lines drawn from the intersections of the radii on the circle to any point on the circumference (peripheral angle)

AUDIO ETC.

(*from page 14*)

How can you sell one line at twice the price of the other? That's the big squeeze, right now. And it is a major reason why the present explosion of change is on such a big scale. It puts an unholy pressure on all the older companies, both big and little.

The tricky thing is that Nonesuch itself is blissfully independent, with no "parent" label above it (except, oddly, the more expensive Elektra label, folk and rock) and so it isn't squeezed a bit. It can make its records as "first-line" and as gaudy and expensive-looking as it can afford. And that's plenty.

Whereas, say, RCA Victrola, stuck down underneath the regular RCA Victor Dynagroove line, can't do a thing to compete in looks. Same with the other companies in the regular price range. Funny situation.

I'll have to leave the rest of this extraordinarily complex subject for another time—maybe by then some of the confusion will have straightened out a bit. But note well that, as of now, almost every company selling at standard prices now has, or is preparing, a second line aimed at the Nonesuch-type competition.

And every one of these lines, inevitably, is plugging hard on *European imports*, tapes licenced right out of the top-grade European lines—which, by the way, sell for a great deal more money over there than in their U.S. form. There are immense complications in this licensing business, and in each company's collection of particular affiliations. There is violent competition, too, to buy up the best tapes over there, of which there are plenty. The supply isn't nearly exhausted yet, for all our boom in low-priced records. (You can be sure that the gratified Europeans are plunging into more and more recording sessions, too! It's an economic honanza for them.)

And hovering in the background, the big international record companies, the monsters, hold enormous resources in hand, but have not yet called upon them directly for U.S. low-priced labels. *They could*, at any time.

Holding Firm

Here, those lines are holding firm. Here Angel, British E.M.I. (His Master's Voice and many others) still sells its records at the regulation higher prices and so does London, British Decca. Between them, these two could tie up most of the continent nicely. London still issues Telefunkens here at regular prices — that's a major German line. Philips, another enormous company, sells its own label here, modestly, at regular prices, same as Mercury, its U.S. affiliate. RCA hasn't yet called on its multiple foreign corporate relatives for low-priced material. Columbia still just sells Columbia, and its parallel-price side kick, Epic. Regular prices. (Ah —but Epic has at least one record from the very same source, the same artists, as a similar Nonesuch release. Twice the price.) None of this monster concatenation of record-power has moved—yet. The price bastions hold firm.

But the smaller companies have moved. Westminster's Music Guild, formerly a "connoisseur" label, is now an excellent low-price Nonesuch competitor. Perhaps most significant is M-G-M's Heliodor label —that's the $2.49-$2.49 label—because its records are very largely Deutsche Grammophon, which also sells under its own name here at regular higher prices. These, of course, are superb records at any price, and the German "*Breitklang*" enhanced stereo on Heliodor, is really something.

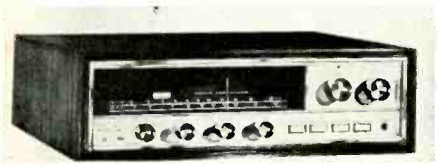
Frankly, it is extremely hard to tell new D-G records (at $5.79 stereo) from Heliodors (at $2.49 stereo)! And I have found one case, perhaps unintentional, where a D-G Archive record still listed in mono form for $5.79 is also available in Heliodor *Breitklang* at $2.49, with stereo added! Crazy, zany, and typical of our present turgid state of confusion.

Will *all the big lines* come down to $2.50? That would settle the whole thing quickly enough! But it doesn't look possible. Too many high-cost big-name artists among the large companies. So—more likely, we'll see new big-company competition in the Nonesuch-type $2.50 area, via more new labels. And the Big Squeeze will still be on, the confusion worse than ever. Just wait a few more months, say until the fall sales push. Then see what happens.

I'll be back before then with some more angles. Æ

NEW PRODUCTS

● **All-Silicon-Transistor Receiver.** What is billed as the industry's first all-silicon-transistor receiver has just been announced by Sherwood Laboratories. It is rated at 130 watts music power at 4 ohms and 100 watts at 8 ohms with only 0.3 per cent total harmonic distortion. IM distortion below 10 watts is 0.1 per cent. This is the model S-7800 receiver with low-noise AM circuitry and FM sensitivity stated at 1.6 μV (IHF). Noise-gated FM stereo switching with an indicator light occurs in the presence of a multiplex broadcast. Tuning is aided by

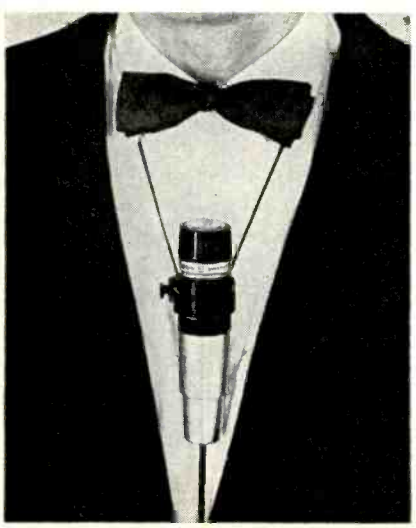


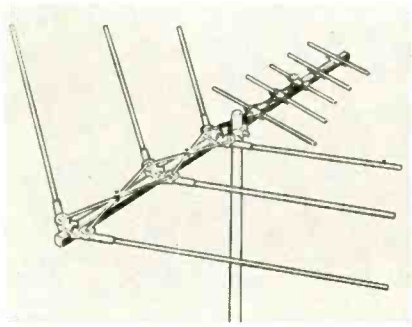
a zero-center tuning meter; there is a convenient earphone jack on the front panel; and rocker switches are used to control tape monitor, noise filter, and main and remote speaker switching. Adjustments are accessible at the front for FM interchannel hush and preamplifier gain. Other specifications: Power bandwidth is 12-35,000 Hz at 1 per cent distortion, phono sensitivity is rated at 1.6 mV; hum and noise is –75 dB on AUX, –63 dB on PHONO, and –70 dB on FM. Chassis size is 16½ x 14 x 4½ inches. Price is $399.50 for the basic chassis; $408.50 in a leatherette case.

Circle 208

● **Wearable Microphone.** The Model 545L Unidyne III is a lavalier microphone just introduced by Shure Bros. Although specifically developed to provide improved performance in those public-address situations requiring a lavalier, it is truly a multiple-application microphone and may also be used in the hand, on floor or desk stand, or other conventional mounts. The microphone does come equipped with a lavalier cord and clip assembly. It has a shock-mounted cartridge to reduce clothing and cable noise and a flexible, small-diameter cable which can be concealed easily if desired. List price of the 545L is $70.00.

Circle 209

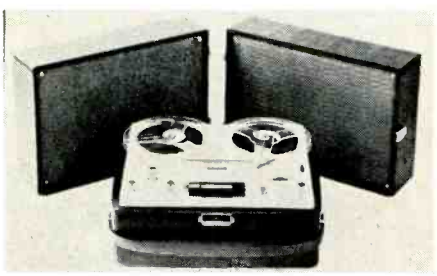




● **Log Periodic Antenna.** JFD has recently released an all-purpose antenna designed to help the city dweller capture VHF/UHF television and FM radio signals. Although an authentic log periodic design, the Model LPV-VU5 is only 45 inches long. Three driven dipoles cover both VHF bands; three active dipoles plus three directors provide stepped up gain for UHF. Frequency response is claimed flat within ±½ dB on any channel. A sharp forward lobe in the polar pattern assures unidirectional pickup and high front-to-back ratio on all channels. A free VHF/UHF splitter is included with the antenna. List price of the gold alodized unit is $17.50.

Circle 210

● **Tape Recorder.** New from Uher is the 2-plus-2 Stereo 7000-D. Called the 2-plus-2 because there are two built-in speakers plus two extension speakers,



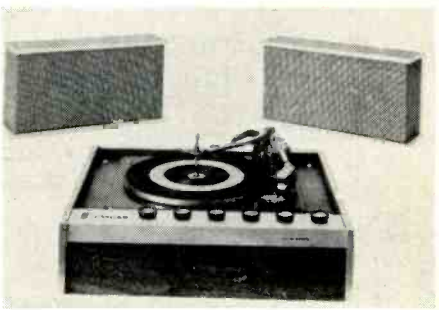
the 7000-D can create a truly wide angle of sound. All-solid-state circuitry is used; two speeds are offered: single channel or quarter-track stereo recording and playback may be had; an illuminated VU-type meter indicates recording gain; tape lifters are employed in all fast modes; inputs for tuner, phono, and telephone are provided; and two dynamic microphones are included. The exclusive Uher "dia-pilot", an automatic slide projector synchronizer, is available with the 7000-D.

Circle 211

● **Professional Bulk Eraser.** Ferranti Electric has introduced a new line of portable and conveyor-belt magnetic tape bulk erasers. The three portable models are capable of erasing saturated tapes at the rate of 100 to 250 reels per hour. All recorded data, audio pulses, or any kind of signal, from d.c. to video, is erased to better than 80 dB below saturation recording level. The portable units handle more than double the amount of reels per hour than the automatic degaussers now on the market and at less than half the price, according to the manufacturer. Model 6, 7, and 8 (illustrated) are static instruments without electrical moving parts. Model 8 handles reels of magnetic tape up to 14½ inches

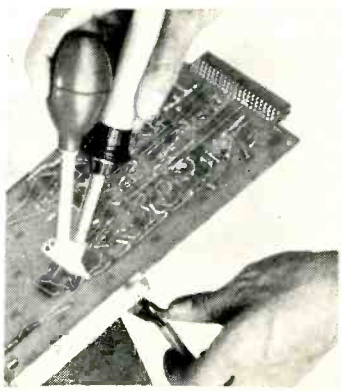
in diameter and from ¼ to 2 inches in width. Model 7 is suitable for continuous tape cartridges not to exceed 8 inches square, with maximum widths of one inch. Conveyor-belt bulk erasers are capable of handling up to 1000 reels per hour under continuous operating conditions. For further information and prices:

Circle 212



● **Compact Stereo System.** One of the first units to introduce the Sony component lines is this compact solid-state stereo system. A full 30 watts of music power on both channels is delivered to each of the two wide-range speakers. A full range of control is available via balance, bass, treble, mode, and function selectors. There are inputs for tape recorder, tape deck, tuner, and auxiliary. Special Sony-manufactured silicon transistors and Sony-designed circuits are used. The phono cartridge is of moving-coil design; the record player is a modified Garrard AT-60. Finish of the system is oiled walnut with aluminum trim. Price is $275.

Circle 213



● **De-soldering Aid.** The illustration shown is a new aid that will be of special benefit to servicemen and kit builders. It is one of several de-soldering tools that

attach to the heat cartridges of Ungar Imperial Line soldering tools. It helps to speed and simplify printed-circuit repair. No tinning of the tip is necessary since the tool has a special coating that resists solder. The tool is designed for easy operation with one hand, leaving the operator's other hand free to remove components. A stainless-steel check valve is provided in the back of the de-soldering tool to prevent molten solder from being drawn up into the rubber aspirator bulb. After each de-soldering operation, molten solder in the collector is discharged into a metal waste receptacle by simply depressing the rubber ball.

Circle 214

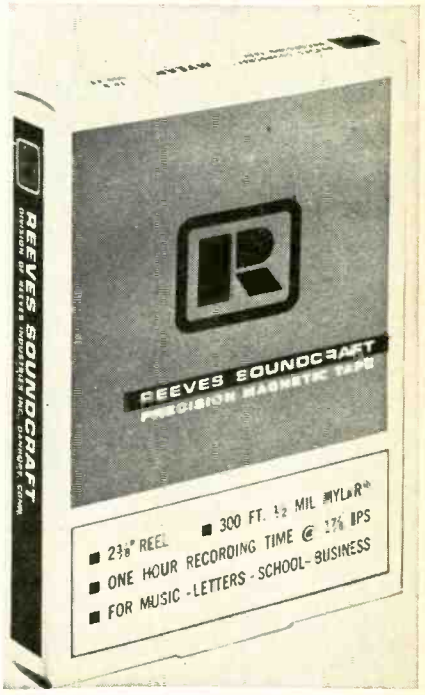
● **New Equipment and a new Name.** The products of the Commercial Sound Division of Harman-Kardon are now assuming the name of the parent organization —Jerrold. In making this announcement, Jerrold also announced the release of a new line of solid-state amplifiers which reportedly achieve maximum reliability by operating all circuits on low voltages. These amplifiers convert the usual a.c. input into 12 volts d.c. so that all circuits operate on very low voltages. This eliminates the stress of high voltages on transistors and other circuit components. Jerrold is claiming that this enables all their circuit components to last longer and maintain their high levels of performance over greater periods. 12-volt operation also makes it possible for every amplifier to be converted to battery operation. An accessory mounts inside the cabinet to provide full power input for mobile, outdoor, or emergency use. Complete information on the Jerrold line of PA amplifiers is available.

Circle 215

● **Furniture Speakers.** Ampex, primarily known for an extensive line of tape recorder systems has released a line of speaker systems. All told, there are four new models ranging in price from $158 a pair to $420 a pair. This increases the speaker line to a total of eight models. All are full-range, multiple-speaker systems with woofers for maximum bass response, mid-range units and tweeters in various combinations. As an example there is the top-of-the-line Model 4010. These are list priced at $420 per pair. Each has a 12-inch woofer, two 3-inch mid-treble units, and an ultra-tweeter. Extended bass response from 30 Hz is offered at a distortion level below 3 per cent. The woofer has a 9½ lb. ceramic magnet structure. Two shielded, back-loaded, mid-treble, wide-dispersion, radiators and the domed tweeter carry response upwards. Crossovers are at 1800 and 8000 Hz. Two continuously variable controls allow sound to be tailored to individual room acoustics. Cabinets are of oiled walnut with eggshell grille cloth. Dimensions are 24" x 14" x 12". Impedance is 8 to 16 ohms, maximum capacity is rated at 75 watts.

Circle 216

● **Triple Play Tape.** A new Mylar-based recording tape on 2⅜-inch reel, which triples playing time without any sacrifice of quality, has been announced by Reeves Soundcraft. The new tape—known as TP-3—was developed to meet the increasing need for 2⅜-inch reels as a result of continuing growth in sales of miniature portable recording equipment. Recently developed oxides provide a 5-dB increase in output without distortion as compared to other extended-play tapes. There is 300 feet of 0.5 mil Mylar on each 2⅜-inch reel. Each is packed in a self-mailer box.



Circle 217

AUDIO MEASUREMENTS

(*from page 30*)

This means that two controls are usually needed: one to vary loudness in the proper way, and the other to adjust level (as a gain control) so the loudness control introduces its effect at the correct levels. For example, a phono input–and any other input–should have a non-compensated pre-set gain control, so the range of level is correct when the loudness control is operated on that input (*Fig.* 6-10).

To set up such a system, the input gain controls should be set so that each control source, phono, tape, radio, and so on, gives the same level of sound, without altering the setting of the loudness control. This should be such that maximum power is reached with the loudness control "wide open." Then lower levels should be correctly compensated.

Output Matching

We think of a preamplifier as providing merely a line level to feed power amplifiers. But this must be matched to the amplifier with which it works. Different systems use different transfer impedances at this point. Professional equipment uses line impedance (150,000, or 600 ohms) at zero level (in the vicinity of one volt). Non-professional equipment often uses about the same voltage level, but not at line impedance.

It is important to check the effect of output loading on preamplifier performance, and to see that a preamplifier is operated at an impedance loading that is acceptable to it. A preamplifier that performs flawlessly with proper output termination can misbehave badly when not properly terminated–a fact not infrequently overlooked.

Such tests follow fairly obvious routine: a matter of checking frequency response and distortion, with different output load impedances connected. Alternative methods may be used to present the information: either complete performance details for definite impedances (*Fig.* 6-11) or variation of performance with varying impedance (*Fig.* 6-12).

Crosstalk and Separation

Other features that need checking–and are peculiar to preamplifiers or control units–are the presence of cross talk, which is leakage of signal into the wanted channel input from sources connected but momentarily not selected; and stereo separation, which is similar, except that the two channels are both wanted, but should be separate.

In each case the wanted signal is removed and a signal injected into the wanted input–the other signal source, or the other stereo channel–and the output measured on the wanted channel.

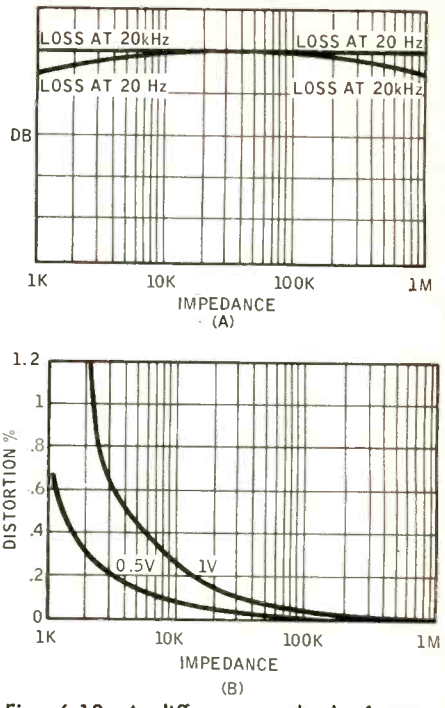


Fig. 6-12. A different method of presentation: for frequency response, loss at two frequencies (20 Hz and 20 KHz) is plotted against impedance termination, while distortion is plotted for two levels aganst impedance termination.

Stereo Balance

An additional feature to check with stereo preamplifier units is balance: how well gain remains matched at different gain settings. Different units employ different methods of achieving balance. Some have separate gain and balance controls, in which case the gains of the two channels should be identical at all settings of the gain control, when the balance control is centered.

The other method is the use of friction-ganged gain or loudness controls: the two controls are concentric, but not rigidly ganged to the same shaft; there are also concentric knobs, with a friction pad between them so that, unless specific effort is made to turn one without the other, they move together. In this case, they should be set together at maximum (full clockwise) rotation, and balance checks made at various settings, obtained by moving the controls together.

The next unit we shall consider testing is the tuner. Anyone conversant with tuners will know how to check sensitivity. Modern tuners have many more features, especially the stereo multiplex variety. Between now and when the next issue arrives, why not take a look at a tuner specification, and ask yourself how you'd check it out for each item down the list? Æ

AUDIOCLINIC

(*from page 4*)

the amplifier is to be used for nothing but guitar, you can take a short-cut and reduce the size of some of the coupling capacitors to eliminate the low frequencies from your amplifier to some extent. This elimination will prevent the grids of some of the tubes from blocking because of sudden charging. Following this same plan, you can lower the values of some of the grid return resistors. This will allow the capacitors to charge and discharge faster, reducing blocking effects. (I do not like this approach, but it is quick and it will help.)

I would use as high a plate voltage as possible on the driver stage so that there would be a maximum swing on all plates. This should be accompanied by the use of fairly low values of plate resistors to take advantage of this increased swing.

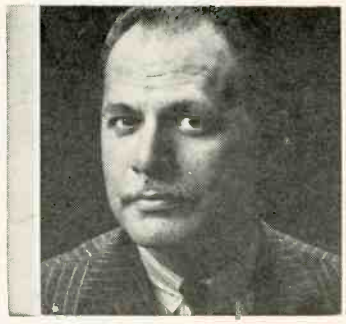
If you plan to use the split-load phase splitter, reduce the values of both the plate and cathode resistors so that the stage has more voltage. This will reduce clipping resulting from insufficient leeway in plate-swing and from grid rectification.

Inverse feedback can be the problem when it becomes necessary to reduce the tendency of an amplifier to oscillate. Reducing feedback can also help where there is not quite enough drive to the output stage. The reduction of feedback will give you more driving voltage. Do not go to extremes here. You still want to have a sufficient amount of feedback—about 17 dB minimum.

I am not sure that the cartridge and voltage divider helped in the instance you cited about the quality you obtained from your high-fidelity amplifier. Perhaps the amplifier was well designed to begin with. Perhaps the 100 K-ohm resistor "threw away" enough signal so as not to overload the magnetic phonograph input of your amplifier; maybe the inductance of the cartridge did nothing for you. You can make two tests which can verify this, provided you still have the amplifier. Feed the guitar directly into the "low-mag" input and control the signal level via the level control of your guitar. Keep the amplifier's gain control well advanced. If the signal is clean then you will know that the cartridge and voltage divider had nothing to do with the quality you obtained.

Next, move the guitar into the "hi-mag" input but don't connect the cartridge. Make a similar check to the one just described. Note the difference in sound if any. If the cartridge's presence still gives you improved sound, then we can be certain that the inductance rolled off some significant frequencies which normally give trouble.

So far as I have been able to discover, guitar amplifiers are really high-fidelity amplifiers. They do not require as wide a frequency response as is true of high-fidelity amplifiers but they must have excellent transient response. I would think that a good guitar amplifier, well designed in every way, would be a fine amplifier for use in a home-music system. Æ



ABOUT MUSIC

Harold Lawrence

The Loneliness of the Electronic Composer

"THE TAPE RECORDER is now established as a creative tool for composers (and) the works produced with it are in the foreground of experimental music today." Although these words by Vladimir Ussachevsky were written over a dozen years ago, the use of the tape recorder and the electronic music it has helped spawn still provoke bitter controversy among critics and musicians and has left the public at large largely confused.

To musicologist Paul Henry Lang, the electronic composer has broken the continuity of history, wants to change the laws of art, and threatens everything we have known and cherished. Others like Jacques Barzun say that in order to understand electronic music you must assume that previous means of musical expression are exhausted, worn out, and that a new language must be created.

What is this new language? Its vocabulary and syntax can include timbres that are beyond the capabilities of traditional instruments and voices, and rhythmic patterns that are too fast or too complex for human performers, and yet are perfectly audible to the human ear. With the help of his studio equipment, the electronic composer can, if he chooses, eliminate music's middle-men (conductors, instrumentalists, singers, and so on) altogether. Concerts in the world of pure electronic music are "performed" by loudspeakers for audiences who are at the mercy of sound systems and the technicians who operate them.

Many people find the depersonalized concert appalling. In a wry commentary on electronic music, critic Harold C. Schonberg speculated that the loudspeaker-performer might one day lead to electronic ballet dancers. "Androids are perfect, have built-in computers instead of brains, and could dance with the kind of split-second rhythmic reflex that the inefficient human musculature could not begin to duplicate. Don't laugh! it's on the way."

The controversy continues to rage. Meanwhile, different schools of electronic composers have sprung up over the past sixteen years since the use of tape machines first became widespread. Roughly they fall into the following categories:

1. The serialist adapts Schoenbergian principles to the organization of sounds recorded directly onto magnetic tape from purely electronic sources.

2. The *musique concrète* composer uses natural sounds which he transmutes, filters, speeds up or slows down, and otherwise manipulates in order to create new sounds.

3. The composer who uses electronic sounds in juxtaposition with natural sounds, treated electronically or not.

4. The aleatoric composer mixes all forms of electronic and "live" music and presents them in a theatrical framework. The notation of his compositions often is merely a sheet of paper with time-cues and a sketchy list of the order of events.

We've read a lot about electronic music. But what about the life of the electronicist? "We are terribly alone in this *métier*," says Frenchman Pierre Henry, one of the leading composers of *musique concrète*. A serious bespectacled man in his early forties, Henry recently described what it means to work incessantly with tape machines. "I lead a monastic life. I go to work at 6 a.m., spend ten to twelve hours at a stretch with my tape recorders. By the time I get home, I'm completely 'dingue' (Parisian argot for 'off my nut')."

How did Henry become an electronic composer? He remembers that he was nine when he first became aware of his fascination with sound objects and percussion instruments. Ten years later he had his own little laboratory and is said to have been the first French composer to "prepare" a piano. At the Paris Conservatoire, Henry studied with Olivier Messiaen. From the start, he felt that orchestral music had reached the end of the road. He joined Pierre Schaeffer in 1949, a year after the latter had begun his experiments with electronically manipulated railway noises. Henry later broke with Schaeffer and the musique concrète group that had been set up at the Radio-Diffusion Française. He left behind 20,000 tapes of his work, and had to begin all over again, building the "notation" for his future compositions.

Henry spends three or four years creating the sounds he will use in a single composition. He finds his sources in natural sounds. "For me a door can become a

Stradivarius. When I used the creaking of a door in my *Variations for a door and a sigh*, I lived with that door for three days; I had it 'speak' all the sounds I could think of. I *became* that door."

The growth of electronic music with its completely new techniques has prompted critics to attempt to re-define music itself. Henry has stopped calling himself a composer. "I dont need to compose. I have yards of tape. I work like a film editor, or like a sculptor who uses ribbons. I produce *montages*."

In the midst of the communications explosion, with messages bombarding us from all sides, the world is very much with us. Paradoxically the electronic composer, using the very techniques that have created this explosion, is more isolated from his audience than were even the garret composers of the Romantic era. For the time being, the public prefers to enjoy its electronic music as background for films and ballets. Concerts are another matter. Æ

LETTERS

(*from page 8*)

sign reading, "Ask any exhibitor to let you hear the organ on a recording with the lowest octave being played. Then come back and hear it on a Hartley."

We were using the Aeolian-Skinner "King of Instruments, Vol. I," on which there was a scale passage running from 16 Hz to the highest note of the sifflute in which there were harmonics over 8000 Hz. Some twenty people came back saying they couldn't find *one* exhibitor with a recording which would demonstrate such sounds. Therefore, we are in full accord with your idea of a "master record."

Perhaps the manufacturers may not like the idea, but I believe the public will consider this to be one of the best innovations ever encountered at any show in years. If votes are necessary, you have ours.

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"Bingo" Card Replies

SIR:

Recently I wanted to set up a new home music system, and being out of touch with developments, I sent back a number of "bingo" cards. In every case the advertiser had offered technical information on a definite recent model.

I never received a scrap of technical information from *any* advertiser. The most helpful sent me reprints, on beautiful glossy paper, of the very advertisement which prompted the inquiry. The least helpful was not from the manufacturer, but from a discount store which suggested I come in for a demonstration, and also to see appliances, lawn mowers, and so on.

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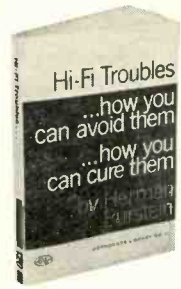

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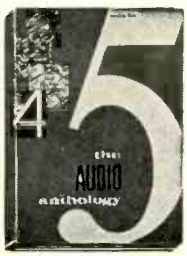

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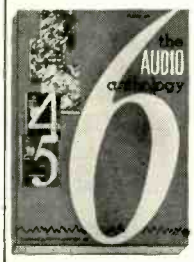

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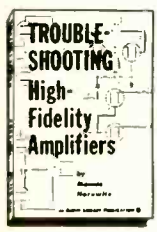
Mannie Horowitz



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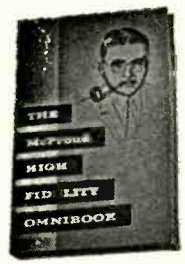

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable context. Covers planning, problems with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

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NEW LITERATURE

● **Tape Head Guide.** The latest edition of "Tape Head Manual and Reference Guide" is now available from Robins Industries. This is a comprehensive, 16-page catalog with 128 new listings. It has been designed for the consumer as well as the tape recorder serviceman and features cross references of 51 manufacturers' recorders. There are 126 new listings divided among 38 manufacturers. For the consumer, a section on care of recorder heads stresses cleaning, demagnetization, and wear prevention. Other features include stereo conversion instructions, head specifications, and dimensional diagrams for hook-up purposes. The guides are available at 35 cents each, at audio retail outlets or direct from Robins Industries.

Circle 204

● **Summer Catalog.** The new Lafayette Radio Summer Catalog is now available. It features a 110-page book of products for home and industry. Special feature is given to Lafayette's complete line of Citizens Band two-way radio equipment, Hi-Fi audio equipment, auto accessories, TV, transistor radios, cameras, binoculars, power tools, and amateur gear. Selected summer products include auto tape players, marine accessories, garden tools, and lightweight motor bikes. There is no charge for the catalog.

Circle 205

● **VOM Manual.** Simpson has just published a 90 page paperback booklet titled "1001 Uses for the 260 Volt-Ohm-Milliammeter." The booklet is a comprehensive collection of test applications for the Simpson 260 VOM. It is divided into nine sections titled Measuring Voltage, Measuring Current, Measuring Resistance, Measuring Power, Other Measurements, Receiver Measurements, Transmitter Measurements, Industrial Measurements, and Automotive Tests. Each test application is explained in the text as well as by schematic or circuit diagrams which show exactly how to set up the test with instructions for the equipment to be tested. There are many tests, charts, and formulas that help to make this manual a useful reference. The booklet is available through Electronic Distributors for 75¢ or by sending $1.00 (for postage and handling) and your name and address directly to Simpson Electric Co., 5200 West Kinzie Street, Chicago 44, Ill.

● **Noise Measurement Pamphlet.** "A Primer of Noise Measurement" is the title of a new 36-page illustrated booklet that has just been published by General Radio Company. It has been written expressly for those without prior experience in acoustics. The new booklet discusses the decibel, human response to noise, and the basic principles of sound-level measurement. Topics covered include noise itself, the sound-level meter, the decibel, weighting networks, and the use and applications of the sound-level meter. There is no charge for this pamphlet.

Circle 206

● **Solderless Terminal Manual.** From Aerovox comes the news that they have released a 28-page illustrated catalog that features non-insulated and pre-insulated solderless terminals. The new catalog contains specifications for flanged and square spade, ring, and quick-connect types. Also included in the catalog is a Buying Guide to help in selecting the terminal best suited for particular applications. The catalog is free.

Circle 207

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Industry People...

● **Walter Goodman,** Vice President of the Jerrold Corporation has just announced that **Robert E. Furst** has been appointed Vice President and General Manager of Harman-Kardon, Inc. of Plainview, N. Y. a subsidiary of Jerrold Corporation. Prior to his appointment, Mr. Furst was Vice President of Engineering for Harman-Kardon. He joined the firm in 1954. Before that he had been Assistant Chief Engineer for David Bogen Company and Senior Project Engineer for both Majestic Radio and Television and Stewart Warner Corporation.

A native of Vienna, Austria, Bob Furst majored in electrical engineering at the University of Vienna. Upon his arrival in this country in 1941, he continued his studies at the Illinois Institute of Technology where he also taught classes in physics and electronics. He is a member of the I.E.E.E. and the A.E.S.

● From University Sound of Oklahoma City comes the news that **William C. Simonite** has been named Distributor Sales Manager of the Company. Prior to this promotion, Bill was University's Sales Manager of High Fidelity Products. **Haskel A. Blair,** President of University, in announcing the promotion states "Bill Simonite will head up all activities of University's Sales Department, coordinating all of the functions of the divisional sales managers and field sales representatives. **Ed Sinclair** continues as Commercial Sound Sales Manager, and **Dick Kirch** continues as Microphone and Special Products Sales Manager."

Before joining University Sound more than a year ago, Bill Simonite was head of his own sales representative organization.

● **Ellis G. Rosen** has recently been named Vice President and General Manager of Superscope New York, Inc. These are the New York offices of the California-based company.

Mr. Rosen has been regional sales manager of the company, Eastern distributor of Sony tape recorders since October, 1963.

Among his previous company affiliations are Packard Electronics and Leonard Radio, both of New York.

● **Casey Piotrowski** has announced several promotions in Lafayette Radio's Advertising Department: **Monte Brick,** with the Company since 1959 now becomes Copy Chief; **David Kipnes,** with the Company since 1961, now has the title of Technical Editor; and **William Penna,** wtih the Company since 1958, is now Manual Editor.

In making these appointments, Mr. Piotrowski said "The rapid growth of Lafayette, especially in the advertising needs of the catalog and the retail store operation, calls for a more specialized alignment within the Advertising Department."

At the present time there are 17 fully-owned Lafayette retail centers.

● Some changes at Heath now. **Jean Ribond,** President of Schlumberger Limited, Heath's parent organization has announced the following: **Charles M. Kirkland,** President of Heath since January, 1963, has been appointed Coordinator-Marketing, Instrumentation, and Electronics at Schlumberger Limited headquarters in New York. **David W. Nurse,** formerly Executive Vice-President of Heath, has been elected the new President of Heath.

In his new capacity, Mr. Kirkland will be responsible for the worldwide market effort of all Schlumberger instrumentation and electronics divisions and will maintain direct liaison with the individual companies. AE

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Desk G63, Box 1056
Oklahoma City, Okla

Name .....

Address .....

City .....

State ..... Zip .....

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The Fairchild Ambicon is an automatic gain control that increases or decreases levels of sound systems in accordance with ambient noise present in the reproduction area.

This compact, 1½ x 7″, solid-state unit is easily integrated into existing sound systems. The Fairchild Ambicon is ideal for air, rail and bus terminals, stadiums and arenas, convention halls, theaters, factories and schools . . . in fact all locations where there are varying amounts of background noise that can adversely affect intelligibility. Price: **$195**

Write today for the complete Fairchild Ambicon story

FAIRCHILD
RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N.Y.

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Advertising Index

PIONEER
TURNTABLES are worth waiting for!

You'll discover something unique in sound re-creation in a new line of premium audio products. Look for the Pioneer symbol at selective audio dealers. Then listen!

A MARK TO REMEMBER ®

Pioneer Electronics U.S.A. Corporation
350 Fifth Avenue, N. Y., N.Y. 10001
Phone: (212) 524-1757

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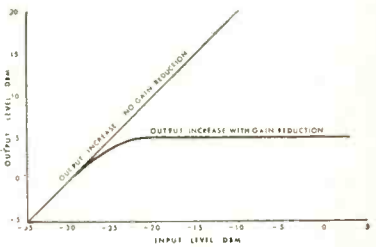
LEVELING AMPLIFIERS



Typical gain-reduction plot

- NO LAG
- FLAT RESPONSE
- REPLACES EXISTING LINE AMPLIFIERS
- LOW NOISE LEVEL

OVER 500 IN USE BY MAJOR NETWORKS INDEPENDENT STATIONS & RECORDING STUDIOS

Our 8th Year Of Service To Industry

TELETRONIX ENGINEERING CO.
manufacturers of
FM Broadcast Transmitters and RF Amplifiers
Audio Relays, Solid State Remote Station Controls
Volume Levelers, FM Broadcast Antennae
308 Monterey Road, South Pasadena, Calif.
EXPORT: GOTHAM AUD. DEV. CORP.
2 West 46 Street, New York, N.Y. 10036

PHOTOGRAPHED AT CAPITOL RECORDS BY FRANZ EDSON

Good records start with Stanton.

A professional needs to know for sure. When he listens to a test pressing, he needs a cartridge that will reproduce exactly what has been cut into the grooves. No more, no less. Otherwise he would never be able to control the final product. The record you buy in the store.

That's why the professionals keep using Stanton. It tells them the whole truth, and nothing but.

In the photograph above, studio engineers are shown listening to a test pressing. This is a critical stage in record making. The stereo playback system they are listening through is fronted by a Stanton 581 EL Calibration Standard. (The turntable also happens to be a Stanton. Other fine turntables will work, too.) They're getting the whole message. You'll get it, too, in an upcoming release.

Each Stanton Micro FLUX-VALVE® Calibration Standard is custom made. That means that each will perform exactly as the original laboratory prototype. We laboriously adjust them until they do. It also means that you will get the same accuracy that the professionals get. Guaranteed.

Stanton Calibration Standards are hard to make. And the price reflects it. $49.50. But that really isn't much to pay for uncompromising accuracy.

STANTON

Stanton Magnetics, Inc.
Plainview, L. I., N. Y.

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For Tough Jobs Choose The Only Microphone With Backbone!

ELECTRO-VOICE
MODEL 676
DYNAMIC CARDIOID

The backbone of the Electro-Voice Model 676 is no mere decoration. It's visible proof of the most exciting idea in directional microphones—Continuously Variable-D (CV-D)™.

Here's how it works. We attach a very special tapered tube to the back of the microphone element. This tube automatically varies in effective acoustic length with frequency. It's a long tube for lows—a short tube for highs. All this with no moving parts! The tube is always optimum length to most effectively cancel sound arriving from the back of the microphone, regardless of frequency.

This ingenious solution* is years ahead of the common fixed-path designs found in most cardioid microphones. The 676 offers significantly smoother response at every point—on or off axis—plus more uniform cancellation to the rear. It is also less sensitive to wind and shock. There is almost no "proximity effect" . . . no boosted bass when performers work extra close.

Long life and smooth response are guaranteed by the exclusive E-V Acoustalloy® Diaphragm. And the 676 has unusually high output for a microphone so small. Of course you get dual output impedances, high efficiency dust and magnetic filters—all of the hallmarks of Electro-Voice design that have made E-V a leader for years.

But that's not all. The 676 has an exclusive bass control switch built in. Choose flat response (from 40 to 15,000 cps) or tilt off the bass 5 or 10 db at 100 cps to control reverberation, reduce low frequency feedback and room rumble.

Write today for complete specifications, or visit your E-V sound specialist's to see this remarkable new microphone. And when difficult sound problems must be faced squarely, stand up and fight back with the microphone with a backbone (and CV-D) — the new Electro-Voice 676 dynamic cardioid!

Model 676 Satin Chrome or TV Grey, $100.00 list; in Gold, $110.00 list. Shown on Model 420 Desk Stand, $20.00 List. (Less normal trade discounts.)

ELECTRO-VOICE, INC.
Dept. 762A, 602 Cecil St., Buchanan, Mich. 49107

*Pat. No. 3,115,207

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

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