AUDIO

DECEMBER, 1961
50¢

...the original magazine about high fidelity!

A CLOSE LOOK AT RCA's "DARK HEATER"

and how it benefits you

You are looking at a major advance in tube technology. The filament at the right in this special demonstration envelope is a new RCA "Dark Heater". The "Dark Heater" operates at a temperature about 350°K below that of the 1500 to 1700°K of a conventional heater (left). Yet at this much lower temperature, the "Dark Heater" can produce the same cathode temperature as the conventional heater. Reason: the superior thermal emissivity of the dark coating.

For additional information on the "Dark Heater" call your RCA Field Representative or write Commercial Engineering, Sec. L-91-DE, RCA Electron Tube Division, Harrison, N. J.

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The cooler operating "Dark Heater" offers many receiving tube advantages to equipment manufacturers, including:

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AUDIO

DECEMBER, 1961 Vol. 45, No. 12

Successor to RADIO, Est. 1917

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AUDIO in General

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AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S., Possessions, Canada, and Mexico, $4.00 for one year, $7.00 for two years; all other countries $5.00 per year. Single copies 50¢. Printed in U.S.A. at 10 McGovern Ave., Lancaster, Pa.

Second Class postage paid at Lancaster, Pa.

RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.
Postmaster: Send Form 3579 to AUDIO, P. O. Box 629, Mineola, N. Y.

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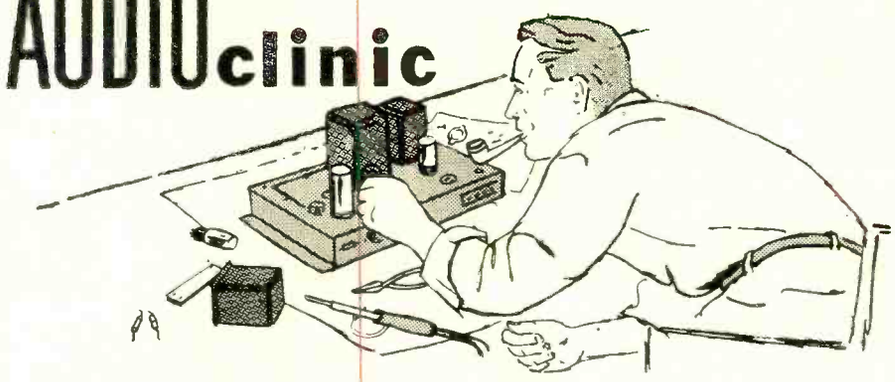


JOSEPH GIOVANELLI*

Multipath Distortion

Note. Sometimes a problem is particularly vexing. Before it is finally resolved, the person confronted with it must explore a large number of possible solutions. Here is an example.

Q. I live in the center of San Francisco near the top of a hill and within a matter of blocks from the tower where KPEN transmits its signal at 101.3Mc. I can easily bring in twenty FM stations but I prefer KPEN. The trouble I experience, in my opinion, is multipath distortion. The highs are raspy, the middle is buzzy, and the lows are not clear. The same trouble is evident on other stations broadcasting FM from the same direction. Stations in other directions come in great, even with no antenna, or even if I have my antenna directed perpendicular to their path. Other stations on the FM band come in fine, no matter what their dial frequency is. I feel confident that the trouble is in the direction.

Here are only the highlights of the many steps I have taken to try to overcome the situation. I own a Scott 300C stereo tuner, and other associated equipment. I have eliminated the other equipment as the source of the trouble by disconnecting them. My "expert" friends said my tuner needed alignment. I took it to the local factory service. Outside of a few tubes, nothing was changed. The trouble remained. I took the tuner to the home of friends. One lives on Mt. Sutro, where the KPEN transmitter is located. The results were excellent. I brought his Scott 300D to my home, and the "old bug" was still there.

The trouble is in the antenna, the experts then agreed. I have been using a twin-lead folded dipole furnished with the tuner. I tried rabbit's ears—but that didn't work. All the TV sets in our immediate area are plagued with "ghosting." They all use yagis. However, three blocks away internal TV antennas work satisfactorily. Even the yagi doesn't clean up the TV picture in this locality, especially the ones coming from the direction of Mt. Sutro. I plugged into the house TV antenna. (I live on the top floor of a four-unit building.) Reception was worse than with the folded dipole.

I bought an FM yagi and put it on the roof. Again no improvement. I was ready to dump everything off the Golden Gate Bridge—if I didn't fall off the roof first.

Without benefit of expert advice, I took the parts of any old antennas around the neighborhood. I cleaned, polished and designed a yagi-type antenna. I assembled it piece-by-piece in the living room, starting with the driven element, adding reflectors, directors, and another driven element until I had clear FM reception—and a very irritated wife. All parts were cut 59.5 inches long to aim for KPEN. The only task remaining was the roof installation. Just as you might expect, reception was not improved. I returned my home-made antenna to the living room for further checks using the entire cable which had led from the roof to the tuner. The trouble persisted. I put the short lead back on and everything was okay.

Even I agreed with the experts that the lead-in was picking up the signal. All the TV sets around here use 72-ohm coax. I went to the electronics supply house for the cable. (Every salesman in town knows my story and problem.) All on hand that day said I should use a shielded 300-ohm cable, not the 72-ohm. When I came home with all the extra equipment for mounting and handling the large cable, I received permission from the landlord to drill a half-inch diameter hole in the window sill for the large line—it just had to work—terribly. The same cotton-pickin' trouble. I ran a number 12 copper wire ground lead from the shield at the top and at the bottom to ground. The trouble was still there. In fact, if I touched the cable with my finger, near the window, and three feet from the set, the trouble would be worse. I brought the antenna back to the living room, coiled the heavy lead around various pieces of furniture. The sound and trouble would vary as I walked by the line. From this, I figured my ground lead was picking up a signal.

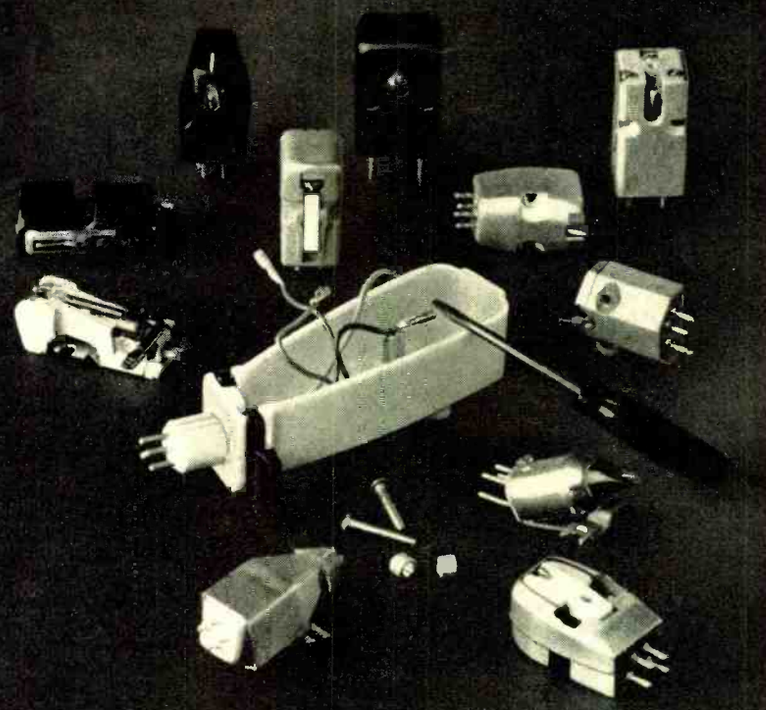
Back to the electronics supply house. They sold me the 72-ohm cable with two impedance-matching transformers with no fight. I didn't even have to tell them I need 42 feet of lead but would buy 50. By using this, the sound was somewhat improved. I might add right here that in all these trials, I had checked all connections with an ohmmeter and had made good solder connections. I felt for the first time that I had hit the right spot because the buzzing could be almost tuned out. It would return only on heavy passages.

Meanwhile, back on the roof, I rotated my home-made antenna so that it was pointing directly away from the transmitter. The improvement was obvious—but so was the signal loss.

Back to the electronics supply house. They outfitted me with an FM antenna considered by some experts to be the best possible FM antenna for multipath distortion reduction. This antenna was no better than the one I built, except in appearance.

The experts now say that I should put an antenna amplifier up the pole near the unit. Then the unwanted signal that the

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



"Which cartridge do you recommend for the Type A?"
"Can I use the professional models?"

THE ANSWER IS: Use the cartridge of your choice ...any manufacturer, any model!

The arm on the Type A will bring out the best in any cartridge ... tracking (and tripping) at the lightest pressure specified by the cartridge manufacturer. This includes the professional models, which were developed originally for separately-sold tone arms because of their high compliance. □ Now, Garrard integrates precisely such an arm into the Type A Automatic Turntable. This is a dynamically-balanced, counterweighted arm, designed and built with the same precision, the same balance, the same freedom from friction, the same playback characteristics and low resonance expected in tone arms separately sold, regardless of price. The Type A arm, operating in conjunction with a weighted, full-size, non-magnetic turntable; a laboratory-balanced, double-shielded motor; and (when you want it) the gentlest automatic record-handling mechanism ever designed; rewards you with the full measure of the magnificent reproduction achieved by any of the latest, finest, stereo cartridges. □ *Extravagant concept, yes... but the price of the Garrard Type A Automatic Turntable is exceedingly modest, only $79.50.*

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GARRARD'S LABORATORY SERIES TYPE A AUTOMATIC TURNTABLE

line receives would be much less in comparison to the wanted signal supplied by the booster. Hence, it would be rejected by the tuner. L. E. Westmoreland, San Francisco, California.

A. With the advent of FM stereo multiplex broadcasting, many observers have noted the presence of *multipath distortion.* This fact could give rise to the belief that such distortion is widespread. It is not.[1]

This distortion is evident far more in television reception than in FM reception. Multipath signal reception shows up on the TV screen as "ghosts," leaving the audio portion of the TV program completely unaffected in most instances. Here again, the eye seems to be a more accurate observer than the ear.

However, your problem is multipath distortion. It can usually be reduced and sometimes completely eliminated by drastic methods. One such drastic method follows.

You are on the right track when you used the yagi antenna. Get the yagi which has the most possible number of elements so that the angle of pickup can be held to the absolute minimum. If a commercial is not good enough, I recommend that you build up one yourself. Be sure your new antenna is within strict design practice. Tune-up must be accurate. Do not adjust for maximum forward gain. Do adjust for maximum side-lobe rejection.

The reason for this adjustment procedure is apparent when you understand what is meant by multipath signal transmission. An FM receiver is located X distance away from an FM station. Signals from the station are received in a straight line between transmitting and receiving antennas. Sometimes, however, some of the signal will strike mountaintops or buildings. These objects will alter the direction of travel of the radiation from the transmitter. Thus, when this energy reaches the receiving antenna, it arrives at a slightly different time, and from a different direction, which may or may not be slight. Hence, there is a combination of two signals which will not be in phase. This, then, is the manner by which multipath signal transmission arises and causes the condition known as *multipath distortion.*

When installing this antenna, use double-shielded coaxial cable if possible.

Assuming that you now have your beam adjusted and matched into the proper kind of coaxial cable, and assuming that the other end of the cable is properly matched to obtain the necessary 300-ohm impedance at the antenna terminals of the tuner (if such be the requirement of the input circuit), ground the coaxial cable at the tuner, at the top end, and at as many other points along its length as is convenient. In addition, ground the mast. Use very heavy wire for these ground connections—perhaps No. 12 or even heavier if can be obtained and worked with. Make the connections to a waterpipe. This is likely to be a better ground than a radiator. Use grounding straps or grounding clamps. Be sure that the metal surface of the pipe with which the ground clamps must make contact is free from paint and oxidation to ensure good electrical contact.

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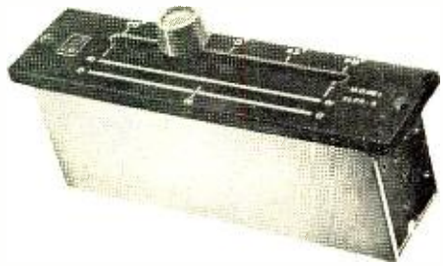
[1] There are responsible authorities in our industry, however, who say that though a condition as gross as that described here is not common, there are subtle changes in tonal quality of which the average person is unaware. These authorities believe that because of these tonal changes, many FM listeners fail to receive the full benefits which is inherent in FM transmission.

(*Continued on page 80*)

Langevin

Movement...



THE 4TH DIMENSION IN STEREO

Through a new tool in recording—Langevin's Exclusive

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*Smooth continuous movement of the soloist at any speed through 180 degrees during recording.

*Authentic position control through Langevin development of geometrically accurate taper.

*Scientifically correct exploitation of biophysical phenomena for ultimate realism and dramatic effects.

Choose Rotary Pan Pots for economy

Convenient and easy to use, Rotary Pan Pots fit anywhere; they have a universal mounting bracket or install with single ⅜ inch clearance hole. Small, 1½" diameter one into two channel model is only 2⅞" long.

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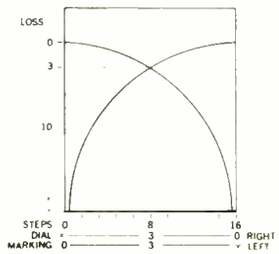
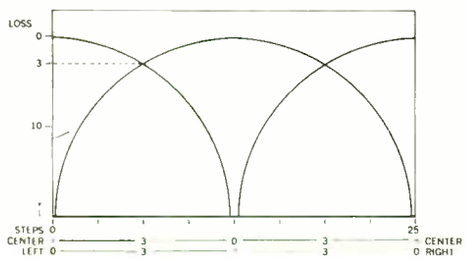
Discloses actual position of soloist at a glance because knob position correlates exactly with angular displacement from zero degrees center.

Easy, Quick Installation

The preamplifier output of the microphone selected for panoramic use is fed to the input of the Pan Pot. The outputs of the Pan Pot feed to the combining networks of the 2 or 3 recording channels.



2 CHANNEL UNITS



3 CHANNEL UNITS

BACKGROUND

In 1934 it was well established that a level change of only 3 db was sufficient to displace the apparent source of an instrument or vocalist completely across the recorded stereo field. Langevin engineers developed the first panoramic controls for this application.

While it is also known that the arrival time of the sound influences the position of the apparent source, it has been proven that intensity offsets the effects of arrival time satisfactorily. In motion picture work at least three prominent screen processes clearly demonstrate the complete success of Pan Pots in achieving dynamic control over position.

THEORY OF OPERATION

The configurations of these mixer control assemblies are different from those usually found in transmission work. In the 2 channel controls, 2 oppositely wound networks are ganged so that the 3 db down point of each control occurs at zero degrees. In 3 channel arrays 3 controls are ganged so that the 3 db down points occur at 45 degrees each side of center, and so that at 90 degrees the extreme opposite control is at infinite attenuation. Note in the diagrams that attenuation of the extreme positions is unusually rapid, and that it is very slow in the regions of overlap from one control to another. This rate of attenuation is precise, and conforms to exact calculations governing angular displacement in the sound field with change in level.

ORDERING INFORMATION

2 CHANNEL UNITS

MODEL RPP-2 ROTARY PAN POT, for mixing 1 channel into 2, 600 ohms impedance in and out. Ladder type, insertion loss 12 db. 270° rotation with —3 db point at 0°, 90° at extreme right and left. 16 steps used per section. Size is 1½" diameter by 2⅞" long. Complete with K-111 type mixer knob and color coded dial plate. Weight, net 6½ oz., 1 lb. shpg. **Price, Net Each $28.50**

MODEL RPP-2T ROTARY PAN POT, Bridge "T", all other details same as Model RPP-2 above but 2½" diameter and 6 db insertion loss. Weight, net 13 oz., 1½ lbs. shpg. **Price, Net Each $44.50**

MODEL SLPP-2 STRAIGHT LINE PAN POT, 1 channel into 2, same as Model RPP-2 above but straight line form, for horizontal panel placement. Supplied with red knob and engraved, color coded escutcheon. Size is 1½" wide by 7" long by 2¼" deep behind mounting plane. Extends 3¼" to top of knob. Weight, net 6½ oz., 1 lb. shpg. **Price, Net Each $64.00**

MODEL SLPP-2T STRAIGHT LINE PAN POT, Bridge "T", 6 db insertion loss, 1¾" wide, all other details same as Model SLPP-2 above. Weight, net 6½ oz., 1 lb. shpg. **Price, Net Each $94.50**

3 CHANNEL UNITS

MODEL RPP-3 ROTARY PAN POT, for mixing 1 channel into 3. Same as Model RPP-2 but with 3 elements and insertion loss of 12 db; left range tapers from zero attenuation to infinity in center at 0°. Right side of control is opposite on same contact row diameter. Center ganged control is zero attenuation at 0° with infinite attenuation at extreme right and extreme left rotation. Comes with Model K-111 type knob as well as dial plate. Size is 3" diameter and 2⅞" deep. Weight, net 13 oz., 1½ lbs. shpg. **Price, Net Each $46.50**

MODEL RPP-3T ROTARY PAN POT, same as Model RPP-3 but bridge "T" and 9.5 db insertion loss. Weight, net 13 oz., 1½ lbs. shpg. **Price, Net Each $79.50**

MODEL SLPP-3 STRAIGHT LINE PAN POT, 1 channel into 3, same as Model SLPP-2 but with pots ganged and 12 db insertion loss. Weight, net 13 oz., 1½ lbs. shpg. **Price, Net Each $102.50**

MODEL SLPP-3T STRAIGHT LINE PAN POT, Bridge "T" all other details same as Model SLPP-3 above except 2" wide and 9.5 db insertion loss. Weight, net 13 oz., 1½ lbs. shpg. **Price, Net Each $151.25**

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LETTERS

The Organ Stops (Us)

SIR:

Mr. Wolkov's article on the electronic organ is marred by a few errors of fact as well as several curious opinions which I, as an organist and engineer, feel should not go unchallenged.

First, he states that 1300 to 1600 pipes are required in a satisfactory pipe organ. This number seems unduly large. There are many organs in use today with appreciably fewer pipes. For example, a two-manual organ of, say, 12 ranks, will total only about 750 pipes—the actual number depending on how the various ranks are apportioned between manuals and pedal. About 90 per cent of the classical organ literature could be played effectively on such an instrument. At least two well known American firms—Wicks and Möller—build three-rank unit organs of about 20 stops that are popular in homes, small churches, and practice studios. These instruments cost only about $4000.

Second, Mr. Wolkov cites only four basic classes of pipe organ tone—diapason, string, flute, and reed. While this is entirely correct, it may be misleading to novice readers as in addition to hybrid tone colors lying between certain classes there are wide variations of timbre within each family. A Koppelflöte, for example, is not at all like a Concert Flute, and Diapasons can be either "stringy" or "flutey." The tonal spectrum of a well designed pipe organ, even if it is a small one, can be quite varied.

Third, it is implied that because the keys in electronic organs merely operate electrical switches electronic organs are insensitive to touch while the reverse is true for pipe organs. Nothing could be further from the truth. Most pipe organs likely to be encountered in this country today use some form of electro-pneumatic action. In these, just as in the electronic organs, the keys merely operate electrical switches.

Fourth, the usual American manual designations for a two-manual organ are, from the bottom up, Great and Swell. In a three-manual church organ they will be Choir, Great, and Swell. Exceptions are infrequent.

Fifth, in the "typical" stoplist on page 40, why are pitch designations omitted? In some cases, such as the Tierce, pitch designation is not needed, but a stoplist in general is meaningless without indication of the pitch at which each voice speaks. The availability of different pitches on the organ is a unique characteristic of the instrument (shared only to a small extent by the harpsichord) which should be emphasized in any serious paper on it. Indeed, one of the most distressing features of some electronic organs is that so few different pitches are often supplied on the manuals.

Sixth, it seems incorrect to lump the Baldwin, Artisan, and Schober organs together as examples of "stabilized LC" oscillators. The Baldwin and Schober organs use vacuum tube relaxation (blocking) oscillators as frequency dividers. The Artisan does not use frequency division but does use LC oscillators similar in principle to that used by Allen and Conn.

Last, I cannot resist the temptation to say a few words in defense of the much misunderstood pipe organ. The space requirements for a musically satisfying pipe organ are not as formidable as one might think. The 3-rank unit organs mentioned previously are not actually prohibitive for home use. The console is about the same size as that of an electronic organ, and the pipes, windchests, reservoirs, blower, and so on will be housed in a separate matching cabinet about $4 \times 6 \times 8$ ft. in size. The two-manual 15-rank organ in my home requires a space about $8 \times 10 \times 15$ ft. exclusive of the console. The lowest octave of the 16' pedal stop is placed horizontally because of the limited headroom, so the layout is far from efficient. An organ of the same size could probably be squeezed into 75 per cent of this volume if efficiently laid out, but this one was purchased second hand and adapted to fit the available space.

Interested readers may care to peruse one or more of the standard texts on the pipe organ. "The Contemporary American Organ," by William H. Barnes, Sixth Edition, 1959, published by J. Fischer and Bro. is the best readily available reference. It also contains a bibliography which readers interested in further pursuit of the subject may find helpful.

WINTHROP S. PIKE,
165 Hickory Court,
Princeton, N. J.

SIR:

I should like to call attention to some errors in Mr. Wolkov's article, as I am sure neither you nor the author would wish misinformation to go unheeded.

The photograph on page 36 captioned "Schober 'Concert' Organ" actually shows the Schober Consolette in its newly designed console. In the table on page 38, the Schober Consolette is classified as a "spinet" type organ; this it most definitely is not. While it is smaller than a concert model physically, and has pedals pivoted at the console, it has 61-key manuals, which no spinet has. The table also states that the Schober Consolette has 13 pedals; actually it has 17.

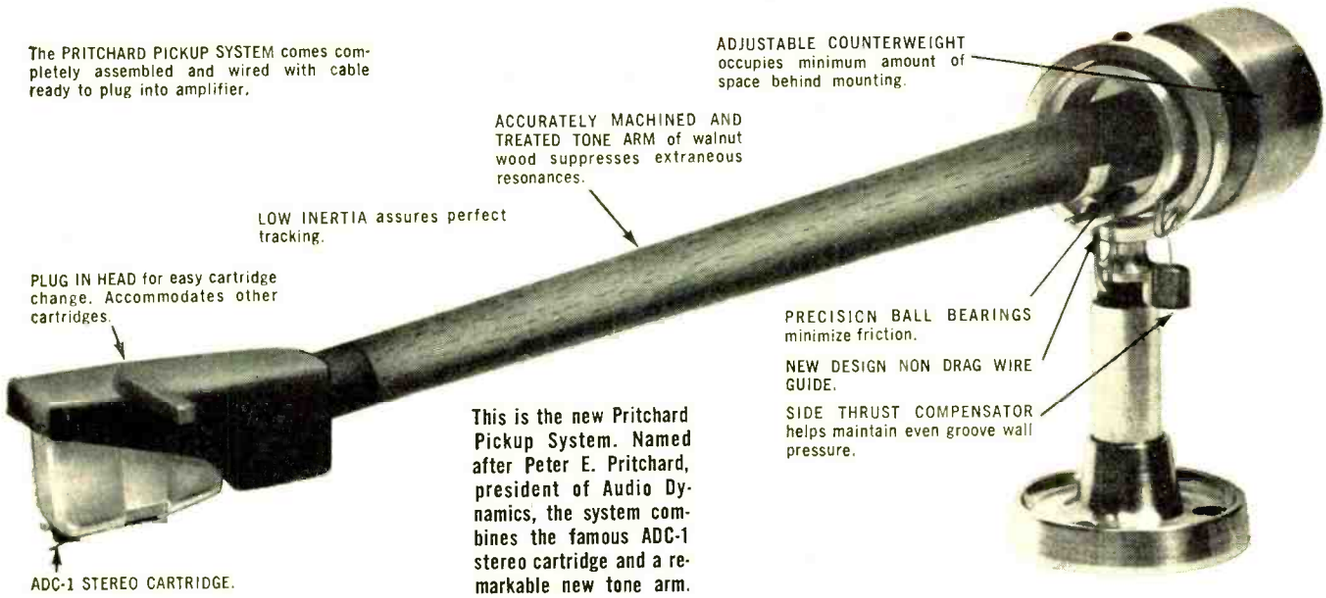
The article states that Schober has only two models. To straighten the record, it should be said that there are actually three Schober Models, the latest of which *is* a Spinet, with 44-key manuals, 13 pedals, and 18 stops.

Correcting the center column of page 40, Schober Organs generate only twelve tones with LC oscillators, the remaining ones with synchronized blocking oscillators. Schober, Baldwin, and Kinsman should not be grouped with Artisan and Conn, which generate *all* tones with LC units.

Referring to the last sentence on page 40, the saving in cost comes about not only through the home constructor's labor contribution, which would not account for such a large reduction in cost, but also because of purchase direct from the manufacturer and elimination of the usual dealer markup of 40 per cent or thereabouts.

Two of Mr. Wolkov's statements are worthy of special attention by those contemplating organ purchase. One should certainly look for very definite differences between voices; and the demonstrator should be required to play simple music that does not hide any deficiencies of the organ in a dazzling display of brilliant playing.

RICHARD H. DORF, President,
The Schober Organ Corporation,
43 West 61st Street,
New York 23, N. Y.



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

REMARKABLE NEW SYSTEM TRACKS AT 3/4 GRAM!

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

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

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

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

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

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

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

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Pritchard Pickup System Model ADC-85 **$85.00**
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Here are the five essentials of true stereo reproduction. They are yours with an ADC cartridge.

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

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

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

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

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

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CHESTER SANTON*

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

Pass in Review

London ✪ LPL 74001

Evidently London Records still believes in the grand gesture. Having decided to throw in the towel and join the ping pong game, they have done so with a flourish of trumpets. In retrospect, the campaign by other labels on behalf of channel-to-channel instrumental arrangements now seems like a timid affair. London's new offensive relies equally on the dazzle of a new slogan and sheer weight of numbers in the first release, Anyone familiar with the stereo releases of labels such as Command, Time, Medallion and so forth will find it difficult to accept the claim that the "Phase 4" process is a totally new concept. The major innovation in "Phase 4" is the use of four tracks on the master tape. At the risk of sounding ungrateful, I'm not convinced that the complicated channeling of sound from four tracks to two adds anything to the sonic effectiveness of this particular recording. "Pass in Review" offers a very carefully arranged parade whose ingredients would hardly be encountered at any one place in real life. There are simulations of marching and mounted troops from all points of the globe and a very generous representation (in a British production) of American military and civilian musical units. The twenty-four selections covered and the tanks and planes in action make this one of the most ambitious parade releases ever concocted by any label.

Sail Away (Original Broadway Cast)

Capitol SWAO 1643

Travel agencies will consider Broadway's first major musical of the 1961–62 season with mixed feelings. Grateful on the one hand for the publicity accorded their industry in what purports to be an almost normal cruise aboard the liner Coronia, the travel people may be pardoned an occasional aisle-seat wince during this irreverent musical comedy. Noel Coward, one of the theatre's more perceptive observers where human foibles are concerned, has drawn upon a bursting bagful of shipboard experiences in his first musical to be conceived, cast and produced in the United States. The stream of satire is interrupted only when the show pauses to take on a cargo of local color at some of the distant ports that figure quite casually in a singularly unprofound plot. "Sail Away" is a one-woman vehicle. The book, music and lyrics by Coward place the burden of the show within the role of Mimi Paragon, the Coronia's busy cruise director. The naive operators of the ship may list a captain as the person in charge of their liner but Mr. Coward knows better; he has found in the person of Elaine Stritch a veritable paragon of Mimis. Miss Stritch, wise to a floating world as seen by Noel Coward, doesn't have to steal the show—it's hers from the record's opening song *Come To Me* in which she stresses to the stewards her duties on board ship.

The show doesn't get rolling in the recorded version until more than half way through Side One. During the preliminaries we are introduced to the male romantic lead, James Hurst—destined for transfer from the passenger list to first place in the heart of the bustling cruise hostess. A subsidiary romantic interest involving Patricia Harty and Grover Dale is used by Coward for commentary on a *Beatnik Love Affair.* Later in the show they are heard in the tricky rhythms of a lighthearted duet called *When You Want Me.* The style of the production as a whole becomes discernible when Coward begins to get his lampooning into high gear in the song *Useful Phrases.* As sung with indignant resignation by Miss Stritch, the lines of print in her foreign language phrase book become more and more improbable. The sighting of Gibraltar is the signal for some sly digs by Miss Stritch and Mr. Coward at the type of American accent held sacred in some areas of our country.

Act Two opens in the native quarter of Tangiers as the burnoosed vendors await the arrival of the tourists with *The Customer's Always Right,* a variation on the song of the pursers in Act One. The comic peak of the show is reached in the scene in the children's nursery back on board ship. *The Little Ones' ABC* finds our heroine struggling with a curriculum that is a prank from start to finish. The piping jeers of the youngest walking passengers lend some neatly effective stereo touches. *Why Do the Wrong People Travel* is Coward's parting shot as the passengers debark. "Sail Away" may not make history as the strongest Coward show but it does send a new Broadway season down the ways with a reasonably wide splash.

Stanley Black: Exotic Percussion

London ✪ LPL 74004

The tape fan is now being invited to sample percussion with a British accent. The Phase 4 stereo process represents a major gamble by London Records that highly directional percussion can still find a market at this late date. This campaign was undoubtedly worked out at the request of the label's American branch in order to meet the challenge of other labels devoted almost exclusively to percussion recordings. London's strategy would appear to be based on two points—a continuing supply of customers taking their first plunge into stereo and the pulling power of percussion by famous names such as Ted Heath, Edmundo Ros, and Stanley Black. There is, unfortunately, a problem involved in asking an established orchestra to change its style overnight. Stanley Black's versatile crew puts up a gallant fight in meeting the demands of these American-style arrangements but the confident and easy manner of Black's previous recordings is in short supply here. The emphasis is on solo instruments as the spotlight roams from side to side picking out the oboe, flute, and French horn in addition to the regular percussion. A female chorus contributes an occasional phrase designed to add further glamour to tunes about South Sea Island temptation.

This release, along with most of the other items in the Phase 4 series, may arouse the greatest curiosity among listeners who are familiar with the techniques used by Command and similar labels in the miking of percussion. Comparison with the tape version of "Provocative Percussion" led to an interesting discovery. In the past, I had never felt that the Command reels had an excessive amount of reverb. Now, I'm beginning to wonder. After listening to this London tape —whose sound can not be considered lacking in body—the Command reel now seems burdened with extra reverb. London Records, despite the complications it has assumed in its new mixing process, has not been tempted to ease its problems through recourse to the echo chamber.

West Side Story (Original Sound Track Recording)

Columbia OS 2070

Whenever a Broadway musical is purchased by Hollywood, Eastern wiseacres invariably contend that the sound track won't match the impact of the original show. Most of the time, the forecasts turn out to be accurate to a disconcerting degree. If the score happens to contain touches of genuine originality such as those provided by Leonard Bernstein in "West Side Story," the head shakers grow in number as the production goes before the cameras. This sound track, except for a few minor points, may embarrass the average doubting Thomas. It is remarkably faithful to the spirit and musical flavor of the original. As in the case of the Broadway album issued by Columbia almost four years ago, the heroine carries off more vocal honors than does her leading man. The movie track has less sardonic bite in the younger-sounding voices of the street gangs and the orchestra under the direction of Johnny Green doesn't propel the music with the vehemence of the Broadway pit band. The original cast recording had another point in its favor—enough reverberation to recreate stage illusion in the listener's living room. This album, like all sound tracks designed to be heard in a reverberant auditorium, sounds tame in comparison. In all the main numbers of the show—solos, duets and dance sequences —the stereo version of the movie recording derives a little benefit from the slight addition of depth and liveliness Columbia has managed in the transfer to two-channel disc. The mono version of this recording (OL 5670) lacks even a suggestion of minimum reverberation. Voices are probably no closer to the mikes in mono but they sound right on top of them in a completely dead studio. Moviegoers in areas of the country far removed from Broadway will be grateful to see this outstanding film production. If they purchase a recording for home listening, they would still be well advised in buying the performance by the original New York cast.

Andre Kostelanetz: Wonderland of Sound

Columbia CS 8457

Lo, how the mighty have been rocked by the competition. Here is the once-dignified Kostelanetz orchestra, now reduced in size, trying to sound convincing in a percussion album. Don't let the fancy title of this release throw you. The sound is good but, compared to the adult entertainment we've had from Kosty in the past, this music is aimed at the audience that buys a lot of records for table phonos. The custom recording console designed and built by Columbia's engineering department handles the ten condenser mikes of this session with aplomb: the decision to use the RIAA curve is a welcome move that simplifies wide-range playback. Unfortunately, these constructive steps are wasted on "teenage" arrangements of *Volare, Vaya Con Dios,* and *Unchained Melody.*

Henri Rene: Dynamic Dimensions

RCA Victor LSA 2396

Stereo Action is evidently a continuing project at RCA. The scene of this recording is the newest and most up-to-date recording studio: Studio C in New York City. This studio was designed expressly to handle sound-in-motion stereo recordings. When the first record in the Stereo Action series came out, it was mentioned here that the more

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complicated circuitry worked out for this process had left its mark on the sound of the record. Subsequent releases have improved in audio quality. At the console of this latest installation, engineer Bob Simpson has fingertip control of a three-track mixing panel. The twelve microphone inputs can be switched into any channel of the three-channel Ampex 300-3. In cases where three channels can not deliver the effect desired by the arranger, an additional fourth channel is available at the mixing console. More important than convenience of operation is the improved clarity that's now part of the Stereo Action releases.

Henri Rene uses three different groups in this album. The arrangements are a refreshing change from the ultra-busy stuff that popped out of the speakers when RCA took up motion as a way of recording. Rene's big band—five reeds, three trumpets, two trombones and six rhythm—gives one the best idea of Studio C's lively properties. Two smaller groups are used to scatter some of the album's wilder ideas. In *Me and My Shadow,* a small vocal group is tagged by an echo of unusual duration. The weirdest touch occurs amid the sound effects of a selection called *Manhattan Idyl:* the right channel has a closeup at head level of a fellow whistling through his teeth. Another unexpected thrill from the show business of today.

Ray Conniff: Somebody Loves Me
Columbia ✪ CQ 401

Mitch Miller: Sentimental Sing Along
Columbia ✪ CQ 407

It may take a while for some Conniff fans to grow accustomed to the new format but the chorus sounds better to me now that it has gone back to the use of actual words in its songs. For years, Ray Conniff has been one of the major exponents of the wordless chorus, using voices merely to convey instrumental ideas by means of utterances sounding something like "ba-ba" "do-do." Because the idea was a commercial success in his case, it gave rise to a host of imitators who managed similar phonetics but who lacked the color and originality of the original Conniff stylings. It reached a point about a year ago where one was almost tempted to call in the neighbor's toddlers to find out what some of these choruses were singing. The counter trend establishes itself firmly enough in this reel that blends moody ballads with items that carry the arranger's familiar hefty beat. In some of the ballads—*Golden Earrings* and *Green Leaves of Summer*—Conniff himself plays a hybrid instrument that will scarcely remind him of his days with the bands of Bunny Berrigan, Bob Crosby, and Artie Shaw. This little instrumental novelty, called a clavietta, has a tonal personality that partakes of the accordian and the harmonica.

Mitch Miller's chorus—never one to apologize for the clarity of its sing-along lyrics—digs way back in its song bag in its latest reel. If you give your sing-along albums a lot of use, this tape of the most popular voice lifters in the business may be worth investigation.

Dorothy Provine: The Roaring 20's
Warner Bros. ✪ WST 1394

Most attempts to recreate the songs of the Twenties are more raucus than they are talented. The razzamatazz style of that period seems easy to imitate yet few performers are able to give full attention to all the details. The whacky lyrics of many of those old songs require an air of abandon while maintaining the fancy diction needed to put them over. A complete departure from the way people think and behave in the Sixties also helps. Of course the cast in this album has had extra opportunity to polish up on its antics. Unlike the typical group assembled for a single recording session, soloist Dorothy Provine, the chorus, girl trio, and a Dixieland Band have been appearing on the Warner Bros. television show that gives the album its title. The band offers fairly predictable entertainment in *Charleston, Black Bottom,* and *Limehouse Blues* but the girls really walk away with the album. Their determined innocence shines through the silliest lyrics. If you have room in your collection for only one tape with which to wrap up the Twenties, this one should turn the trick. AE

AUDIO ETC.

Edward Tatnall Canby

BIG, BLACK BOX

As part of an abortive stereo tape project last summer I had the use of an interesting tape recorder of a type I had not previously played around with, the Tapesonic Model 70, from Premier Electronics. Though I worked on it with other things in mind (I always do), I might as well record my observations, for this is one of those often asked-about tape recorders that fall midway between the "amateur" and "professional" types. (The quotes indicate that nobody really can say what is professional and what isn't.)

This model, first of all, features one immediately "professional" aspect—it is big, black, and bulky. Just barely portable in its large black covers (at 65 pounds), like a big Ampex but in one large suitcase instead of two slightly more modest ones. There are reasons for this, of course; but I should observe that for many a hi-fi soul these big, black cases spell the right kind of status in the recording world. No streamlined plastic here!

Secondly, the Tapesonic has an even more important external feature, normally associated with "amateur" machines. It is low in price. Relatively at least. For a mere pittance of $535 (less case) you get the works, and a lot of them. So many it's hard to believe. On a big, heavy frame, rack-sized, you'll find big 10-in. reels, three stereo heads with easily removed covers, hysteresis drive motor plus two special reel motors, complete mixing for two independent inputs and outputs on either channel, a stabilizing idler wheel, automatic tape lifter, even that satisfying *click* that comes from microswitch relays inside. You get three speeds, via two capstan sizes and electrical switching, two fullsize lighted VU meters—none of those little baby meters that you can't read—a brace of big signal lights to tell you what is or isn't going on—I could go on and on to include more details such as the electrodynamic relay differential braking action (Tapesonic's words), never requiring adjustment, the unusual interlock that protects against accidental erase and yet allows you to stay "in gear" (i.e. in record position) even though you stop the tape, the automatic stop that operates when the tape runs out or breaks (leaving the capstan in position against the tape, but shutting off the drive power) . . . enough for the moment.

All that, plus top-quality performance (as checked out by a reliable engineer friend of mine) for well under six hundred bucks? 30–20,000 cps plus or minus 2 db at 7½ ips, 10,000 plus or minus 3 db at 3¾ ips? Something must be wrong! There must be a joker.

There isn't any joker that I can see. The Tapesonic is an honest machine, which uses ingenuity and cuts corners wisely to get under the low price wire. The corners are cut, definitely—they had to be. But, if my experience is indicative, they are not in the essentials. Not in the circuitry, in the heads, the quality of the drive, the solidity and durability of the hardware. The machine is well built beyond a doubt and it will not fall apart on you after a few weeks, nor will it soon lose ground in respect to the high standard of performance it achieves when new.

The compromises are very largely in the means for control, the non-essential but important external elements that can be made beautifully automatic and all-electric at $1500, but must be of a simpler sort in the $500 range. Frankly, at first I found "driving" the Tapesonic like driving a temperamental auto. I ran into some horrendous transport troubles, merely by not knowing the machine well enough—I practically ruined two master tapes of my radio program, for instance, by wrapping long stretches of them around the capstan. (As the capstan got larger, the pitch of the music went higher and higher. It took me a fatal ten seconds to figure out what in the devil was going on before I grabbed at all the switches in sight to stop the mayhem.)

For the price, Tapesonic simply cannot have an Ampex-type all-relay system. The pushbuttons are mechanical, and necessarily less sensitive to quick and positive action than the relays in more costly machines. Moreover, this machine does not have the fancy take-up arms that are so helpful in absorbing sudden shocks, too-quick starts and stops. If you want them, go out and pay a much higher price. Tapesonic can't sport the arm-actuated automatic stop of the Ampex either, but it gets in a self-stopping device just the same, as already mentioned, via a microswitch against the tape. You have to disconnect the mechanical part yourself.

The pushbuttons are very positive, very loud, and quite terrifying to work at first. Push the START button and CLANK! goes the big capstan idler wheel against the tape, one of the relays that is included. Push the rewind and nothing happens—interlocked. You must push STOP first. The rewind (and fast forward) starts slowish on the big 10-in. reels, which are plenty heavy, but it keeps on accelerating, to a hum and then a roar. Frightened me out of my wits. CLANK! and the STOP button goes off like a cannon; but the stop is smooth as silk. A big, tough machine, this one, and no namby-pamby amateur's toy!

Odd things happen, mostly harmless, when you push wrongly (i.e. not strongly enough). The STOP button often goes into neutral, locking all controls until you push it all the way. If you don't turn on the main power switch there is no holdback on the reels at all; on numerous occasions I found my tapes quietly spilling out on the floor, as the reel coasted around on the loose. With large reels, there was a "bounce" on the take-off (take-up, I should say), before the tape settled down, which could be troublesome in split-second playback. I always left enough leader to cover a few seconds before getting down to serious recording.

As for inputs, outputs, and mixing, I had no trouble at all and admire the symmetrically arranged front panel, with the two channels completely accessible and independent via six phone-plug sockets and eight black knobs. You can plug anything into anything. Two mike inputs with separate controls, two high-level ditto, a dual friction knob for playback output, a three-way record/play switch for *each* channel, separately—you start each one up by itself. Thus you may make three-head stereo, listening to playback of your recording as it is made, or you may record on one channel only—either channel—or feed one playback into the other channel's input. This recorder will do anything. It can eat its own tail.

I only missed two things, probably not feasible at the price. In stereo recording you *must* move both mike level controls together, or risk false sidewise motion and resultant confusion in the playback; a master mike gain control is very useful, at least for a mere amateur or part-time pro. Secondly, there are no monitor (phone) outputs as such. You use the regular (cathode follower) outputs. Thus if you are feeding your channels into something else, you can't use phones too. Well . . . I'm just persnickety; most people wouldn't want to anyhow.

The Tapesonic comes from Premier Electronic Labs in New York and is by no means a Johnnie-come-lately machine—I had one of the first of these recorders, for a while many years ago and I must say, the developments since that time are remarkable.

The basic stereophonic machine is now four-track, plays two-track, half-track, full-track; but you can get a two-track model if you want higher quality at double the tape. That's what I had. The monophonic model is only $400, less case. I think you will find that this machine, once you get onto its mechanical idiosyncrasies—born of that low, low price—is an unusually good compromise unit in the area between the small, compact light-construction, home machines and the heavyweight, monolithically durable and hideously expensive professional models. If you don't mind size, this big baby is worth an extended look-see and listen-hear.

UNTO THE SECOND GENERATION

Funny—stereo pickups seem to go through first, second and third generations, all in a group, each generation having somewhat similar points of reference in respect to its contemporaries. And this even though, nominally, cartridges appear, like babies, spaced all along the time-line, so many months after conception. This year, I've been working with a whole group of cartridges that, to my way of thinking, are perhaps to be called second-generation. The third-generation type, just now coming into general promotion in the magazines and write-ups, I have yet to try out. Think I'll wait until production is settled down a bit.

Anyhow, to be more specific, there were first of all the "prototype" stereo cartridges, the first-on-the-market jobs, which began to appear in *very* short quantity along with the earliest stereo discs, spring of 1958. I had a Fairchild on loan at that time and I do believe it was one of the first stereo cartridges ever to get outside

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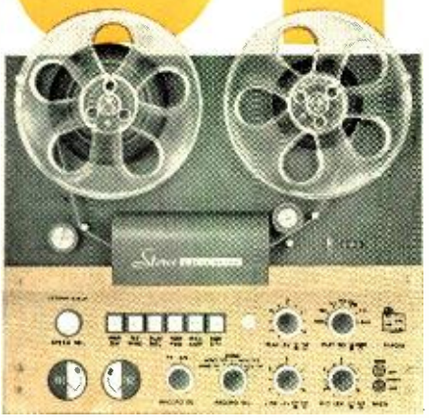

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a lab or out of a lab technician's hands. Gave a lecture with it to a batch of librarians out in New Jersey. As I remember, it was wired out of phase, but nobody bothered much about that in the early days.

I know. Technically speaking, a prototype is an individual, semi-handmade item that is *not* on the market; but we all know that many new products today are actually sold in a limited-production run, as a kind of market and technical test operation. So with the "prototype" stereo cartridges.

Then came the first generation, in the dozens. Regular production, regular market, high claims for ultimate perfection, but a lot of unsuspected bugs, too. I went through a half dozen of these valiant early attempts at perfection and I hate to say how much trouble I had. (I did say it, here and there, in this column.) Worthy attempts, and generally successful too, with many bugs soon removed by regular production changes. Nevertheless, after a year or so, many of these first generation models quietly disappeared. Many more were replaced by the second generation lines, which to my way of thinking were enormously improved, in an astonishing number of ways, but in the large, mainly in over-all reliability under all sorts of conditions. That's what it added up to. Also in a much greater uniformity, from brand to brand.

The first generation cartridges sometimes weren't even physically interchangeable, being of crazy sizes and shapes, often big and heavy. Some of them had three terminals, some four. You'll note a general shiftover to the now-standard four-terminal system in the still-dominant second generation cartridges, plus big reductions in size and often in weight. Smaller mass, of course, especially in the vital mechanical areas. And increased compliance.

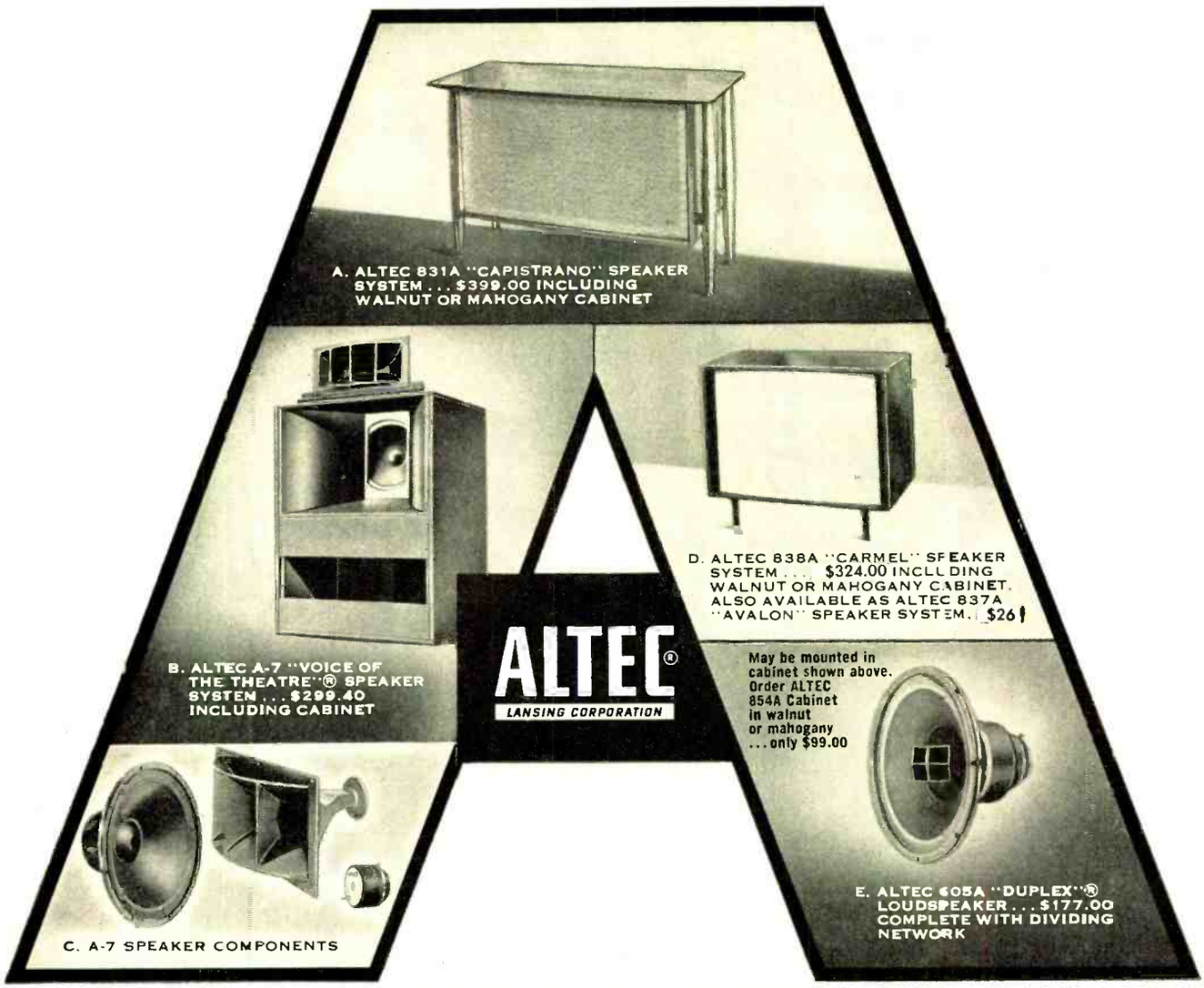
Compliance

It's odd how consistently each of my generations follows an unwritten standard pattern, in respect to such things as compliance. The second-generation stereo cartridges adhere remarkably close to a three-way arrangement (omitting at the moment the area of the ceramic cartridge—I'm speaking of magnetics, which still dominate the hi-fi component field). In the "regular" models, high quality and for use with turntables but preferably not with record changers, the compliance figure sticks very close to the area between five and six, square, (i.e., vertical and lateral). When these models first began to appear, this seemed startlingly high.

For the deluxe, lightweight special models in this second generation, usually built into an integrated arm, compliance ran even higher. The Shure Dynetic ran up a figure of 9, which seemed incredible only a few years ago. (It was—with the older type stylus, which too-easily bent itself out of shape, or broke. Tubular construction cured that bug.) At the other extreme, the ruggedized changer-type versions of these cartridges (sometimes merely a stylus difference) ran up merely to around 3 or 4×10^{-6} cm/dyne. That was considered a good safety standard. So you might say, the 3–5–9 compliance ratio was the standard for the second generation of cartridges, and still is at this writing.

Now since compliance is a highly significant detail in cartridge specifications, stemming from a whole galaxy of internal parameter adjustments and an equally vital galaxy of external hypotheses concerning arms, tables, records, people's fin-

(*Continued on page 60*)



UNDENIABLE FACTS
ABOUT FULL-SIZE TWO-WAY SPEAKER SYSTEMS

From the birth of high fidelity to the present day, competitive merchandising has inspired many gimmicks, passing fads, and innovations to confuse the loudspeaker question. The last decade has seen an endless variety of "trick" speakers and countless midgets known as "compacts."

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EDITOR'S REVIEW

THE PAST YEAR

REVIEWING THE PAST TWELVE MONTHS, one looks back with a certain amount of joy at the handing down, on April 19, of the F.C.C. decision regarding FM stereo, thus ending the long period of waiting for an opportunity to have stereo from the radio, as well as from tape—which we have had for some eight years already—and from records for almost five years. Aside from the benefits of stereo from radio at the moment of listening, it also gives the tape enthusiast a source of music with which he can begin to build up a library as many have done from mono radio over the past years.

The delay in getting adapters on the market seemed, at first, to be a thorn in radio listeners' sides, but as it turned out the real delay was in the lethargy of radio stations to convert to stereo. And still there are only about twenty-six stereo broadcasters on the air, with a few more scheduled to join the ranks "very soon." It is to be hoped that more and more stations will be joining the parade in the next few months.

We have heard of stations complaining that the stereo generator equipment was delayed by the manufacturers so that even though they had ordered the necessary apparatus for the conversion, the material had not been delivered. Then, too, there is the expense involved—not only in the transmitter but in the studio. Depending upon the studio facilities and whether the entire studio plant is to be converted—which may mean a number of studios—there is no question that the conversion is likely to be expensive. But to a certain extent it is the duty of every FM broadcaster to offer the latest in broadcasting techniques to the listener, just as it is his duty to provide technical quality in accordance with the F.C.C. standards, but adherence to these standards is mandatory, whereas his choice of stereo or non-stereo is his own.

It would seem to this observer that the obvious advantage of stereo to the broadcaster lies in the co-operation he should be able to obtain from the dealers in his own area, much as has already occurred in the New York area. And the dealers, of course, have been obtaining some co-operation from the manufacturer. In all, it is a "you-scratch-my-back-and . . ." affair. From our side of the fence it seems that FM stereo has begun to be a good thing, and we want to see it in more widespread use and in more localities.

"WE TAKE OUR TEXT . . ."

We have had a number of interesting comments on the advertisement on page 29 of the November issue. This ad was originated by Merrill Lynch, Pierce, Fenner & Smith, Inc., and was reproduced by Garrard Sales Corporation, who caused it to be inserted in AUDIO. We expressed ourselves to the Garrard organization with the idea that if we had seen it first we might have run it as a "public service" ourselves, even though we have never before made any direct references to either politics or ideology.

Of all the letters received, not a single one raised a word of objection over the idea. Two thought it should have been an editorial, and a few more thought it should not have been coupled with any advertiser's name. Everyone else agreed with the idea and commended us for having carried it.

For anyone who either did not see the page in the November issue or who wishes a separate copy, reprints are available on request from Garrard Sales Corporation, 80 Shore Road, Port Washington, N. Y.

COVER PHOTOS

Each month we use one cover photograph. When we have to create it ourselves it takes time and energy, and we are inclined to be physically efficient—that means "lazy," son—and we would much rather run photos of readers' own installations, and we would pay money for them too. Well, not so much money, perhaps, but we evaluate the reader's photos against our own time and we figure that twenty-five clams, U. S., is about right. No particular rules—photos should be horizontal, 8×10 inches or larger, and should show hi fi components tastefully. And if you do show any hi fi magazines in the photo, it is suggested that we would be more responsive if they happened to be AUDIO.

Merry Christmas & Happy New Year

from all of us to all of you

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

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

Pickering and Company—Plainview, Long Island, New York

OTL Vacuum Tube Amplifier

M. W. P. STRANDBERG*

An amplifier less an output transformer has long been an attractive idea—which has never been fully realized with vacuum tube circuits. This latest approach compromises performance at maximum output to achieve good sound and stability.

THERE IS A TYPE of audio amplifier that is referred to in abbreviation as OTL — an output - transformerless - amplifier. It would seem that this type of amplifier died almost before it was born. Exceedingly capable practitioners in the amplifier art officiated in its creation,[1, 2, 3] and on the face of it, the amplifier and the idea behind the amplifier—eliminating the harmful effects introduced by an output transformer by eliminating the transformer—are so logical that one is puzzled by its untimely demise.

In retrospect, it seems that there was an undue optimism in respect to the rapidity with which transistors would take over in the field of audio amplifiers. The special techniques required to adapt vacuum tubes to OTL amplifiers were not particularly necessary because complementary pair transistors, which would readily match present-day speakers, have always seemed to be about to take over the high-fidelity amplifier field. But power transistors have not been tamed to work in high-fidelity amplifiers as quickly as it seemed that they would several years ago. Power transistors seem to adapt only reluctantly to the high feedback requirements for high-fidelity power amplifiers.

Unfortunately, the OTL amplifier was launched initially with the idea of matching it to a special high-impedance speaker with a coil impedance of approximately 500 ohms. For this reason, this type of amplifier has been associated with special speakers and has made it seem an oddity rather than a generally applicable device. Essentially, this is the crucial point of the whole idea, since the high-impedance speakers are awkward to manufacture, and the design of an OTL amplifier for existing speakers is certainly not an obvious design problem that can be run off on the back of an envelope. At the outset, it seems that if one wants to make an OTL amplifier using vacuum tubes, then triodes must be used in order to drive the universally available low-impedance speakers. The difficulties encountered in developing the drive for these triodes are still apparently so great that no chief engineer would assign a staff to its development unless he is interested in investing many engineer-man-months in such a design. On the basis of the ready acceptibility of transformer output amplifiers, this would certainly be a foolhardy thing to do on a commercial basis.

Let us look at the figures. For a 16-watt amplifier to drive a 16-ohm speaker, one apparently needs one ampere rms current, or 1.4 amperes of peak current! Such a current requirement without an output transformer would appear to require a very husky power supply transformer, since even the lowest impedance triodes such as 6AS7's require 150 volts to deliver this much current—and they do not have even one-tenth of this power rating, 100 watts. Thus the picture of an OTL amplifier based on a series output stage using triodes begins to take the form of a 1.5-ampere, 300-volt power supply with a transformer one cubic foot in volume and ten 6AS7's with 150 watts of filament power to warm the hearthside on a cold winter night!

Futhermore, although it is easy to say that the output transformer of a conventional amplifier limits the amount of feedback that can be applied to sweeten the amplifier characteristics,

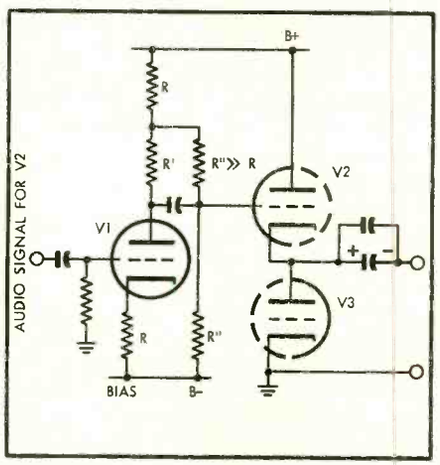

Fig. 2. Bias-balancing circuit for series output triodes.

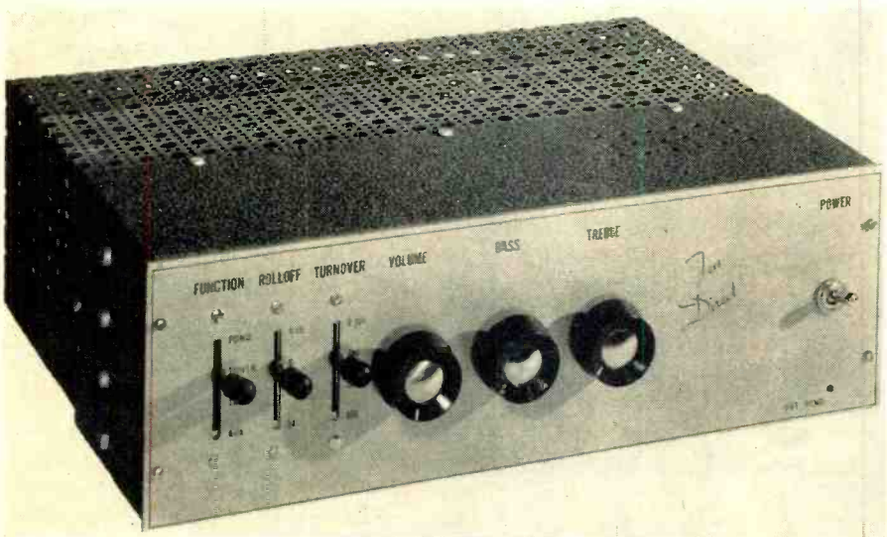

Fig. 1. OTL amplifier.

* *103 Prospect St., Marshfield Hills, Mass.*

[1] A. Peterson and D. B. Sinclair, "A Single-Ended Push-Pull Audio Amplifier," *Proc. I.R.E.*, Vol. 40, No. 7 (Jan. 1952).

[2] Frank H. Gilbert, "Commercial O-T-L Amplifier of Unique Design," AUDIO ENGINEERING, Aug. 1952.

[3] Kerim Onder, "Audio Amplifier Matches Voice-Coil Impedance," *Electronics*, Vol. 27, No. 176 (Feb. 1954).

the transformer is certainly not the sole limitation. It is simply naive to think that without a transformer the circuit feedback can be cranked up to 40 db, say, without other radical changes in circuit design. Actually, the transformer and other circuits restrict the allowable feedback that can be conveniently applied to a conventional amplifier, and the operation of replacing the transformer with a capacitor changes the problem only slightly. Thus, without careful design, little additional feedback is allowable in the OTL amplifier. Because of this realistic fact, for any actual improvement to be achieved in an OTL amplifier, circuit advances must be made, and it would seem that in a commercial world where present sales are more interesting than future circuit developments, the OTL amplifier will have little commercial support.

Note well, however, that although at first glance the OTL amplifier is a monster from the point of view of space and power consumption, with a slightly different approach to amplifier design, the neat package shown in *Fig.* 1 can be achieved. This amplifier is an OTL amplifier with dimensions approximately 4-in. × 10-in. × 13-in. which produces 15 watts average power when terminated by a 16-ohm load with less than 1 per cent intermodulation distortion below this power level. The development of the amplifier shown in *Fig.* 1 began innocently enough several years ago with the simple conviction that the removal of the output transformer could yield benefits and with some idea of how to overcome the obvious objections given above. Several years of developmental anguish followed. Although the anguish was spread out over several years, this is hardly a fair measure of the effort; the years were necessary because the amplifier was being made to satisfy the need for a good home high-fidelity amplifier. The anguish was necessary because the problem was difficult and the designer a nonprofessional, tormented by countless passers-by who were only too willing to point out the futility of the effort—transistors would soon be cheaply available, the tendency in high-fidelity amplifiers was toward the 100-watt-plus category sets, and so forth.

However, the fruits of the effort have made the travail seem trivial. The first A-B test in a large local audio comparator room was gratifying. Pitted against the leading conventional hi-fi amplifiers, the OTL was audibly more ingratiating to the designer. But the frosting on the cake was the amazed announcement by the manager of the comparator room that the OTL amplifier was much better to his ear also. He then proceeded to see how much effect the speaker that was used had on the test and succeeded in proving to himself (and to the writer) that the OTL amplifier apparently improved every speaker system, when compared with the leading hi-fi "name" amplifiers, except for one do-it-yourself speaker kit which persisted in making the violinists seem to be playing in a large olive barrel.

So much for history, now let us look at some facts of the design.

Power Supply

As we have indicated above, the power supply would be a very formidable beast unless we realize that for home audio equipment we are not interested in operating at maximum power continuously. If we accept the proposition that the peak power will be required only intermittently, then we can compromise and use a power supply that has a current capability approximately a quarter or a third of an ampere at 300 volts. It turns out that most of the regulation in the power supply is due not so much to the transformer but to vacuum rectifier tubes, and for this reason a 300-ma supply operated with a silicon rectifier can deliver the peak current requirement in a choke input circuit with a regulation determined almost totally by the choke resistance. For example, in the amplifier being described, the power supply potential varies from approximately 320 volts at no load to 280 volts at full laod.

Output Tubes

It is quite apparent that to achieve an operating impedance near that of conventional speakers, triodes must be used in the output. Again, using the principle that peak power will be demanded only intermittently, we may utilize the characteristics of triodes outside of their continuous operating region. From this point of view, it can be readily demonstrated that a pair of 6AS7 tubes can, in a series output arrangement, be made to supply 16 watts of average power intermittently. The most favorable load for these tubes in a series arrangement is approximately 70 ohms. This is close enough to 16 ohms or 8 ohms so that reasonable efficiency in transfer of power from the output triodes to the speaker can be obtained.

Feedback

With a little reflection, it will appear obvious that if we try to increase the amount of feedback in an audio amplifier, it rapidly becomes necessary to investigate the linearity of the feedback loop itself. For example, one may not introduce the feedback signal on the cathode of the first amplifier on whose grid the signal is placed. There is enough nonlinearity in the grid-cathode characteristic so that appreciable distortion can be introduced at this point. This is avoided by using a linear, passive resistive network which combines the feedback signal with the audio signal.

From well-known principles of feedback theory, it also becomes apparent that if we try to increase the feedback, then the high-frequency and low-frequency gain characteristics must be controlled over an increasingly greater frequency interval. Controlling the high-frequency gain characteristic in order to insure stable operation under all load impedances is not difficult when either a direct-coupled or a capacitor output is used in the amplifier. The low-frequency characteristic, on the contrary, becomes more difficult to control and, in the case of the amplifier being described, it is necessary to control gain and phase shift characteristics in the feedback amplifier at one or two cps in order to insure stable amplification under all load impedances. In this respect, the low regulation of the power supply is an advantage since, if a high-regulation power supply is used, annoying difficulties arise from low-frequency oscillation or motor boating. For high feedback, high gain is also required, and thus there is an increase in the number of stages over which the gain and phase shift must be controlled. In the amplifier being described, a combination of d.c. coupling and low-frequency phase correcting networks were used in order to achieve an overall feedback of 40 db.

Output Circuit

The main difficulty of using triodes is, of course, that they have a low voltage gain and hence require a large bias and also a large driving potential in order to achieve full output. In this amplifier, the bias is approximately 65 volts, and hence the drivers are required to deliver a 130-volt peak-to-peak signal with negligible distortion. Furthermore, in the conventional series output circuit it is difficult to establish bias for the upper tube in the series chain, and still preserve balance between the upper and lower tube. This is particularly difficult under conditions where the plate potential B+ is changing by as much as it does in an OTL amplifier where large, intermittent current demands are made on the power supply. The solution to this problem that was finally used in the OTL amplifier being discussed is a network that essentially transfers the bias of the lower tube with a gain of 1 to the bias of the upper tube. The circuit is indicated in *Fig.* 2. The operation may be described as follows: The cathode resistor of *V1* has a voltage drop that is essentially the bias po-

tential for output tube *V3* because the cathode of *V1* is essentially at ground potential. Since current in *V1* is identical in both plate and cathode, the drop across *R* in the plate is also the bias potential. Now, however, it is subtracted from the plate potential B+. Since the two dropping resistors to the grid of *V2* are equal and large compared to *R* (or unequal to compensate for their loading on *R*) it is apparent that the bias applied to *V2* will be exactly one-half of the plate voltage minus the bias voltage applied to *V3*. Thus, quite independently of the variation in either the plate supply potential or the bias potential, the bias on the series output tubes will be balanced. In order to create an alternating signal potential that has a peak value equal to the bias potential and low distortion, an additional plate resistor *R'* is included as shown in the plate circuit of *V1*. The alternating signal potential is a.c. coupled by means of capacitor *C* to the grid of *V2*. Actually, the use of a triode for *V1* as a source of drive for the output tube *V2* is not a favorable arrangement, since such a large drive potential is required in order to drive the triode output tubes. For this reason *V1* is a pentode, and a slight modification of the circuit must be made in order to account for the fact that some of the cathode current is supplied by the screen current. The dynamic balance of the output tubes can be still maintained with accuracy in spite of this slight additional complication, and the use of two pentodes to drive *V2* and *V3* in a high-gain, phase-splitting circuit allows one to achieve low-distortion, high-level drive for the output tubes. As indicated in *Fig.* 2, the output is not directly coupled to the speaker. It is taken through an electrolytic capacitor that is by-passed by a small mica capacitor in order to maintain a low output im-

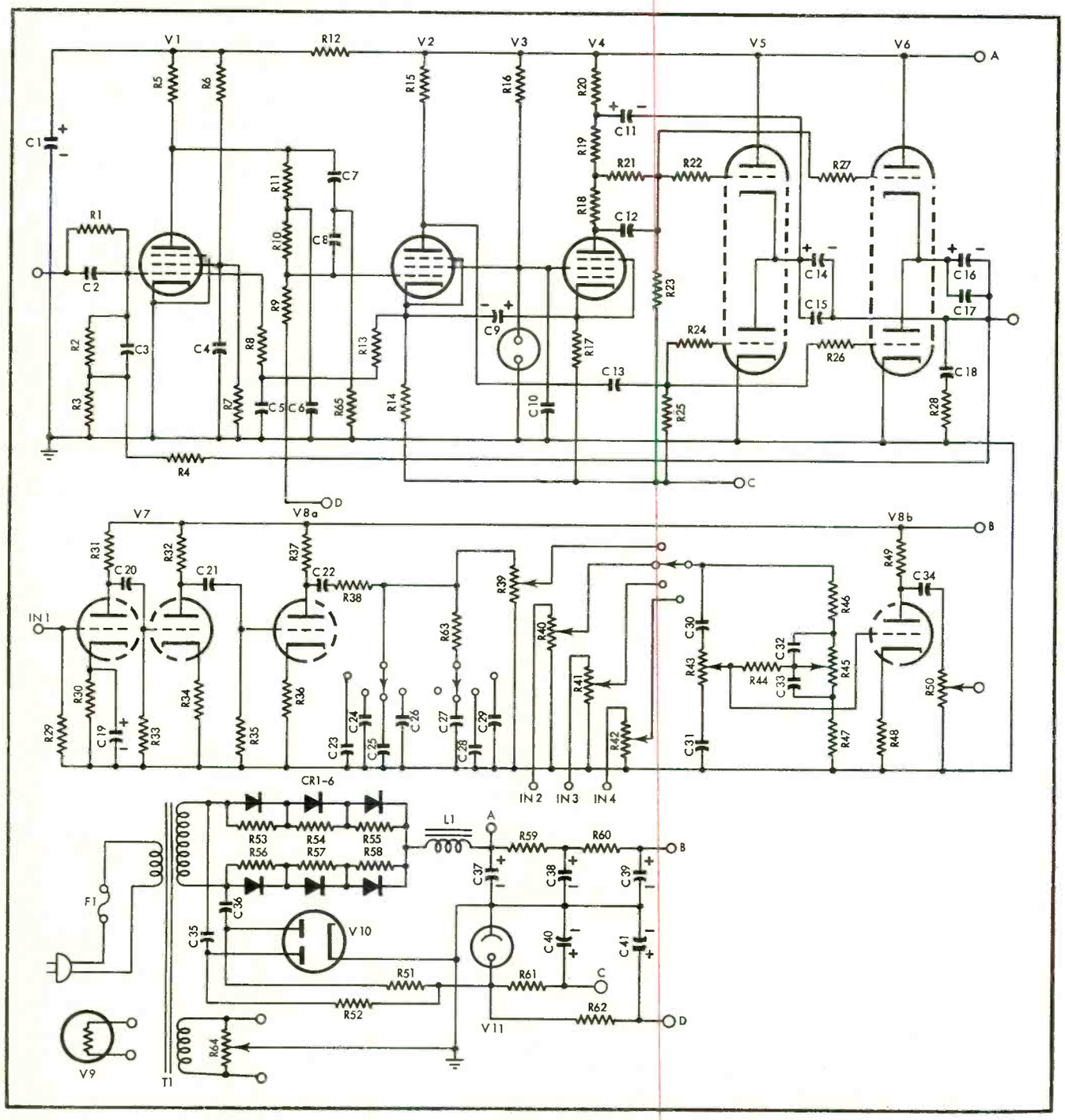

Fig. 3. OTL circuit including preamplifier.

pedance at high frequencies. Essentially one-tenth of the output potential is fed back to the input through a passive, linear resistive network so that, with two stages of pentode gain, together with the loss of voltage gain in the output triodes, the over-all feedback is approximately 40 db.

As we have indicated above, d.c. coupling is used between the first and second voltage gain stages. This d.c. coupling network includes a low-frequency parallel-T notch network to shape the gain-phase characteristic at low frequencies to insure stability at the low frequency cut-off. The resulting circuit is indicated in *Fig.* 3.

Results

The over-all circuit at low power is flat from a few cps to 100,000 cps. However, since we are not interested in the low-power characteristics but in contours of power available as a function of frequency, typical power output contours are given in *Fig.* 4. The intermodulation distortion of 9 amplifiers were less than 1 per cent below 10 watts average into 16 ohms; some ranged as low as 0.5 per cent. Harmonic distortion is insignificant and hardly measurable. A feature that seems to be unique in this OTL type of amplifier is that the intermodulation distortion decreases with decreasing power output and becomes difficult to measure at a level of 1 watt. A typical or conventional preamplifier can have intermodulation distortion of approximately 1 per cent also. In other words, unless great care is taken in the over-all system, the intermodulation distortion contribution coming, for example, from a recording and the associated preamplifier can be greater than the distortion introduced by the actual amplifier itself.

It will be noticed from the maximum power curves that the power drops off at a rate of approximately 3 db per octave below 60 cps. This is, of course, an indication of another of the compromises made in the design—a modest output capacitor. It will be noted that in this frequency range there is an appreciable fraction of the output voltage drop across the output capacitor. For a given plate supply, this will limit the output power. It will be realized that one could use a ten times large capacitor with no great difficulty, since such capacitor sizes are now conveniently available although they were not so several years ago. Actually, such a measure is not of great importance since the impedance of many speakers tends to rise in this region also. For example, a Goodman's Axiom-80 has an increasing resistive component of impedance which has a maximum of about 80 ohms at 30 cps, the audio power available is essentially flat to below 30 cps. The amount of recorded information below these frequencies is trivial in this writer's opinion so the compromise thus expressed is a reasonable one.

It has also been the writer's experience that the OTL type of amplifier is very tolerant of acoustic feedback. For example, this type of amplifier can be placed inside the speaker cabinet itself and there will be no apparent acoustic feedback. This is of particular importance when one wishes to operate a hi-fi system in a console arrangement. If the available high-fidelity apparatus is surveyed, it becomes apparent that either we must make engineering compromises in order to reduce acoustic feedback effects to a tolerable level, or we must resort to engineering complications of an annoying magnitude in order to decouple the power anplifier from acoustic feedback through the console cabinet.

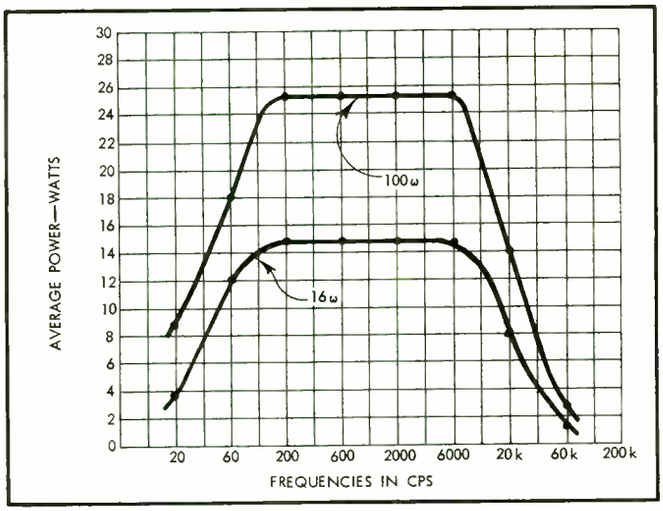

Fig. 4. Average power output versus frequency contours for 16- and 100-ohm loads.

The amplifier limits quite sharply when driven to its maximum power output. From the standpoint of intermodulation, the amplifier goes to pieces with dramatic rapidity. However, it is a fact that listening tests indicate that the ear must be quite tolerant of intermodulation introduced by a sharp limiting process, since under conditions of strong limiting, music retains its ingratiating or harmonious quality. It should also be pointed out that any speaker system with reasonable efficiency will create a lease-breaking amount of sound in any home audio system, since typically, one requires between an eighth and a quarter of a watt of power for average listening conditions. Thus, the great argument for high power in the fifties or hundreds of watts must be based upon the use of exceedingly inefficient speaker systems or the hope that if the audio system is run far below its peak power capabilities, the intermodulation distortion will be negligible. It seems needless to point out that this contains a good deal of wishful thinking because the sources for intermodulation that exist in transformer-coupled amplifiers do not necessarily yield a rapidly diminishing amount of intermodulation with reduction in power output. Furthermore, as we said above, sharp limiting does not appear to be objectionable to the ear, and hence, limiting in an audio amplifier need not be avoided as long as it is carried out in a proper fashion.

A set of 9 amplifiers of the type pictured in *Fig.* 1 was built several years ago and several have been in continuous home-use operation for a period of nearly two years without requiring any maintenance. These were used under conditions encountered in a home environment, and these tests bear out the premises upon which the design was made in the first place—that is, that one need not build an amplifier that will deliver an ear-shattering amount of power at all times, but only on an intermittent basis. This type of philosophy allows one to reduce dramatically the size of an OTL amplifier without apparently reducing its life expectancy. Æ

PARTS LIST

(All resistors ½ watt unless otherwise noted)

R1	470,000 ohms	*R62*	15,000 ohms
R2	470,000 ohms	*R63*	10,000 ohms
R3	470 ohms	*R64*	50 ohms
R4	4700 ohms	*R65*	2.2 megohms
R5	100,000 ohms	*C1*	40μf
R6	100,000 ohms	*C2*	39pf
R7	33,000 ohms	*C3*	39pf
R8	470,000 ohms	*C4*	6μf
R9	2.4 megohms	*C5*	0.1μf
R10	1.2 megohms	*C6*	8800pf
R11	1.2 megohms	*C7*	4400pf
R12	22,000 ohms	*C8*	4400pf
R13	470,000 ohms	*C9*	50μf, 6v
R14	75,000 ohms	*C10*	0.1μf
R15	160,000 ohms	*C11*	5μf, 150v
R16	110,000 ohms	*C12*	0.1μf, 600v
R17	75,000 ohms	*C13*	0.1μf, 600v
R18	68,000 ohms	*C14*	125μf, 250v

(*Continued on page 58*)

Signal Sampling For FM Stereo

R. SHOTTENFELD and S. ABILOCK*

Using a new technique in the FM-stereo field, diodes and a synchronized oscillator provide a sampling circuit which eliminates all vacuum-tube circuitry from the signal path, avoids the need for user-operated controls, and provides an indication of the presence of a stereo signal.

External appearance of Pilot Model 200 stereo adapter.

WITH FEW EXCEPTIONS, present day multiplex adaptors and FM-stereo tuners use circuits that operate on the principles demonstrated to the Federal Communications Commission at the Uniontown, Pa., field tests. The successful system had two proponents, and two prototype adaptors were shown. The circuits of these two units, while outwardly different, were similar in their use of frequency separation filters.

In one prototype (G. E.) the composite signal is first separated by filtering into two components: the sum signal, $(L+R)$, and the sidebands of the difference signal, $(L-R)$. After carrier reinsertion (the carrier having been suppressed in the transmitter) the difference signal, $(L-R)$, is recovered from the second component by means of AM detection. Finally the left and right channel audio signals, L and R respectively, are obtained by matrixing the sum and the difference signals.

In the other prototype (Zenith), direct but imperfect demodulation of the composite signal is accomplished by means of a synchronous switching circuit. Separation of L and R is then completed by partially matrixing the switch output with the sum signal, $(L+R)$, obtained from the composite signal by filtering.

A serious disadvantage in the use of frequency separation filters and matrixing soon makes itself evident when an attempt is made to use these circuits in the design of a high-performance multiplex adapter. In order to obtain essentially complete separation it is necessary to match both the signal levels at the matrix and the transmission time delay through the filters to an extremely high degree of precision for every frequency in the audio spectrum. A circuit to match the signal levels is not very difficult to construct especially if a gain control is used. However, the time delay problem is not so easily solved. It would take a large number of filter sections to match the frequency response and the time delay of a low-pass filter and its corresponding band-pass structure to the precision necessary for complete separation of L and R over the entire audio spectrum. It is practical to use only a few filter sections in consumer equipment. Therefore, separation can be made high only over a limited frequency range, and it must decrease at the upper and lower ends of the audio spectrum where the frequency response and the time delay of the filters fail to match.

When we began the development of a commercial multiplex adaptor, our first approach was to work with filters and matrices. As soon as we encountered the difficulties outlined, we set about searching for a different way to do the job. The outcome of our subsequent investigation and the resultant radically different circuits form the substance of this article.

What are the most desirable properties of a good commercial FM-stereo adaptor? First of all, the unit should perform well with the widest possible variety of tuners—those made in past years as well as current models. It should have sufficient inherent stability to be able to maintain its high level of performance despite varying input signal levels, environmental changes, and reasonable aging of tubes and components. Installing and connecting the unit should be simple and require no mechanical skill. To fit easily into existing custom installations or consoles, the unit should be compact and require a minimum of panel space. And, *there should be a minimum of controls to operate.* The Pilot Model 200 multiplexer has these desirable properties plus two very unusual circuits, one of which is the subject of a patent application.

The Adapter Block Diagram

The block diagram, *Fig.* 1, shows the major circuit functions and the signal paths for the Pilot Model 200. Three paths extend from the input terminal. The upper path is for a monophonic signal and it contains only a de-emphasis network. The central path contains all the circuits which have to do with demodulation of the composite signal. The lower path contains the circuits which work with the pilot and the stereo subcarriers. At the right end of the diagram all the signal paths terminate in the Stereo-Mono Switch circuit block. From this, in turn, two paths extend to the outputs.

In the demodulator path the first circuit block is the tuner compensating network. The purpose of this network is to provide phase and amplitude correction to composite signals from tuners with frequency response rolloffs at 53,000 cps. The ideal tuner, of course, does not have any rolloff, and for such a tuner the compensating network is not necessary and should be removed. However, the great majority of tuners do require this network. Its use provides a very substantial improvement in separation. The network shown at (A) on the schematic diagram, *Fig.* 2, consists of a 680,000-ohm resistor, a 39-pf capacitor shunting it, and a 1-megohm resistor to ground. The configuration is that of a

* *Engineering Dept., Pilot Radio Corp., 37–44 36th St., L. I. C. 1, N. Y.*

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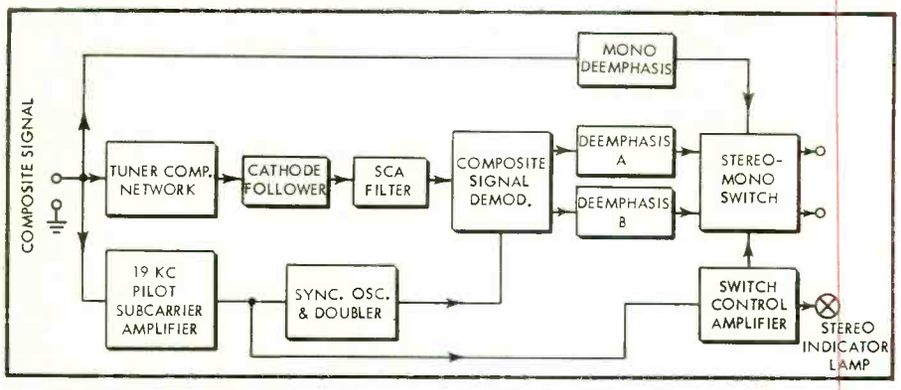

Fig. 1. Simplified block diagram of Pilot Model 200 multiplex adapter.

phase-lead high-frequency boost network. The values were selected to make it the inverse of that circuit in an average tuner, which produced the undesirable rolloff.

That a modern tuner should require a corrective network does not indicate that it is a poor tuner. The wide frequency response needed for stereo reception is not necessary for monophonic reception, and most tuners designed before the advent of stereo broadcasting do not have it. (It is worthwhile noting that the capacitance of the connecting audio cable contributes to the rolloff, and therefore it should be as short as possible.)

Another factor contributing to poor separation of some tuners made prior to the FCC approval is that the multiplex output jack is coupled to the FM detector through either a small capacitance or a high resistor. Such a tuner cannot furnish a correct composite signal to a multiplex adapter that has a conventional value of input impedance. The remedy is to increase the coupling capacitor to at least 0.1 μf, or to short out the resistor.

After passing through the tuner compensating network, the composite signal, with all its frequency components in correct time relationship and proper relative amplitudes, passes through a low-distortion cathode follower to provide a low-impedance driving source for the circuits that follow.

Next in order is the SCA filter. This is a band-rejection network, not a simple resonant circuit that provides only an attenuation notch. This network provides uniform attenuation over the range of frequencies from 67,000 to 76,000 cps and affects the response at 53,000 cps by much less than 1 db. The advantage of such a filter is that there is attenuation for the SCA sidebands as well as the carrier, and that the upper sidebands which produce low-frequency beats with 76,000 cps are uniformly attenuated.

At this point the composite signal enters a circuit that represents a radical departure from any presently used for stereo demodulation. With this method the left- and right-channel audio signals are extracted directly from the compos-

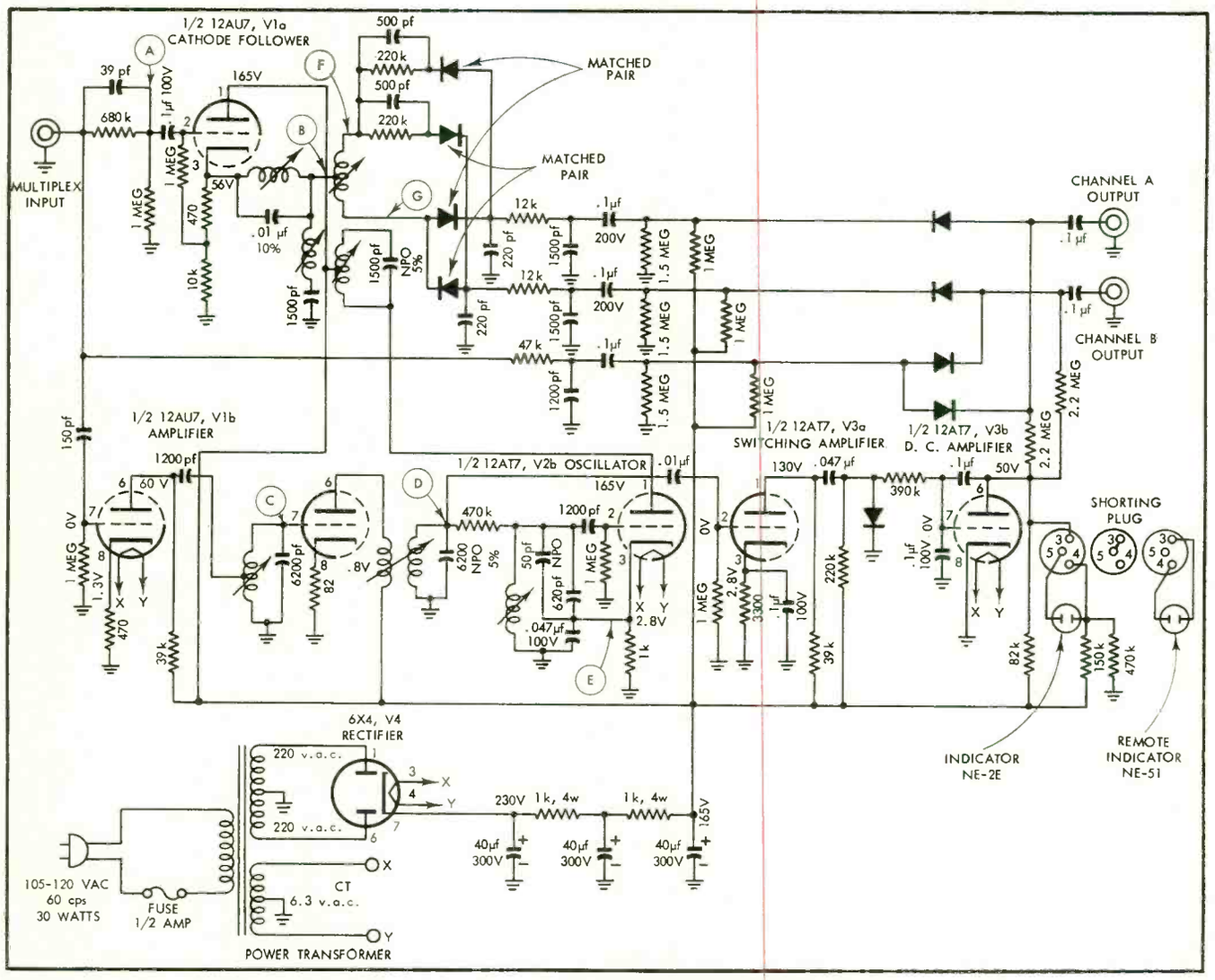

Fig. 2. Complete schematic diagram of Pilot Model 200 adapter.

HOW TO CHOOSE A LOUDSPEAKER

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

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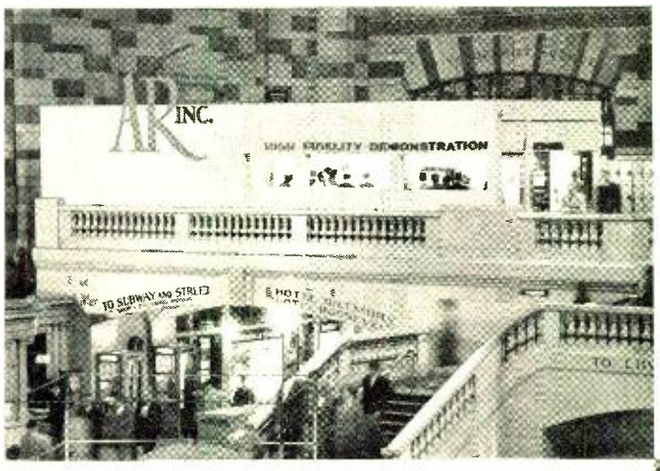

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ite signal without using either filtering or matrixing. The circuit is capable of perfect separation over the entire audio spectrum, and its output is substantially free of stereo subcarrier. It consists essentially of a synchronous switch that samples the composite signal on an impulse forming basis, and a "data hold."

Synchronous Switching

In order to explain how the circuit works we will begin by first showing how the composite signal is formed. When the waveform is clearly in mind it will become much easier to understand how the demodulation takes place.

The various waveforms that contribute to the formation of the composite signal are shown in *Fig.* 3. As the L and R signals are entirely independent, each may be chosen arbitrarily. For convenience the L signal will be represented by a sine wave, and the R signal by a rectangular waveform as shown at (A) and (B). The sum signal $(L+R)$ is shown at (C), and the difference signal $(L-R)$ at (D). Double-sideband suppressed-carrier amplitude modulation of $(L-R)$ upon the 38,000-cps stereo subcarrier is shown at (E). The wavy lines within the envelopes represent 38,000 cps, and the entire diagram represents the upper and lower sidebands resulting from modulation, without the carrier. The addition of $(L+R)$ to the $(L-R)$ sidebands is indicated at (F). This is the composite signal except for the omission of the 19,000-cps pilot, which plays no direct part in the demodulation process.

The key to the demodulation process is to note that in (F), alternate peaks of the 38,000-cps waveform terminate on envelopes which have the same waveshapes as the original L and R audio signals. Thus, in the composite signal, the L and the R signal information is maintained separately on the two envelopes which form the boundaries of the 38,000-cps waveform. And, the L and R signals can be recovered separately and independently by circuits which allow the appropriate output to "view" the composite signal at suitably timed instants.

The mathematical expression for the composite waveform at (F) in *Fig.* 3 is:

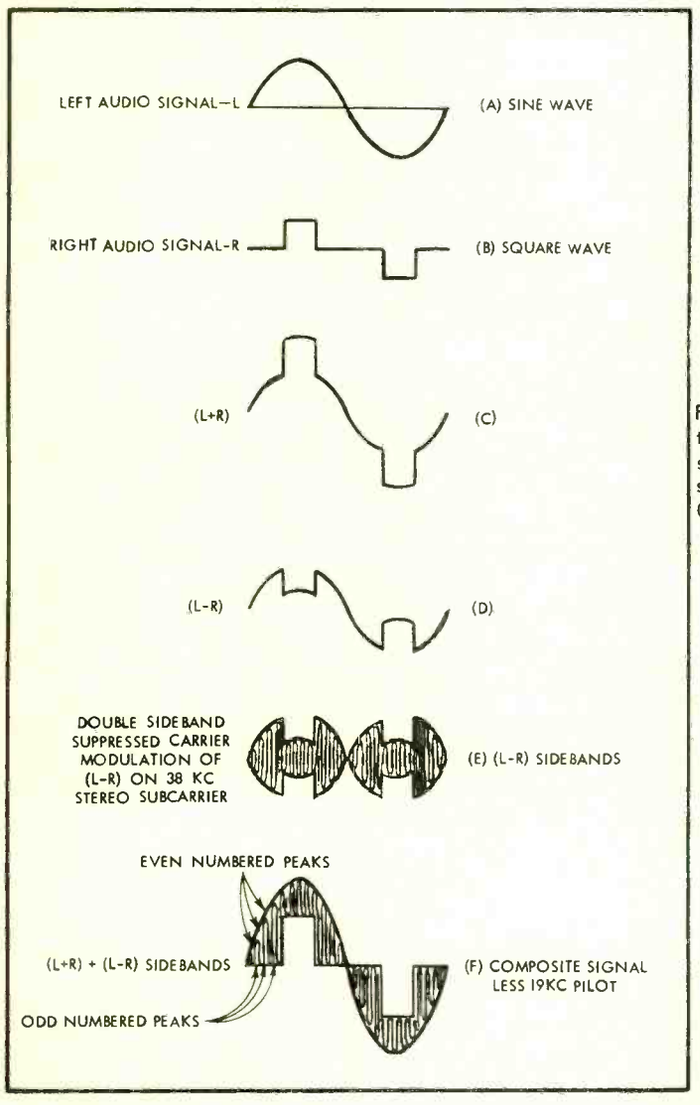

Fig. 3. Composition of composite stereo signal. For simplicity, the 19,000-cps pilot signal is omitted.

$$E_t = [L+R] + [L-R]\,[\cos 2\pi f_{sc} t]$$

Where: L is the left channel signal as a function of time
R is the right channel signal as a function of time
f_{sc} is the stereo subcarrier frequency, 38,000 cps.

Now define a sampling function $\overline{E}_t = E_t$ at the instant $t = n/2f_{sc}$, n being the series of consecutive integers 1, 2, 3, . . ., and: $\overline{E}_t = 0$ at all other times.

Then:

$$\overline{E}_t = [L+R] + [L-R]\,[\cos n\pi]$$

Notice that for even values of n:

$$\overline{E}_t]_{n,\,even} = [L+R] + [L-R]\,[+1]$$
$$= 2L = \textit{pure left signal}$$

And for odd values of n:

$$\overline{E}_t]_{n,\,odd} = [L+R] + [L-R]\,[-1]$$
$$= 2R = \textit{pure right signal}$$

The result of applying the mathematical sampling function to the expression for the composite signal is the same as physically viewing the waveform for very brief instants, a series of narrow spikes emanating from the base line and terminating at the values of E_t at those instants.

From sampling theory, it is known that the original continuous function can be completely and accurately recovered from the sampled function by low-pass filtering, provided that the sampling rate is more than twice the highest-frequency component of the original signal. This can be done for the signals involved in FM stereo, because 38,000 cps is more than twice 15,000 cps, the upper limit of the audio band.

When the sampling consists of very narrow pulses, the energy content is quite low and the recovered continuous function should have a very low amplitude compared to the input signal. The impulse signals also contain a large component at sampling frequency that require an extensive filter to remove.

The desired output can be greatly increased and the sampling frequency component decreased by making use of a circuit which has the ability to hold the output constant at the level of the preceding sample until the next one comes along. Such circuits are called "data holds," or "memory circuits." The output waveform now becomes a "staircase" or "step" function approximation to the continuous function. There is a good deal more energy in this and therefore the output signal level is more nearly the same as the input signal.

Other circuits used for stereo demodulation have used switching signals of long duration approaching one-half cycle at 38,000 cps in order to build up the energy of the output signal. Unfortunately this does not provide com-

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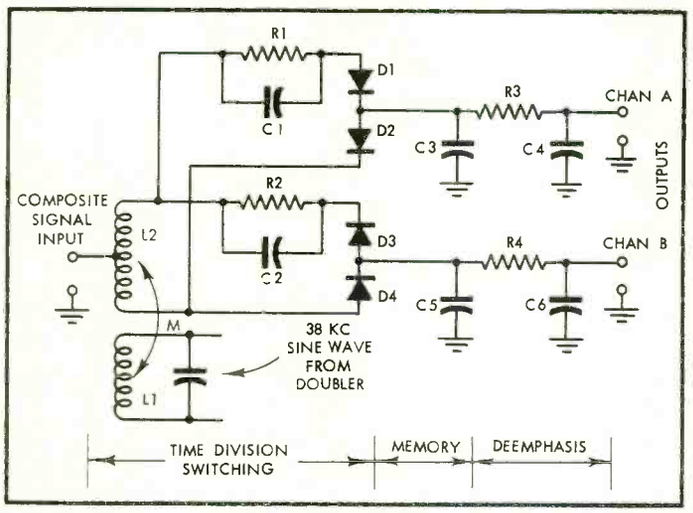

Fig. 4. Composite stereo signal demodulator.

plete separation and so subsidiary matrixing must be resorted to.

In the Model 200 circuit, just the opposite is done. Narrow sampling impulses are used because complete separation can be obtained that way. When the "data hold" is used to build up the energy of the recovered signal, the output can be within 1 db of the input, and the component at sampling frequency is much reduced.

The actual circuit is shown in *Fig.* 4, which is a part of the complete schematic *Fig.* 2. L_1 and L_2 are the primary and secondary of a transformer tuned to 38,000 cps. L_1 receives a 38,000-cps signal from the frequency doubler. L_2 is an accurately center-tapped coil. The composite signal is fed into the center tap of this coil. The voltage developed across L_2 causes the diodes D_1 and D_2 to conduct for a small fraction of a cycle each time that terminal 1 of L_2 is positive with respect to terminal 2. The network R_1 and C_1 controls the conduction time interval by biasing the diodes into non-conduction. As long as the diodes do not conduct, their common terminal is disconnected from the input. When they do conduct, there is a low-impedance path between their common junction and the input. By properly phasing the 38,000-cps signal, the conduction of the diodes may be made to coincide in time with the peaks of the composite signal waveform, and by making the conduction period very short the high separation associated with impulse sampling is achieved.

Diodes D_3 and D_4 are similarly connected to L_2, but their polarity is reversed so that they conduct on the peaks of the other half cycle. Their common junction is therefore connected to the input only when the other set of diodes is not. In other words we have a momentary contact SPDT switch that alternately connects the input to the Channel A and the Channel B outputs.

The "data holds" are simply the capacitors C_3 and C_5. The value of each is made small enough so that it can charge rapidly to the composite signal voltage in the small time that the diodes conduct, and the leakage to ground of the entire output circuit, which tends to discharge the capacitors, is made so small that the voltage across them remains essentially constant during the time interval between conduction instants. This, then, is the mechanism of step function formation. $R_3 - C_4$ and $R_4 - C_6$ are standard de-emphasis networks.

Notice that the two halves of L_2 and the diodes D_1 and D_2 form a bridge circuit. The 38,000-cps energy injected into L_2 does not appear between the input terminal and ground; neither does it appear between either output terminal and ground. In practice the bridge need not be balanced to a high degree of precision. A fair balance will give quite good suppression of 38,000-cps and the de-emphasis network also helps. The diodes must have a quite rapid turn-on and turn-off characteristic, otherwise suppression of stereo subcarrier will depend too strongly on matching this characteristic between the two diodes.

Needless to say, the diodes must conduct synchronously with the peaks of the 38,000-cps waveform in the composite signal. Failure to do so will result in loss of separation. The separate L and R signals are next fed into the stereo-mono switch.

Returning now to the block diagram and schematic, consider the lower signal path. A two-stage tuned 19,000-cps amplifier selects and amplifies only the pilot subcarrier. It is important to remove all vestiges of modulation from the subcarrier before using it to synchronize the oscillator, otherwise distortion may result. The oscillator section, V_{2b}, strongly locked to the pilot subcarrier, generates the 38,000 cps that actuates the demodulator. The oscillator coil, 79–113, is loosely coupled to the output of the 19,000-cps pilot subcarrier amplifier by the 0.47-megohm resistor only. This kind of coupling ensures that both tuned circuits operate at resonance.

If inductive or capacitive coupling were used there would be a detuning effect that would shift the phase of the oscillator when the amplitude of the synchronizing signal varied. This undesirable affect is avoided by using pure resistance coupling, building up a large synchronizing signal and loosely coupling it to the oscillator so that strong synchronizing action is obtained even with the weak coupling that is necessary to avoid interaction between the two tuned circuits.

All the tuned circuits must be accurately temperature compensated to avoid phase shift as the unit heats. It is most important to compensate each circuit by itself. Unless this is done there will be a variation in the ability to maintain proper phase with different signal levels as the unit heats up.

The Stereo-Mono Switch

Next consider the stereo-mono switch. A schematic of this circuit, broken out of the complete schematic, is shown at *Fig.* 5. Some FM stations broadcast SCA programs in the stereo subchannel frequency range in addition to the regular monophonic programs. This will cause interference with a monophonic program if listened to through a multiplex adapter. For this reason it is advisable to use the multiplex circuits only when actually listening to a stereo program. Many multiplex adapters provide a manual switch for this purpose. Such adapters cannot be tucked away unless the associated equipment has switching that can bypass the adapter.

Automatic switching, actuated by the pilot subcarrier, is used to bypass the multiplex circuits when they are not needed. Therefore, this multiplexer, which has no controls for the user to operate, can be installed in any out of the way spot.

The circuit consists of two major parts: the switch-control amplifier, and the switch element itself. The switch-control amplifier consists of a stage of amplification for 19,000-cps pilot V_{3a}, a forward biased diode D_1, a slow-acting d.c. amplifier V_{3b}, and a neon lamp indicator. V_{3a} receives a 19,000-cps signal from the pilot-subcarrier amplifier V_{2a}. The output of V_{3a} appears across the diode D_1 which is forward biased by the current through R_2. As the input voltage increases, starting from zero, at first nothing happens at D_1 because the current through it causes it to be a short circuit across the load resistor R_1. As soon as the 19,000-cps current exceeds the bias current in D_1, the junction of R_2 and R_3 starts to go negative with respect to the cathode of V_{3b} and this tends to lower the plate current of the tube.

(*Continued on page 48*)

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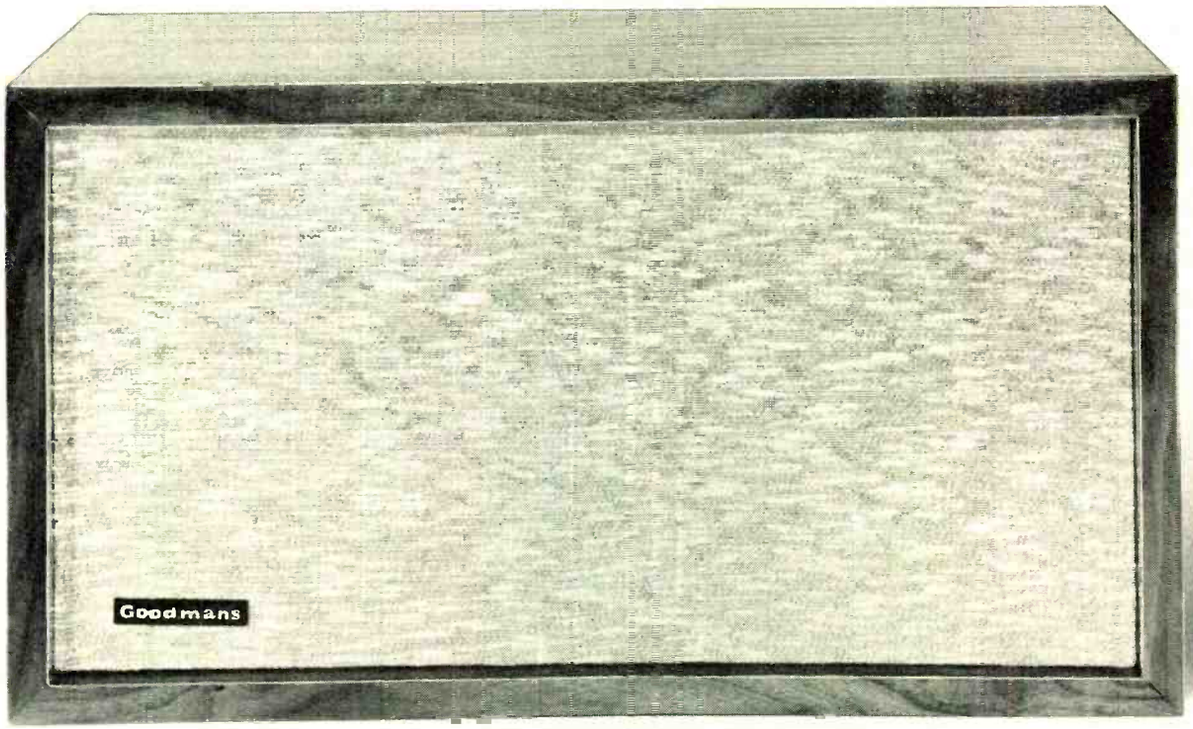

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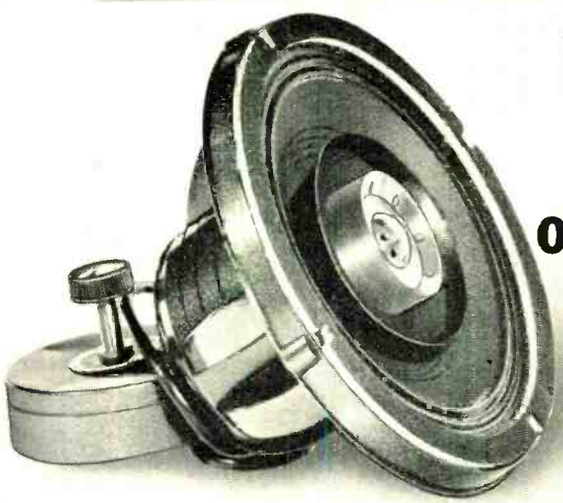

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Electronic Organ Tuning

R. D. HERLOCKER*

A simple method for tuning electronic organs by fifths and octaves.

AN ELECTRONIC ORGAN, like any other musical instrument, needs to be tuned from time to time, unless, of course, it is one in which the tuning is mechanically fixed for all time, such as the Hammond. Tuning an organ can be a tedious and even a frustrating job, especially with instruments of the type of the Conn or Allen organs, which have independent oscillators for every note.

The job is further complicated by the use of the tempered scale, in which there is no simple relation between the frequencies of any two notes in an octave. In the so-called scientific scale, two tones a fifth apart, such as C and G, have a frequency ratio of exactly 1.500. However, in the almost universally used tempered scale this ratio is $2^{7/12}$, or 1.4983, just short of the ratio of the scientific scale. Similarly, the frequency ratio of any two adjacent tones in the chromatic scale such as D and E-flat or B and C is $2^{1/12}$, or 1.05948.

This "tempering" of the scale, to fit in all twelve of the tones of an octave, with equal frequency ratios between the notes of all similar pairs of notes, solves several problems for the musician; for without it, the pianist or organist would have only one key-signature which was really in tune, all others being out of tune to varying degrees. However, it does complicate life for the person who has to tune such an instrument.

Since I have a weakness for trying to reduce all formulas and equations to charts or graphs, the chart accompanying this article, *Fig.* 1, was worked out as an aid to tuning my own organ. No claim is made for any particular originality in it since similar charts have appeared in the literature in various forms. Least of all could it be claimed to eliminate the use of such tuning aids as the Stroboconn or the Schober Autotuner.

However, I believe that this chart is easier to use than others which have been published. After the initial pitch has been determined, the only tone intervals to be considered are octaves and fifths, which are far easier than any other intervals to match or to beat against. The basic procedure, after the first tone has been set, is to go up the scale from that first note an interval of a fifth (as from A to E), zero-beat the two tones, and

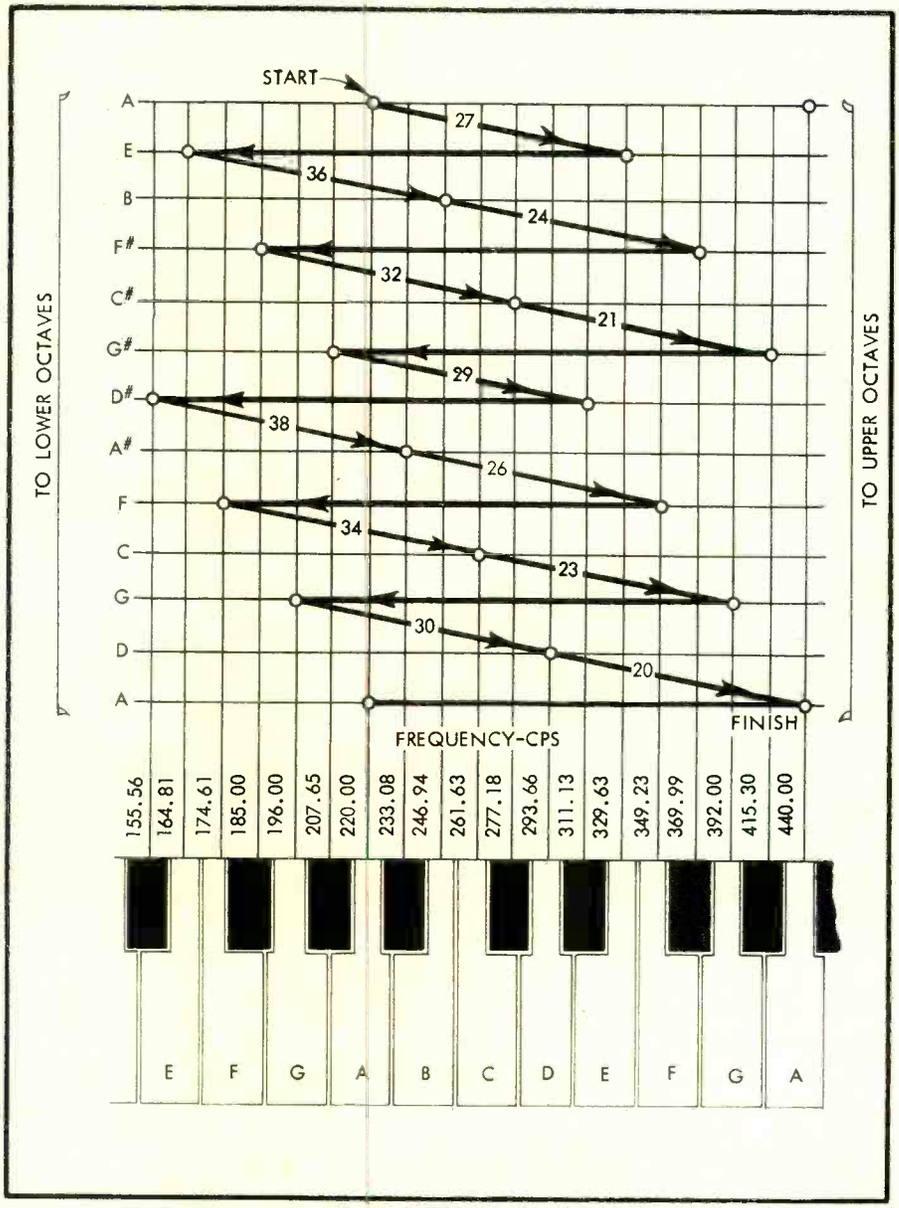


Fig. 1. Electronic organ tuning chart. Each successive fifth is flatted by ten beats in the indicated number of seconds.

then apply a small correction factor to take into account the difference between the tempered-scale frequency ratio and the 1.50 ratio obtained by zero-beating.

In the case of a frequency dividing type instrument, such as the Baldwin, when all notes in the octave-and-a-half range covered by the chart have been properly tuned, the entire instrument is in tune. In those instruments with independent oscillators, notes of the remaining octaves above and below this range will have to be tuned by zero-beating against the corresponding notes in the range already tuned.

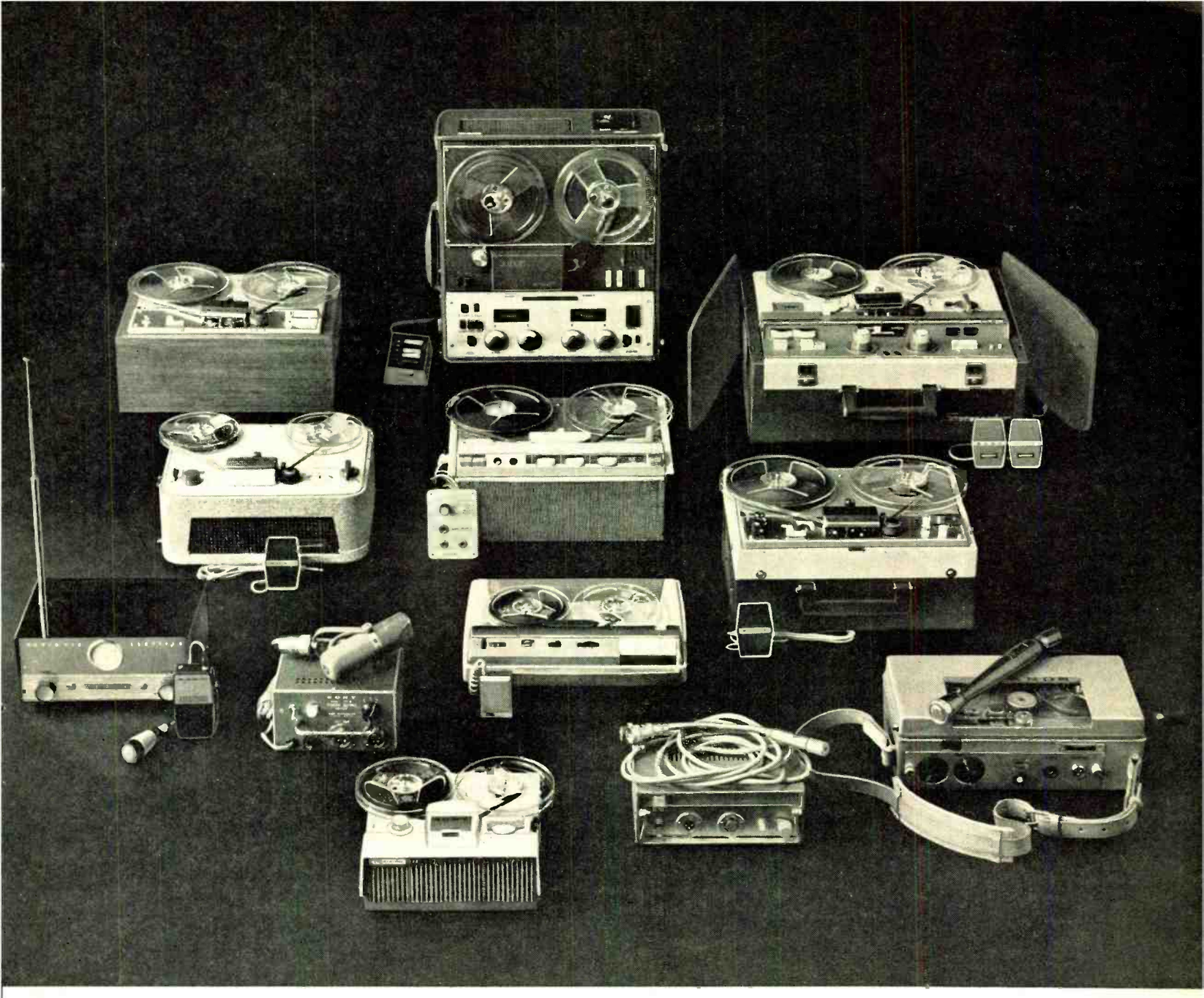
Detailed Procedure

Detailed procedure for tuning an organ with the help of the chart is as follows:

Some means of holding down two keys or pedals simultaneously must be provided. This may be done either with weights, or with wedges inserted at the

(*Continued on page 85*)

* *8528 Schreiber Drive, Munster, Indiana.*



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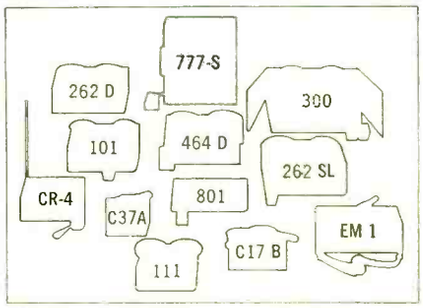

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Treble Emphasis

*Q. I own a **** tape recorder with separate record and playback heads. I have noticed in A-B monitoring that my tapes have a distinct treble emphasis, particularly at 3¾ ips. I would like to know what I can do to optimize frequency response at 3¾ ips.*

A. To begin with, yours is a machine of European manufacture, and it should be taken into account that European designers generally consider frequency response to be reasonably flat if it falls within ±5 db, as contrasted with the American standard of ±3 db. Hence, despite the treble emphasis you notice, your tape recorder is probably operating within its design specifications. If you desire to reduce the treble emphasis, this can be done in one of several ways: (1) Increase the bias current slightly. This will have the advantage of reducing distortion at the same time, but on the other hand you will probably be impairing treble response at your lowest tape speed, which is 1⅞ ips. (2) Decrease the treble emphasis employed in the record amplifier circuit. This would require the use of a smaller capacitor in the equalization network; you would have to experiment with various values. Unless you are technically competent in these matters or have the assistance of someone who is, your easiest course is to increase the bias current. When adjusting bias current, check the frequency response on the basis of A-B monitoring or, preferably, with an audio oscillator and a VTVM. I should add that as a third alternative you can leave the tape recorder alone and achieve some measure of treble reduction by means of the tone control of your preamplifier.

Incomplete Erasure

Q. I have never been able to achieve really clean erasure with my tape recorder. Is it the fault of the erase head?

A. A faulty erase head is one of several possible reasons. Other possible causes are: (1) Insufficient oscillator current may be reaching the erase head. (2) The erase head may be improperly positioned vertically, so that the gap of the head does not span the same part of the tape as the gap of the record head. (3) The tape oscillator frequency may be too high, resulting in a decrease in the efficiency of the erase head. (4) You may be recording at an excessive level, so that the erase head is required to perform beyond its normal capabilities.

If you are tempted to reduce the bias frequency (which can often be done very simply by turning a slug in the core of the oscillator transformer), be on guard, because you may thereby seriously affect the quality of your recordings. Too low an oscillator frequency tends to result in audible beat notes between the bias current supplied to the record head and the upper harmonics of the audio frequencies that are being recorded. Also, changing the oscillator frequency may change the amount of bias current reaching the record head, thereby affecting both treble response and distortion.

Your best course might be to rely on a bulk eraser. This assumes you are willing to erase all the recorded tracks at once, rather than one at a time.

Stereo Recording

Q. When making stereo tapes from stereo records or from other tapes, should I set both gain controls of my tape machine at the same number on the dial?

A. The gain controls should be set for equal readings on the record level indicator for each channel. While this may not be very easy to do, depending upon the amount of difference between the signals of the two channels, you must try to average out each reading by eye. This may or may not correspond to equal settings of the gain controls, depending upon how well matched the gain controls happen to be: this also depends upon whether there is good balance between the two channels of the stereo disc or tape that you are copying.

Head Demagnetizing

Q. Should one demagnetize the erase head as well as the other heads? In what order should the heads be demagnetized?

A. It pays to demagnetize every metal object that comes in contact with the tape. This includes not only all the heads but also other components, such as guides and rollers. The order of demagnetization does not matter.

Q. I own a bulk eraser, which I would also like to use to demagnetize the tape heads on my machine. Is there any reason why I shouldn't use it in this manner?

A. There is a very good reason if your tape recorder uses a meter as a record-level indicator. The bulk eraser is a brute force device, which can easily ruin the meter if brought close enough.

Microphone Sensitivity

Q. I am shopping for a microphone to be used with my tape recorder. What should be its sensitivity? Should I get a low-impedance or a high-impedance microphone?

A. If you purchase a high-impedance microphone, its sensitivity should be rated at approximately −55 db or better. ("Better" means a less negative value; thus −52 db means greater sensitivity than −55 db.) If the microphone is not sufficiently sensitive, your tape recorder may not have sufficient gain to achieve full recording level, resulting in a poor signal-to-noise ratio. Some of the least expensive microphones are rated at −50 db or better. The factors of frequency response and distortion, as well as sensitivity, enter into selection of a microphone, and it is generally necessary to make some sacrifice in terms of sensitivity in order to obtain good performance in the other respects. That is why the better microphones typically have ratings in the vicinity of −55 db rather than −50 db. In the case of a low-impedance microphone (or one that gives you the option of switching between low and high impedance), the rating should be −55 dbm or better.

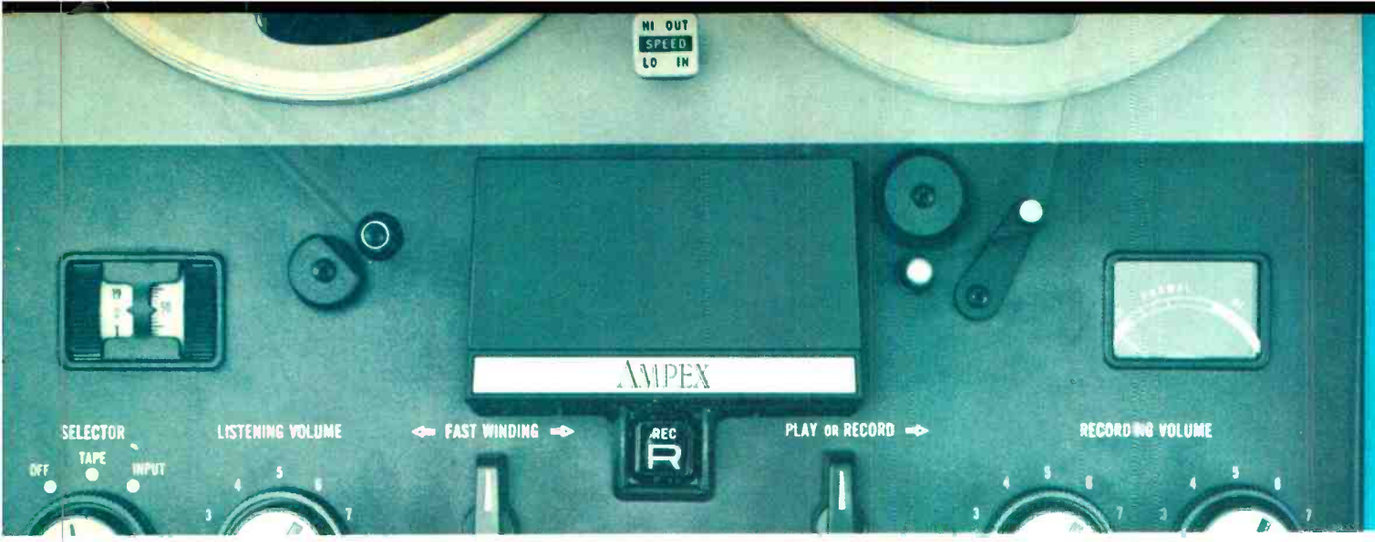
Assuming that all your recordings are to be made within a few feet of your tape machine, permitting a short cable, a high impedance microphone will be satisfactory. But if the cable is to be appreciably more than 12 feet or so, you must employ a low-impedance microphone in order to avoid substantial treble losses due to cable capacitance. At the same time, in order to get enough signal to drive your tape recorder, you will require a microphone input transformer, unless your machine happens to be one of those rare units already equipped to accommodate a low-impedance microphone. Find out from the manufacturer of the high-impedance microphone you plan to purchase how much capacitance can be placed across his microphone without causing significant treble loss. Then determine how many feet of cable are permissible on the basis of the capacitance per foot of the cable you will be using. Cables with a capacitance of about 25 picofarads per foot are readily available. If your needs exceed the cable length you have calculated, then a low-impedance microphone is indicated, together with a microphone transformer. Make sure that the transformer will work satisfactorily with the microphone you have picked.

Tape Head Lubrication

Q. In one of your articles, you refer to the practice of lubricating tape heads. Could you please tell me what to use for this purpose?

A. I suggest that you obtain one of the special preparations made for this purpose and available at most audio dealers and electronic supply houses. Similarly, you may obtain preparations for the purpose of removing dirt and oxide from the heads and other parts contacted by the tape. Æ

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



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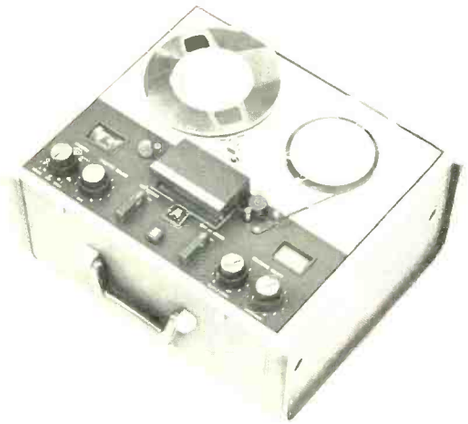
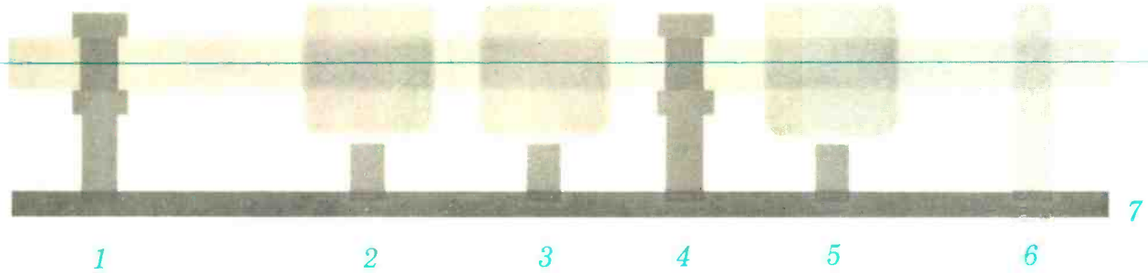
Two years in development, the new 1200 Series incorporates many of the precision tracking and narrow-track head techniques of Ampex Professional and Instrumentation recorders. The new 1200 Series makes possible the convenience and economy of 4-track recording/reproduction with full professional quality previously attainable only in 2-track.



FINE-LINE *alignment — the first high fidelity adaptation of tracking techniques and tape guidance principles used in computer and instrumentation tape equipment.* **FINE-LINE** *alignment on the 1200 Series provides full frequency response by keeping the tape track width (.043") in precision alignment with the channel width (.043") of the record and playback heads. This alignment starts the moment the tape leaves the supply reel and continues past: (1) the constant-tension holdback; (2) the new 4-track selective erase head; (3) the new 4-track record head; (4) the micro-adjusted tape guide, (5) the 4-track playback head; (6) the capstan, until the tape reaches the take-up reel. All are precision mounted on (7) a professional, micro-milled die cast frame to guarantee fine line alignment throughout the life of the recorder.*



THE FINE LINE AMPEX 1200

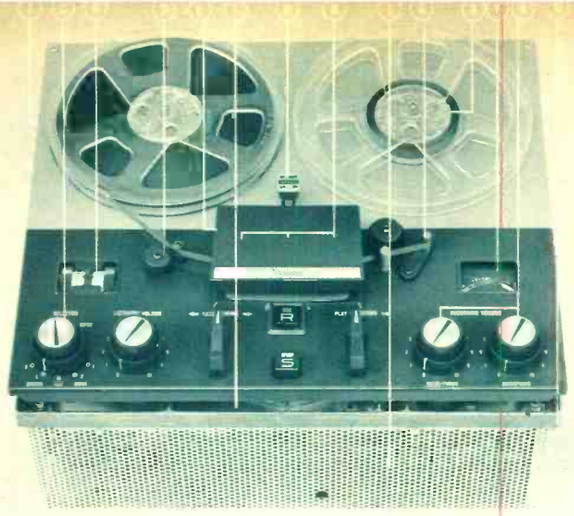
NEW PRECISION TAPE TRACKING in the 1200 Series required tracking techniques in the tape guidance system previously used and associated only with professional recorders and multi-track instrumentation tape equipment. The key to these techniques is providing perfect alignment of the tape from the time it leaves the "supply" reel until it reaches the "takeup" reel. This is lost in most 4-track recorder construction when the stamped metal plate (conventionally used in home-recorder construction) strains or warps out of alignment from the weight of the motor, clutches, flywheel, and other mechanical assemblies that hang from this top plate. The kind of alignment necessary for narrow-track recording requires the stability of a professional-type, die cast frame — micro-milled in one operation so that the tape guidance system and head assembly are mounted on the same reference plane. And that's exactly what Ampex has done in the 1200 Series. We call it **FINE-LINE** alignment. You can see it by looking under the top plate. You can hear it when you record and playback 2- and 4-track stereo tape or 4-track monophonic tape. It costs slightly more, but is lower cost in the long run. On the average, Ampex-built recorders outlive lower-cost machines two to three times.

3 NEW PRECISION HEADS — not only a 4-track record head, but a 4-track **playback** and a new selective **erase** head (essential to monophonic recording on any **one** track) have been added to the Ampex 1200 Series. To eliminate any possibility of track interference, all three of these new heads now have narrower channels (.043") to precisely match the track-width of the tape, while maintaining the famous wide recording range and longer life characteristic of Ampex recorders.

AMPEX

PRESENTS

THE FINE LINE
AMPEX 1200



The New 1200 Series includes over 170 changes in design to provide highest performance and trouble-free operation. Among the major feature and construction advantages are:

(A) **Exclusive, automatic tape take-up** — eliminates the annoying problems of hand threading.

(B) **Built-in mixer** — 4 inputs (2 mic, 2 line) for professional recording techniques.

(C) **Master selector switch** — permits **simple** changes from stereo to mono, choice of individual track, A-B comparison of original and recorded program, sound-on-sound, automatic shut-off.

(D) **Constant holdback tension** — provides equal tension throughout reel of tape.

(E) **Selective Erase Head** — permits increased monophonic flexibility with sound-on-sound, language study, etc.

(F) **Precision recording level meter** — for accurate, professional quality recording, reads both channels by simple switching — provides easy comparison and balancing of recording levels.

(G) **Exclusive "Auto-Set" shut-off** — offers choice of 2 automatic shut-off positions for unattended recording or playback.

(H) **Convenient speed change (3¾-7½)** — rugged, dependable.

(I) **Professional recording electronics** — (similar to Ampex 351 series broadcast recorder) insures professional recording quality.

(J) **Directional selective braking** — provides quick, positive stops without stretching thin-base tapes.

(K) **Heads** — separate erase, record, playback for optimum performance in each function.

(L) **Tape transport** — a precision **system** of constant-holdback tension, powerful 4-pole uniform-speed motor, and capstan assembly provide mechanical specifications (wow & flutter) comparable to broadcast recorders.

(M) **Die cast frame.**

(N) **Tape position indicator.**

SPECIFICATIONS

The Ampex 1200 incorporates the widest range of abilities ever built into a single unit:

RECORDS 4-track stereophonic
4-track monophonic

PLAYS 4-track stereophonic
2-track stereophonic
4-track monophonic

SPEEDS records and plays at 3¾ and 7½ ips with up to 8 hours, 32 minutes of monophonic recording or playing.

RECORDING INPUTS: High impedance inputs (radio—phono—TV—auxiliary). Approximately 0.25 v rms for maximum normal recording level; high impedance (600μv) microphone inputs.

PLAYBACK OUTPUTS: Approximately 0.75 volts rms from cathode follower with tapes recorded to maximum normal recording level.

FREQUENCY RESPONSE: 50-15,000 cps ±2 db at 7½ ips; 50-8,000 cps ±2 db at 3¾ ips.

SIGNAL-TO-NOISE RATIO: Better than 55 db at 7½ ips; Better than 50 db at 3¾ ips.

FLUTTER AND WOW: Under 0.2% rms at 7½ ips; Under 0.3% rms at 3¾ ips. (Measured according to American Standards Association.)

TIMING ACCURACY: Perfection of pitch to within ⅓ of a half-tone.

HEADS:
Manufactured to the same standards of precision that exist in Ampex broadcast and recording studio equipment. Surfaces are lapped flat within 10 millionths of an inch, resulting in uniform performance characteristics throughout the life of the head. Stereo head gap alignment: the one head gap in the stack with respect to the other is held within 20 seconds of arc, equivalent to less than 10 millionths of an inch — a degree of precision achieved through use of a unique process involving micro-accurate optical measurements within a controlled environment. Head gap length is 90 millionths of an inch.

DIMENSIONS: Portable cases 9" x 15" x 17½". Unmounted recorder 13" x 6⅛" depth below top plate, 1⅜" above. Recorder weight 36 pounds.

POWER REQUIREMENTS: 117 volts, 0.9 amperes, 60 cps (recorder); 117 volts, 0.5 amperes, 60 cps (amplifier-speaker).

SPECIFICATIONS STANDARDS:

(1) These technical specifications accurately reflect the true performance of every unit off the production line. not a hand-picked sample.

(2) These are professional specifications. measured by professional equipment standards and instruments and are comparable to those used in broadcast and recording industry.

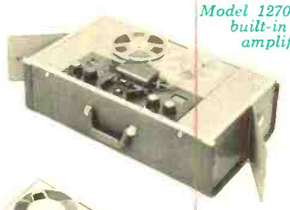
As such. most of these ratings are conservative and individual units may be found to exceed these published specifications. These specifications are not comparable to "sales literature specifications" often used in consumer recorder merchandising.

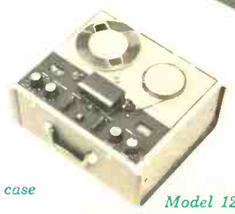
THE FINE LINE
AMPEX 1200

Ampex adds a major contribution to 4-track recording and reproduction with the introduction of FINE-LINE alignment in the 1200 series 2- and 4-track stereophonic and 4-track monophonic tape recorder/reproducers

Model 1260 with pair of matching Ampex Amplifier-Speakers (2010)

Model 1270 — Portable with built-in matched pair of amplifier-speakers





Model 1250 — Without case (not shown)

Model 1260 — Portable

AMPEX

THE FINE LINE
AMPEX 1200

AMPEX AUDIO COMPANY • Sunnyvale, California

Tape Copying—Home Style

R. A. JOSS*

The ordinary tape recorder can copy all program sources—except tape. With the modifications described herein the Ampex 960 can copy mono or stereo tapes and the principle is probably applicable to most three-head machines.

WHEN I FIRST got my Ampex 960 I figured I had it made. I could now tape everything—mono and stereo records, mono and stereo FM-AM broadcasts, TV sound, and, of course, I could make live recordings via a microphone. It wasn't long afterwards that I realized that one sound source available to me could *not* be copied on the Ampex—other tape recordings.

The solution was simple: buy a tape deck to use for copying. But this was out of the question as my budget had already been severely strained to buy the Ampex. Also I doubted that inexpensive tape machines would give me the quality I wanted. Furthermore my preamp lacked a tape-head input, which would mean buying a deck with built-in preamp, making its cost even higher.

So What to Do?

An examination of the circuit diagram of the Ampex revealed an interesting possibility. The circuit parameters of the microphone preamps on the recorder were almost identical to those of the playback head preamps. Might it not be possible to add switchable equalization to the microphone preamps so that "flat" equalization could be selected when using microphones, and NAB equalization with a tape head connected. This was done on the left-hand channel using a 560 μf capacitor and a potentiometer with a SPDT switch, the shaft of the control extending out the side of the machine. With the switch in the "off" position, "flat" equalization was provided for the microphone; and in the "on" position, NAB equalization was provided, with variable treble rolloff controlled by the position of the potentiometer. To my surprise (since I am not all *that* knowledgable about electronics) this seemed to work fine, so the next step was to obtain a Viking FF 75 tape deck *sans* heads. A little judicious scouting around the local Ampex dealers located a traded-in Ampex two-track stereo head which I purchased for a nominal sum, an aluminum mounting bracket was made up and the head installed and carefully aligned on the FF 75. Either track gave good quality output through the left-hand modified microphone input of the Ampex, there was lots of reserve gain, and the copies were (to me) indistinguishable from the originals.

Accordingly, the right-hand mike input on the Ampex was modified in the same way. But here the results were not as satisfactory. The hum level on the left-hand channel had been below audibility, even when the bass boost of the NAB equalization was added, but on the right-hand channel, as soon as NAB equalization was switched in, the hum level on that track became objectionable. It was still fine as a microphone input, however, and after changing tubes, shock mounting the electronics, and sundry other measures, I gave up and settled for mono copying only, on the left-hand channel.

This technique worked fine, with one slight drawback. There was no way to listen to the original tape, without making a recording and listening via the playback head, since on the Ampex there is no provision for monitoring the microphone inputs.

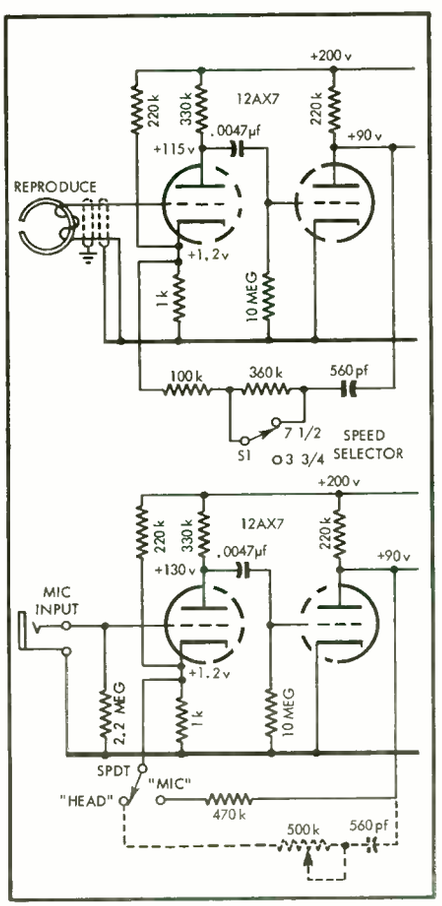


Fig. 1. Comparison of playback head and modified microphone preamps on left channel of Ampex 960. Dotted lines indicate addition.

Using One Machine

Not being able to copy stereo tapes, or two tracks in one pass, still rankled, however, and I was at loss to solve the problem. Then one day a good friend and hi-fi buff, one L. N. Stanners by name, of Quebec City, saw my set-up, was duly impressed, but made one simple observation which got me to thinking. "There's no way," he queried, "you could make copies using only *one* machine?" Suddenly, a great light dawned. After all, the Ampex had completely separate functions: record head and recording electronics; and playback head and playback electronics. If its drive mechanism could be made to drive *two* tapes, the original crossing the playback head only, and the copy crossing the erase and record heads only, and both tapes were driven by the capstan and pressure roller, it should be possible to make exact replicas, since the speeds would be identical, the playback electronics would feed a high quality high level signal to the "line" inputs of the recording amplifiers, and everything would be ticketyboo.

So, the head cover and head shield were removed, and an attempt was made to thread the original tape from the takeup reel, through the tension device, behind the head assembly, through the slot for the retaining screw of the head shield, across the playback head, through the capstan and pressure roller and on to the takeup reel. No luck. The tortuous tape path added far too much drag and stalled the capstan. So, reluctantly, the hold-back tension device was omitted and the tape threaded from the takeup reel, around the speed shift lever, in the head cover retaining screw slot and across the playback head. Despite bypassing the guide post, the tape tracked perfectly and the drive mechanism easily coped with the new tape path.

* *8103 Arcadian Road, Montreal 29, P. Q., Quebec.*

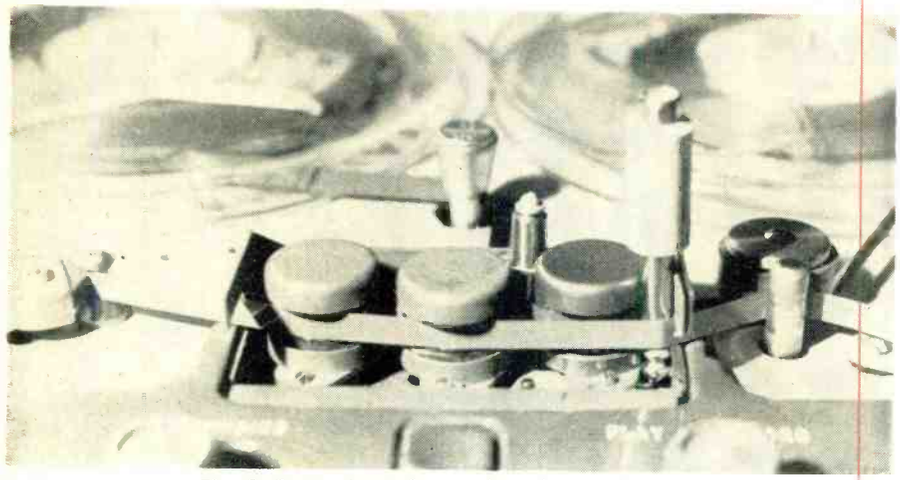


Fig. 2. Front view of tape threading technique.

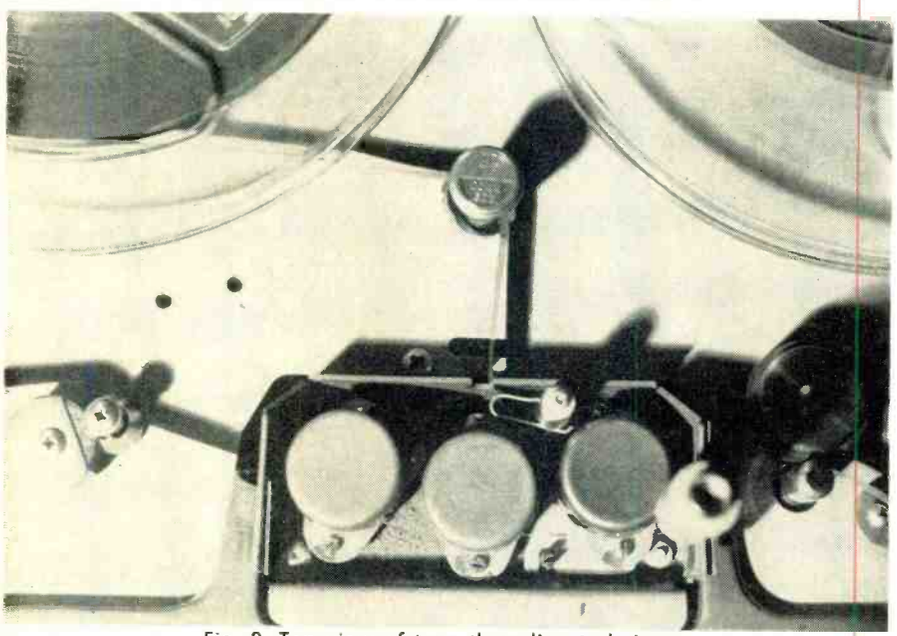


Fig. 3. Top view of tape threading technique.

Fig. 4. Over-all view of copying set-up. The Dynakit preamp was added later.

Next, a blank tape had to be threaded across the erase and record heads. The Viking was temporarily pressed into service to provide the supply reel and takeup reel for the blank tape. The blank tape was threaded through the hold-back tension device, across the erase, record and playback heads and together with the original tape as a sandwich between the capstan and pressure roller, then back to the takeup reel of the Viking. With both the Ampex and Viking in PLAY, the Ampex capstan drove both tapes perfectly with no detectable loss in speed.

Now for the moment of truth. Would the system make good copies? The outputs of the Ampex were connected to its line inputs, the Ampex placed in the record mode and a copy made by monitoring the record meter. The results? *Most* peculiar—the copy sounded as if it had been recorded in a monstrous echo chamber. A bit of experimenting with *two* recorded tapes on the rig, while I listened to the output of the Ampex, showed what was wrong. The original set-up had both tapes in contact as they passed across the playback head. Hence, *both* tapes reproduced, the outer tape at slightly lower level than the inner, but quite distinctly. It became obvious that the "copy" tape would have to contact the erase and record head, but bypass the playback head before passing through the capstan and pressure roller sandwiched against the original tape. The tape geometry was now getting a little complicated, but it was found that the copy tape had to be *just* out-of-contact with the original tape as they passed over the playback head, and a phone plug inserted between the tapes just past the playback head gave sufficient separation. (Any polished shaft of the right diameter would have sufficed—the phone plug just happened to be handy.)

Success

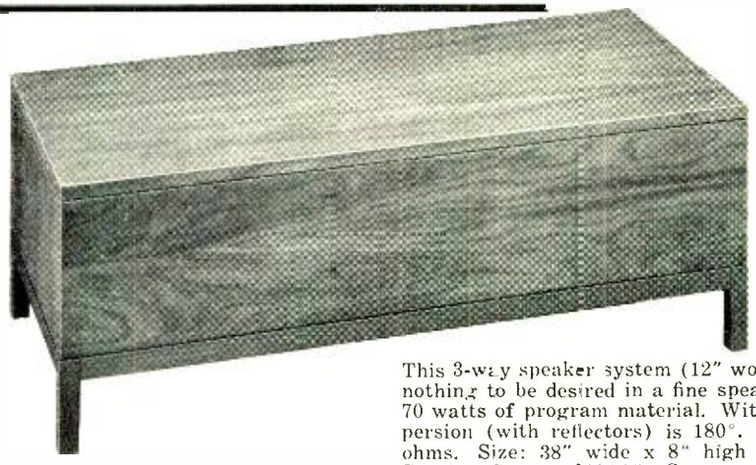
My efforts were crowned with complete success. High quality tape duplicates could easily be made—the only slight problem being insufficient holdback tension on the supply reel on the Ampex. This was solved by inserting a piece of felt between the plastic reel and the top plate of the machine to provide a little drag on the reel.

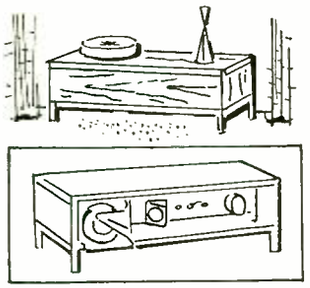
The final problem I set myself was to see if the Viking deck could be completely eliminated. (Now only its supply reel and takeup reel were being used for the copy tape.) Replacing the supply reel with a free running spindle was no problem, but what about takeup torque for the takeup reel? Well, was a takeup reel really necessary? Answer—No, it wasn't. The copy tape could be arranged to spill on the floor and then recovered by moving the empty supply reel to the Ampex takeup reel, threading the final end of the copy tape through the capstan and pressure roller and putting the machine in PLAY. No tangles, no snarls, but I would not recommend trying FAST

(*Continued on page 48*)

NOTICE!

No grille cloths, no visible speakers, nothing to mar the striking beauty of this genuine furniture!



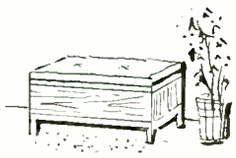


M-2-38 in an M-2-40 Bench

This 3-way speaker system (12" woofer, 8" midrange and 3" tweeter) leaves nothing to be desired in a fine speaker system. Power handling capacity is 70 watts of program material. With two systems in tandem for stereo, dispersion (with reflectors) is 180°. Full crossover network. Impedance: 16 ohms. Size: 38" wide x 8" high x 16" deep. Available in utility form. Speaker System $124.95. Contemporary Bench, Oiled Walnut Finish $69.95

RAVENSWOOD

"Reflection Coupler" Speaker Systems* reflect sound from rear of cabinet, transforming your wall into a concert stage!



M-2-22 in an M-2-24 Bench

A three-way speaker system (12" woofer, 8" midrange and 3" tweeter) designed to reproduce the full range of audible frequencies with minimal distortions. Power handling capacity is 50 watts of program material. With two systems in tandem for stereo, dispersion (with reflectors) is 180°. Full crossover network. Impedance is 16 ohms. Size: 22" wide x 8" high x 16" deep. Available in utility form. Speaker System $74.95. Contemporary Bench, Oiled Walnut finish $49.95

M-5000

Luxurious performance, completely without compromise, this model combines the very best of components (12" woofer, 8" midrange and 3" tweeter) to satisfy the most critical listener. Power handling capacity is 70 watts of program material. With two systems used in tandem for stereo, dispersion (with reflectors) is 180°. Full crossover network. Impedance: 16 ohms. Size: 28½" wide x 16" high x 7" deep. Available in utility form (flat black) or finished in oiled walnut. Utility $124.95, Oiled Walnut $144.95

UNSTEREOTYPED STEREO

SPEAKER SYSTEMS

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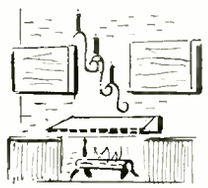

M-500

A complete three-speaker system (8" woofer, 8" midrange and 3" tweeter), this model covers the audible range with fullness and accuracy. Power handling capacity is 50 watts of program material. With two systems in tandem for stereo, dispersion (with reflectors) is 180°. Impedance is 16 ohms. Full crossover network. Size: 24" wide x 16" high x 6½" deep. Available in utility form (flat black) or finished in oiled walnut. Utility $74.95, Oiled Walnut $94.95

** Patent Applied For*

M-50

Ultra-compact, this two-speaker system delivers a range that is hard to believe. Power handling capacity is 35 watts of program material. With 2 systems in tandem for stereo, dispersion (with reflectors) is 180°. Full crossover network. Impedance: 16 ohms. Size: 20" wide x 16" high x 6" deep. Available in utility form (flat black) or finished in oiled walnut. Utility $44.95, Oiled Walnut $54.95

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AM-FM Stereo Tuner, T-1000, $99.95
Stereo Pre-Amp and AM-FM Tuner, TCC-2000, $249.95
Stereo Power Amplifier, 30 watts per channel, PA-2000, $99.95
Stereo Power Amplifier, 65 watts per channel, PA-3000, $199.95

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A Transistor Protector

GEORGE FLETCHER COOPER

Thermal runaway is the culprit which will destroy a transistor unless the circuit is properly designed. The circuit protector described here takes advantage of the high collector impedance of a transistor to maintain relatively constant current.

IN THE CHANGEOVER from tubes to transistors most of us have found it necessary to get used to the hard and bitter fact that transistors are not indestructible. Even though you may not have to pay for them yourself this can be rather annoying—and I would imagine that when it is your own money which vanishes in a few milliseconds you would feel that "rather annoying" is not sufficiently strong. Total failure may be the result of doing something quite stupid, of course, in which case there really is nothing more to be said but there are some circuits which start off behaving quite normally and then . . . well then it is just too late.

Thermal Runaway

The basic effect which can land you round at the bank asking for a loan is, as you no doubt realize, thermal runaway. In general, this is a danger when the circuit you are using is one which is designed to let you get as much power as possible from a particular size of transistor, which very often means either a class-B amplifier or an inverter. These circuits are not easily made inherently stable because, for one reason, making them stable usually means a severe limitation of their output. Some of them have the rather unpleasant characteristic that they are most dangerous at some particular signal level, not when they are first set up.

Thermal runaway is the result of the fact that the collector current in the zero bias condition changes very quickly with junction temperature. Typically the grounded-emitter current with base open-circuited may increase by 8 times in going from 25-deg. to 45-deg. Centigrade. When your luck is out you may get the junction up to a temperature at which there is so much current that more heat is being generated in the transistor than is leaking away, so it gets hotter and. . . When you open up a wrecked transistor and look at the size of the germanium die you will see why the whole process takes place very quickly.

Users of power transistors take it for granted that they must mount the transistor on a large heat sink to help to keep it cool. For small transistors I have found it convenient to use two different types of heat sink. One is a simple radiating flag, made by cutting out a rectangle of aluminum, say 1/32-in. thick, and about 1½-in. by ½-in., and rolling one end of this into a cylinder—a drill forms a suitable mandrel—which will slip over the transistor. This is the form shown by some transistor manufacturers.

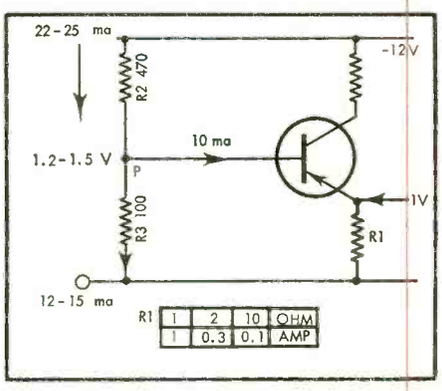

Fig. 1. The transistor protector drawn as an amplifier.

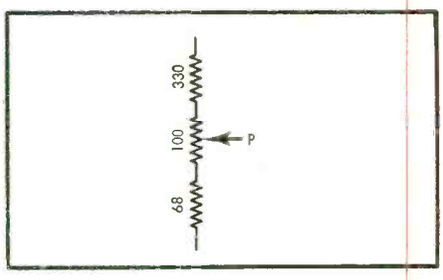

Fig. 2. To deal with a range of beta values, the bias chain R2 R3 includes a potentiometer as shown.

The other is more massive and consists of short sections of aluminum bar into which holes are drilled. Some silicone grease is put into the hole and the transistor, which should fit fairly closely, is then pushed in. These have the advantage of providing more mass and slowing everything down.

A recent painful experience in which two flagged transistors in a finished piece of equipment proceeded to "walk away briskly" so that the meter could be seen swinging firmly but, as it turned out, inexorably towards the destruction point led me to decide that prevention was better than retardation. Oddly enough we already have prevention up in the 15–25 amp class by the use of a special trigger circuit so that I chose, rather arbitrarily, a limit of 1 amp for the protector. There is nothing really special about this limit, however, and you can extend the principle up to higher currents if you wish, though each protector circuit will only have a limited range of currents over which it will work. The reason is that you need to use a big transistor if you mean to pass 25 amps and you cannot safely or wisely use this size of transistor down in the milliamp region.

Mostly we work with 12-volt supplies, with the battery permanently connected to the charger so that the terminal volts are up around 13–14 volts. This is only material if you are anxious to use the protector on 24–28 volts, when you must use a transistor with a higher voltage rating. Fortunately this is one of those simple circuits in which you do not have any difficulty in choosing a suitable type of transistor. I happen to have chosen one of the Clevite Spacesaver units (CST 1739-43) which will pass 3 amps and stand 20 volts in any condition you care to name.

The Basic Circuit

The basic principle of the circuit is very simple. The current through a transistor is almost independent of the collector voltage. Examining the data sheet through a magnifier it looks as though, for the CST 1742 and 1743, the collector current rises from 0.9 amps at 0.5 volts collector-emitter voltage to 1.0 amps at 15 volts collector-emitter voltage when the base current is 10 milliamps. If, then, we start with a 13-volt supply and a load which wants to take about 1 amp connected in the collector, we shall only drop about half a volt in the transistor and we shall get 12.5 volts across the load. Suppose, however, that at about 12 volts the load attempts to take 2 amps. This is not permitted, and the control transistor offers it only 1 amp, which means that there will only be 6 volts across the load while the control transistor drops the remaining 7 volts. And if the load is a short-circuit, well, the

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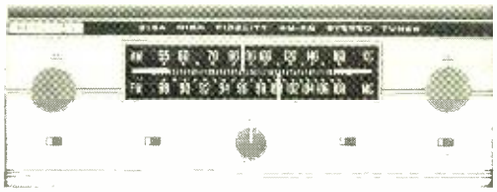

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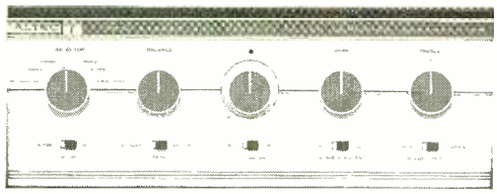

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control transistor will still only pass 1 amp although it has 13 volts applied to it.

Perhaps we should look at the circuit diagram in *Fig.* 1. It is arranged here to look like a conventional amplifier because this makes it easier to follow. The emitter resistance R_1 is chosen to give 1 volt drop at the rated current so that for 1 amp we have $R_1 = 1$ ohm and for 100 milliamps we have $R_1 = 10$ ohms. You can, I hope, work out other values for yourself though I do not recommend you to go beyond $R_1 = 100$ ohms, corresponding to a current of 10 ma. A suitable set of resistors is then assembled on a switch.

Consulting the maker's curves I find that V_{be} is likely to range from 0.2 to 0.5 volts, from which I see that I must hold the base, point P on the R_2R_3 chain, at around 1.2–1.5 volts. Obviously I do not want any thermal runaway trouble with this transistor, so I make R_3 fairly low, and I have chosen initially a value of 100 ohms. The current through R_3 is then about 12–15 milliamps. For the CTP 1742 and 1743 there will be around 10 ma flowing into the base when the collector current is 1 amp, so that the total current in R_2 will be 22–25 milliamps. For a supply of around 13–14 volts the drop across R_2 must be about 12 volts and this will give us as the nearest standard value $R_2 = 470$ ohms.

This simple circuit is just a straightforward amplifier without very much negative feedback and is therefore rather dependent on the beta of the transistor. I have accordingly modified the base bias circuit to the form shown in *Fig.* 2, with P now connected to the slider of a potentiometer which can be used as a continuous control for the current. This is treated rather as a trimmer and can be left alone in the early stages of operating a breadboard, or else you can use the operating procedure I shall describe later. You can see immediately that if the current could increase by about 20–50 per cent of its selected value the transistor would be reverse biased by the emitter drop, so that this circuit will probably hold the current to around 10–20 per cent of the wanted value. It is not worth while calculating or measuring this exactly because all we are after is something to hold down a device which will take ten or more times the prescribed current if it gets into trouble.

A refinement to this system which I should introduce if I were designing it to sell is a simple indicator circuit. The circuit of this is shown in *Fig.* 3. Under normal conditions the collector of the control transistor is bottomed so that the voltage is around −1.5 volts. The Zener diode in the coupling to the indicator transistor is chosen to have a drop of around 4 volts although this is not frightfully important. With everything operating properly then, the Zener diode will not have enough volts across it to make it conduct and the second transistor will be cut off. When the conditions are abnormal the control transistor must drop enough volts to keep the current limited and the collector voltage will move towards −12 to −14 volts. As soon as it reaches −4 volts the Zener diode can pass current and thus current can be driven through the limiting resistor into the base of the indicating transistor.

The collector load of the indicating transistor is a 12-volt lamp bulb taking as little current as possible. I am not sure if it is easy to get anything below 50 ma. As the indicator transistor is made to conduct, this bulb will light up to show you that things are not what they should be. For a 50-ma bulb the

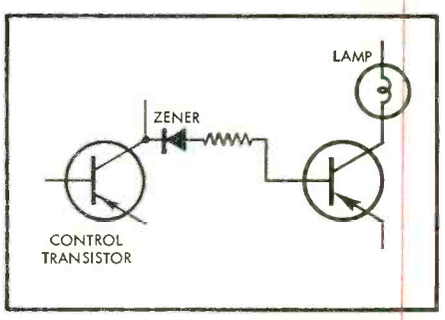

Fig. 3. An indicator added to the control transistor is a refinement.

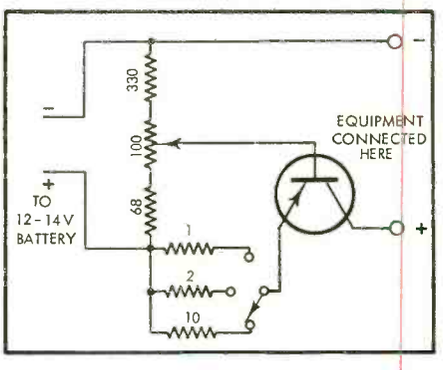

Fig. 4. The circuit as it appears to the user.

control transistor needs to be able to pass this current, of course, and it must also be able to dissipate 150 mw when halfway on. It will be prudent to put in 100–200 ohms emitter resistance, while the base resistance will probably be around 4700 ohms though this depends on the beta of the indicating transistor. This section of the device is, as I have said, strictly for amusement only and should be tailored to whatever transistor and lamp you find the most convenient.

Building the Protector

As usual I have been more interested in how the system works than how you make it. Now we must turn to the hardware. If we limit ourselves to 2 amps, since that is getting towards the limit of the transistor I have considered, the worst condition we can encounter is when the load is a complete short circuit. The internal dissipation in the control transistor will then be around 25 watts. The thermal resistance of the Clevite Spacesaver transistors averages 1.4° C/W but may be as high as 2.5°C/W. We cannot expect to get the external heat sink down below 1.5°C/W, so the thermal resistance may be 4°C/W. In an ordinary room at 25-deg. C, the 25 watts we are putting in under emergency conditions will then bring us up to 125-deg. C at the junction. This is far too high.

I carried out this exercise because it is very tempting to try to take 3 amps through a transistor rated at 3 amps. In fact we must limit this particular circuit to something around 1 amp, giving us 12 watts dissipation in the worst condition and a consequent temperature rise to around 75 deg. C. A check of the leakage current-temperature curves shows that we shall not be in any trouble here, as the leakage current will be less than 20 ma.

The heat sink for 1.5°C/W is nominally a 6-in.-square sheet of aluminum 1/16-in. thick. The transistor is best insulated from this and the edges of the sheet bent round to protect the shell from accidental connection to ground. I used an available box, about 4-in. cubed, and folded the edges of the transistor plate down about 1-in. all round so that it fits into the bottom of the box and leaks some more heat away into this skin. Ventilating holes allow the air convection currents to flow over the main plate and the box lid carries the switch for selecting values of R_1, the trimming potentiometer and the terminals. The circuit as it looks to a user is shown in *Fig.* 4. It is exactly the same circuit as *Fig.* 1 but redrawn to emphasize the construction rather than the fact that it is basically an amplifier. Somehow I find that by arranging a circuit in a conventional form it is easier to understand.

Using the Protector

When using this protector the first step is to connect the ammeter or milliammeter in series with one of the output terminals and then short circuit the pair of wires which will go to the apparatus. This will enable you to trim the base potentiometer to the design current you want. Again, you could fit meter and switch to the unit, but it is rather a matter of taste which I leave to you. Having set up the device there really is no more to it except to put a voltmeter across the terminals and get to work. So long as the voltmeter shows around 12 volts you know that the equip-

(*Continued on page 81*)

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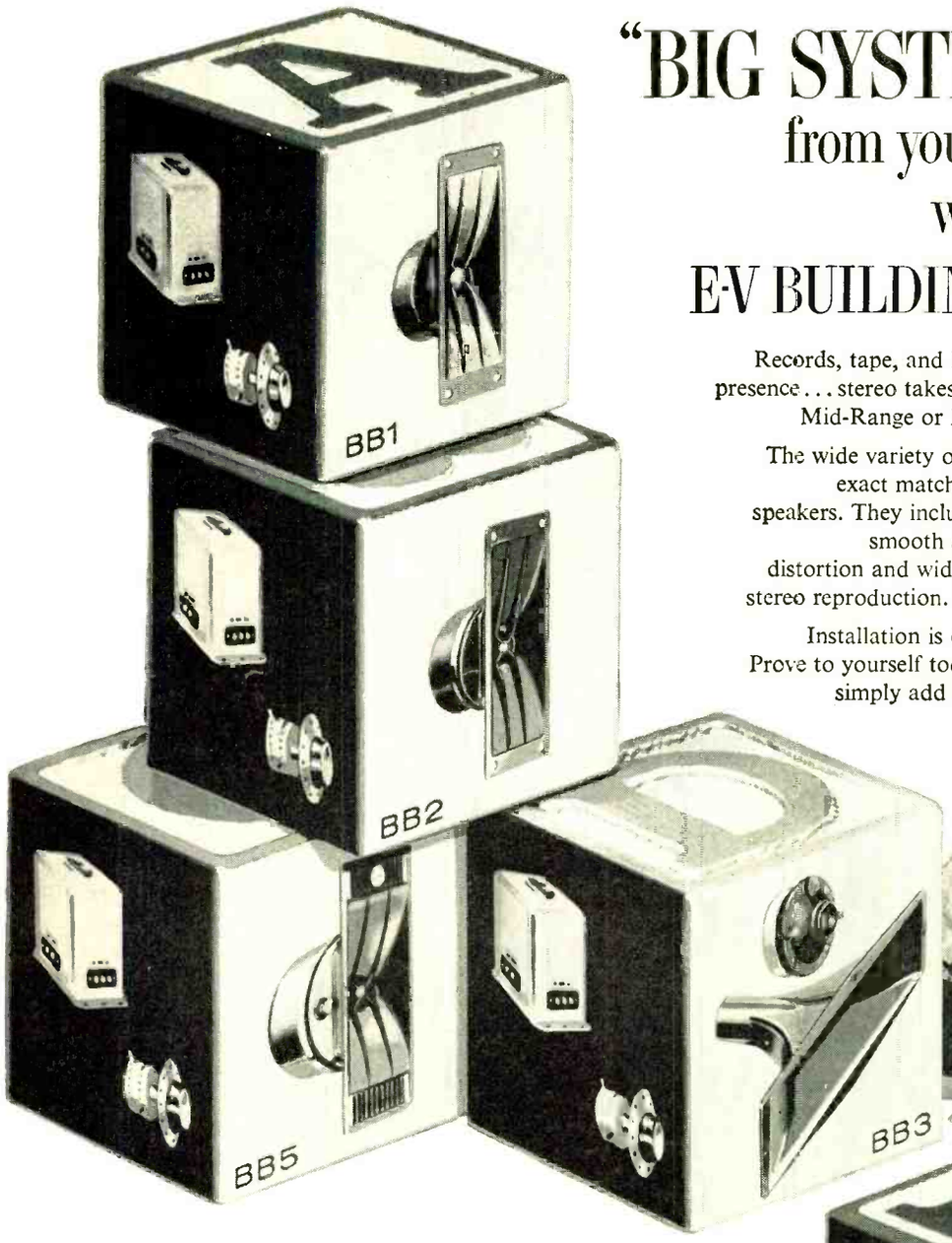

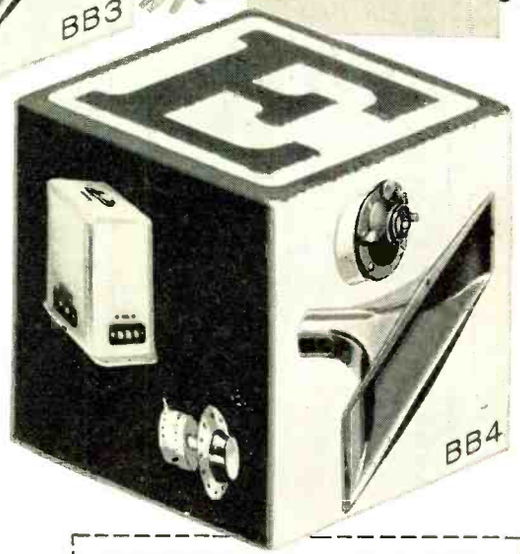

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Equipment Failure Alarms

ALLAN M. FERRES*

A failure alarm will prevent expensive and embarrassing "down time" for equipment which operates without constant supervision.

ELECTRONIC EQUIPMENT can be designed and built with a high degree of reliability. Failures, however, still do occur. Unless the equipment is continually monitored, some time may elapse before the failure is detected and appropriate corrective action started. This undiscovered "down" time of the equipment can be both embarassing and expensive.

Described here are three failure alarms, flexible enough in design so that they can be used with several types of equipment under various conditions. These alarms will activate a buzzer or other warning device when the equipment to which they are connected fails. Corrective action can then be started without undue delay.

The alarm buzzer should be powered by a battery so that a failure of the alarm unit's power supply, or its a.c. line, will not prevent the buzzer from sounding. Under usual conditions, the operating life of the battery is equal to its shelf life. Two of the circuits are arranged so that a tube or other part failure in the unit will cause the alarm to sound. This "fail safe" design adds considerably to the reliability of the warning system.

Figure 1 is the circuit of an alarm used to monitor a 24-hour-a-day recorder. This tape machine is fed from a tuner to provide a continous off-the-air check of a broadcast station's program material. It can be used to monitor any continually operated amplifier or tuner.

When no signal is applied to the input of the unit, the bias provided by *R8* and *R9* cuts off *V2b*, and the normally closed contacts of the relay remain closed. These contacts are wired, through *S1*, to operate the alarm buzzer. The output of the recorder or amplifier to be monitored is connected to the input terminals of the alarm. This output is amplified by *V1* and then fed to *V2a*, a power detector. The signal voltage causes the cathode of *V2a* to become more positive and this cathode voltage, applied to the grid of *V2b*, overcomes its cut-off bias. *R7* is a grid-current limiting resistor. When *V2b* draws plate current, the relay operates, opening the normally closed contacts and the alarm buzzer circuit.

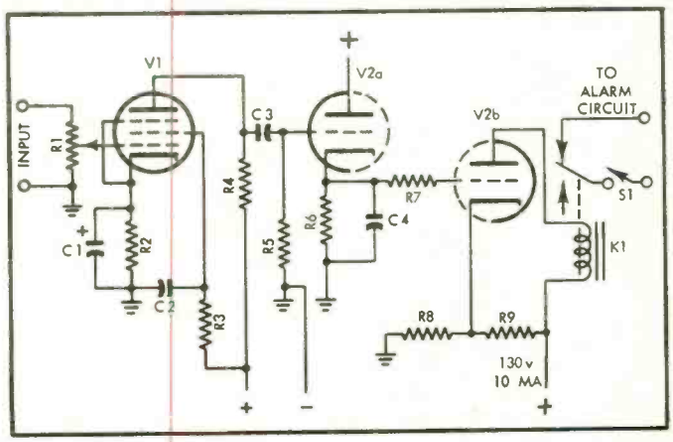


Fig. 1. Alarm for a 24-hour-a-day recorder.

If the input signal falls below a predetermined level, the relay drops out and the alarm sounds. The time constant of *R6* and *C4* provide a ten-second delay before the alarm sounds after the dropping of the input signal. This prevents the normal pauses in a radio broadcast program from sounding a false alarm. If a longer time delay is required, the capacity of *C4* should be increased. If a balanced line is to be monitored, a suitable bridging transformer, of course, must be added to the input circuit.

With *R1* set at maximum, the sensitivity of the unit is high enough so that a signal of 12 mv or greater will prevent the alarm from sounding. The relay will drop out if the signal level falls to 4 mv.

The ratio of pull-in and drop-out signal voltages can be controlled by adjusting the relay armature spring.

To set up the failure alarm for operation, connect the input terminals across the output of the amplifier to be monitored, and set the input level control, *R1*, full on. Feed a tone into the amplifier and adjust its level so that the minimum acceptable signal voltage appears at the output of the amplifier. A level 20 db below the normal operating level is usually satisfactory. Slowly reduce the setting of *R1* until the alarm sounds. The unit is now ready for use. The alarm will stop as soon as normal program level is fed through the amplifier.

If it is necessary to change the output level of the amplifier frequently, adjustment of the alarm unit can be made more quickly if *R6* is shunted by a 1.0 μf capacitor and a switch connected in series with the positive lead of *C4*. Opening this switch will eliminate the ten second delay while the unit is being adjusted.

Figure 2 is the circuit of a carrier failure or Conelrad alarm. It was designed to be used with a receiver in an

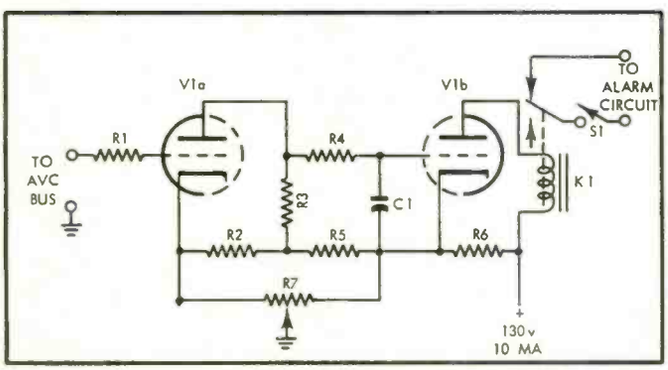
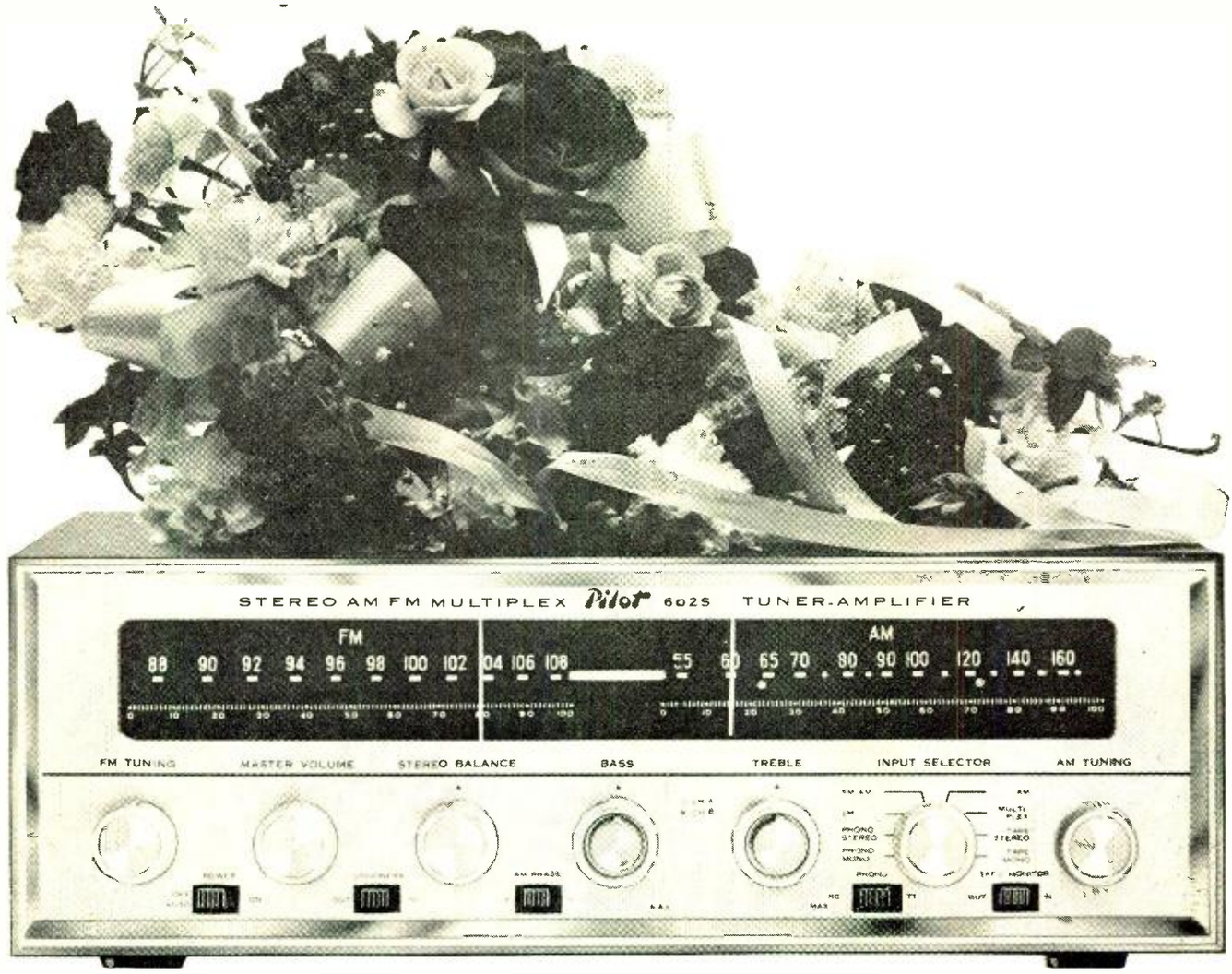


Fig. 2. Carrier failure or Conelrad alarm.

* *Dark Hollow Road, Tinicum, Penna.*



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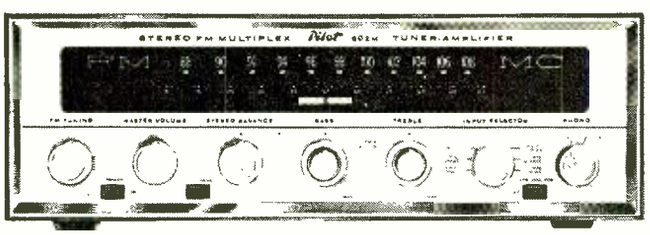

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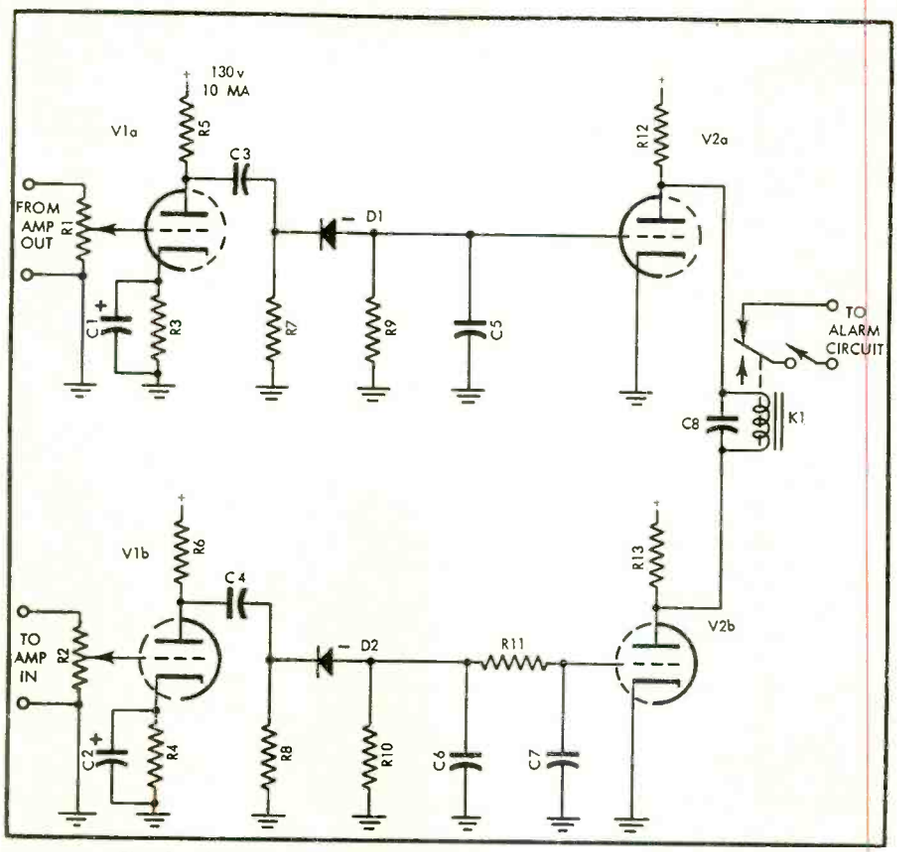

Fig. 3. Alarm for amplifiers which are not in constant operation.

electrically noisy location. The local noise level was so high that the a.v.c. voltage produced by the transmitter carrier was only slightly greater than that produced by noise when the carrier failed. This design is necessary because most carrier alarms are not sensitive enough to detect small changes in a.v.c. voltage. It can also be used with receivers which do not produce enough a.v.c. voltage on weak signals to operate other types of alarms. Its sensitivity is such that only a 0.5 volt change in control voltage is required for reliable operation, and it can handle a wide range of a.v.c. voltages. Its use does not upset the normal operation of the receiver.

The input of the unit is connected to any convenient point on the a.v.c. bus of the receiver. The negative-to-ground voltage, which is developed on the bus by the received carrier, is applied to the grid of *V1a*. A positive-to-ground voltage is applied to the cathode of *V1a* by *R7*. *R7* is adjusted so that *V1a* justs cuts off. For example, if the grid receives a minus 15 volts from the a.v.c. bus when the carrier is tuned in, *R7* is set to provide a positive 14 volts on the cathode. This places the grid 1 volt negative, with respect to the cathode, cutting off the tube.

With *V1a* cut off, there is no voltage drop across its plate load resistor, *R3*. Then bias on *V1b* is only the 0.75 volts developed across *R5* and the tube draws enough plate current to pull in the relay. The relay contacts are wired to the alarm buzzer so that the alarm is silent with the relay pulled in. When the carrier goes off the air, the voltage on the grid of *V1a* is less negative and current flows through its plate load resistor. This produces a voltage drop across *R3* which is negative at the plate end of the resistor. As *R3* is in series with the grid circuit of *V1b*, it is cut off and the relay drops out, sounding the alarm.

R4 and *C1* are used to provide a ½ second delay in the operation of the relay so that instantaneous carrier breaks, which might be caused by areovers at the transmitter, will not operate the alarm. If these short carrier breaks are to be monitored, *R4* and *C1* can be omitted.

If the alarm is used with a transformerless receiver, an isolation transformer *must* be used in the power line cord of the set. The receiver's B-minus lead should be connected to the receiver chassis, then this becomes the ground point which is connected to the alarm unit.

To set up the alarm for operation, tune the receiver off the carrier to be monitored (and off any other station), and slowly turn *R7* from its cathode end to the point where the alarm sounds. When the carrier is tuned in, the alarm will be silent.

The alarm unit shown in *Fig.* 3 is used with amplifiers which are not in constant operation. It was designed for use with a remotely controlled tape machine used for making short radio spot announcements. It can also be employed with banks of tape machines used for tape duplication, or with power amplifiers of paging and music systems.

The input to the equipment to be monitored is amplified by *V1b*, rectified by *D2* and this rectified voltage is used to cut off *V2b*. The output of the equipment is similarly amplified by *V1a*, rectified by *D1* and cuts off *V2a*. When both an input and output voltage are present, both sections of *V2* are cut off, and there is no difference of potential between the plates of *V2*, relay *K1* does not pull in. When there is neither an input or output signal, both sections of *V2* are drawing maximum plate current and still no voltage appears across the relay. If a signal is fed into the equipment, and, due to some circuit or operating fault, no signal appears at its output, *V2* is cut off, *V2a* draws maximum plate current. This places a voltage across the relay and it pulls in, operating the alarm circuit.

When this alarm is used with a tape machine having separate record and playback heads and amplifiers, *R11* and *C7* must be added to the circuit if a momentary operation of the alarm is to be avoided at the start and end of each recording operation. Due to the spacing of the record and playback heads, a delay exists between the time the signal is fed into the record amplifier and the time the recorded signal appears at the output of the playback amplifier. At the end of each recording an equal time delay exists between the end of the recording signal and the end of the played-back signal. The length of this delay depends upon the tape speed and the spacing between the heads. *R11* and *C7* delay the operation of the relay by the input signal long enough to prevent the alarm from sounding when a recording starts and stops.

The values of *R11* and *C7* must be determined by experiment for each type of machine and tape speed. The values listed are suitable for an Ampex 350 operating at 7½ ips where the delay is about 0.25 seconds.

To place this alarm unit in operation,

(*Continued on page 82*)

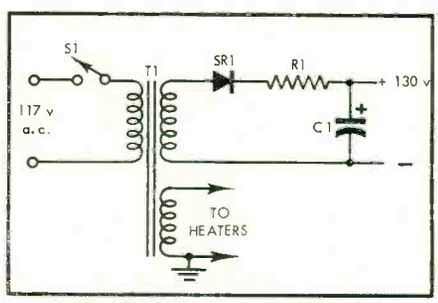

Fig. 4. Power supply adequate for any of the failure alarms.

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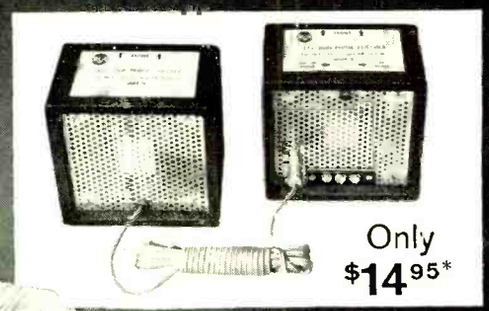

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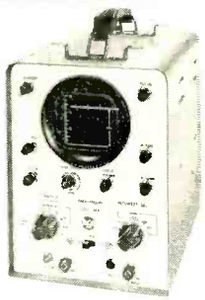

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HAROLD C. MANGELS (and wife)*

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Fig. 1. Front view of the system.

THIS-DO-IT-YOURSELFER and his wife became interested in building a component high-fidelity system as a natural adjunct to their interest in doing-it-themselves and in music. In their own words, "We chose a hobby which we both could enjoy creating, planning, and finally listening" By planning each step carefully, they assembled a stereo system which consists of an EICO HFT90 tuner kit, a Harman-Kardon Citation I preamp kit, a Dynakit Stereo 70. a pair of Bozak 207-A's plus matching enclusures. and a Bell stereo tape deck They also have a "center" channel consisting of a Pilot amplifier and a Jensen speaker

Of course these selections are clearly related to their do-it-yourself orientation—almost all of the electronic components were kits and were built as a family project They also built the enclosures for the Bozak speakers Finally, they devised the ingenious method for enclosing the system shown on this page

They installed their system in two hanging cabinets, each one 4-ft long and 12-in deep. Instead of rigidly fastening these cabinets to the wall, they hung them on door hinges so that the components would be readily available for servicing

The left cabinet contains the Dyna anplifiers, a utility cabinet, the Pilot center amplifier, and the Jensen center speaker The right cabinet contains the EICO tuner, the Harman-Kardon Citation I preamp, the Bell tape deck, and provision for tape storage

The Mangels are true audiofans—they are already thinking about their next system. In their own words, "As happy as we are with our system, we are already planning improvements. Perhaps an improved tape deck, maybe multiplexing, or possibly the new Bozak midrange speaker" Æ

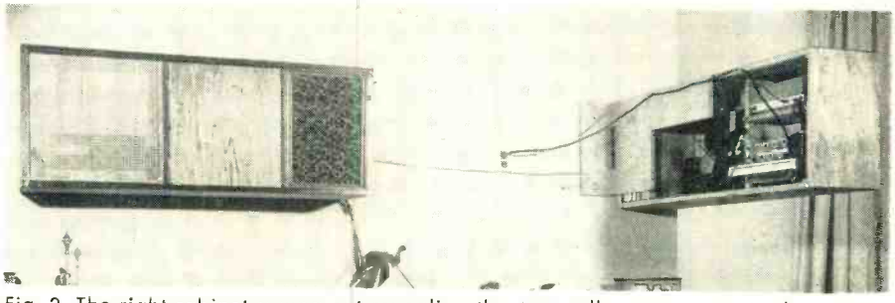


Fig. 2. The right cabinet swung out revealing the unusually easy access to the components.

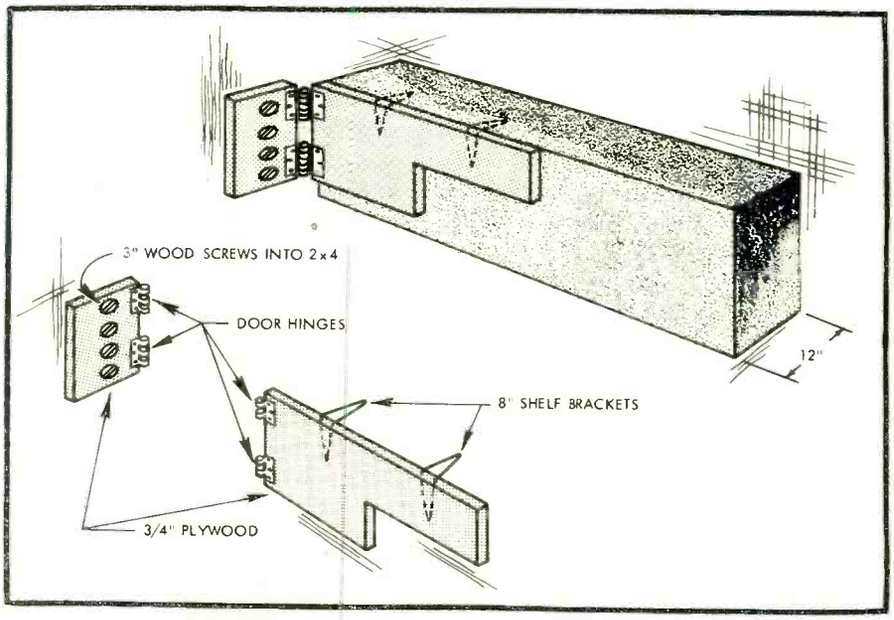


Fig. 3. Drawing showing how the right cabinet is mounted. The hinge for the left cabinet is mounted in a similar manner on the left end of the cabinet.

* *4196 E. 9th Lane, Hialeah, Fla.*

HOW TO BUY YOUR FIRST (OR YOUR LAST) SPEAKER SYSTEM

If you demand magnificent sound . . . undistorted bass to beyond the limits of audibility—if you demand superb cabinetry and decor flexibility (with five interchangeable grille frames that snap on and off to match *any* decor) . . . then consider the unique University Medallion XII 12" Three-Way Speaker System. Medallion owners *stay* Medallion owners. Let's look inside the Medallion and see why.

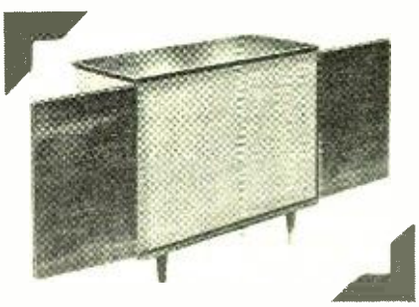
Integrated within its precisely-matched cabinet are three superlative speaker components: the 12" high compliance woofer that delivers bass frequencies down to the very threshold of feeling; a newly-engineered 8" speaker to assure you of all-important mid-range *impact;* and the Sphericon super tweeter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

compare
UNIVERSITY
(in every price category) against all other brands

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

Amplifier requirements? Any amplifier capable of delivering a modest ten clean watts. Medallion dimensions? Only 24" x 17" x 11¼" deep. Available with or without base—for use as highboy or lowboy. Finishes? Walnut, oiled walnut, fruitwood, mahogany *and* unfinished for custom installations. And the Medallion is the world's *only* system with "select-a-style" snap-on grilles. Want to change your decor at some later date? The Medallion stays where it is—all you change is the grille! In Contemporary, Italian or French Provincial, Colonial and Swedish Modern. Medallion prices start at $139.95, without grille. Grilles from $9.95. Base, $14.95.

Write for University's "Informal Guide to Component High Fidelity," Desk R-12, University Loudspeakers, Inc., White Plains, New York.



For a solution to a *really* difficult space problem, investigate the TMS-2 *single* cabinet stereo speaker system.

For bookshelf speaker systems with astounding 'big system' sound, look into University's RRL speaker systems.

UNIVERSITY

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TIMELESS BEAUTY AND THE SOUND OF TRUTH

SIGNAL SAMPLING

(*from page 28*)

The action so far is this: With no input signal, the *grid* of V_{3b} is at the same potential as its cathode. The tube conducts strongly, and its plate voltage is low—about 50 volts. When the 19,000-cps input signal to V_{3a} exceeds the threshold value, V_{3b} becomes biased and its plate voltage rises. Because of the high gain, the transition of V_{3b} plate current from saturation to cut off is very rapid and the plate voltage swings from 50 volts at saturation to almost 160 volts at cutoff. A filter consisting of R_3 and C_2 allows only the d.c. component of the rectified output of D_1 to reach the grid of V_{3b}, and the capacitor C_3 slows the time of response of V_{3b} to prevent transients from reaching the switch itself.

The stereo indicator lights up when the voltage across it is 60 volts or more. One terminal of the neon indicator lamp is connected to the junction of R_5 and R_6 which maintains that terminal at about 80 volts positive with respect to chassis. When the plate of V_{3b} is at 50 volts to ground, the indication lamp is across only 30 volts, and therefore does not light. When V_{3b} is cut off its plate voltage of 160 exceeds 80 volts by more than 60 volts, and therefore the lamp lights up.

The switching elements themselves are silicon diodes. They also are controlled by the plate potential of V_{3b}. For the mono signal, D_3 and D_4 have a common anode potential, maintained at about 80 volts by the voltage divider consisting of R_8 and R_{13} whose impedance is very high compared to the signal circuits. Their cathodes are separate, one going to Channel A output and the other to Channel B output. The cathode potentials of D_3 and D_4 can be varied by the plate swing of V_{3b} acting through R_{10} and R_{11}. When the plate of V_{3b} is at 50 volts, the cathode of D_3 and D_4 are negative with respect to their anodes and the diodes conduct. The signal path through them is closed and the mono signal is connected to both the outputs.

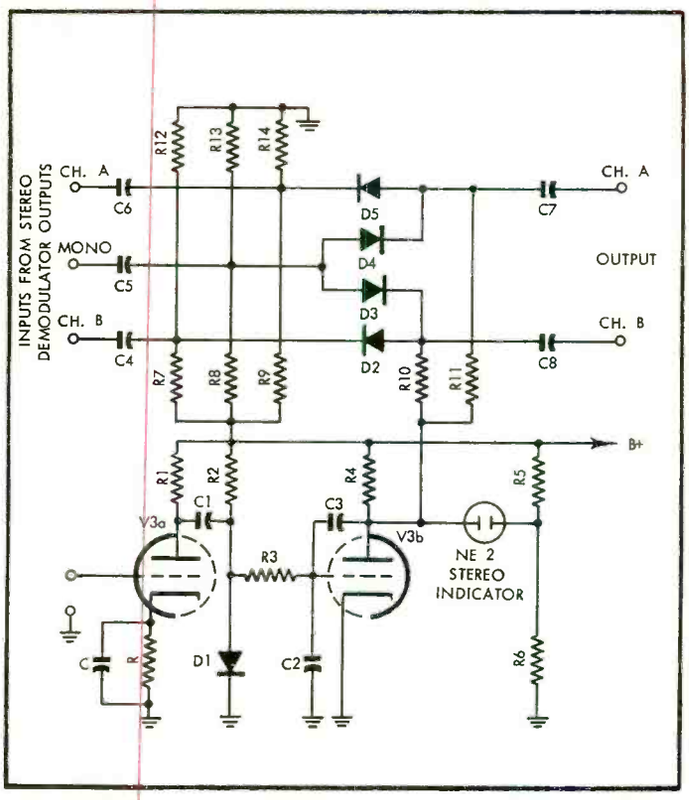


Fig. 5. Composite of pilot-controlled stereo-mono switch.

Conversely when V_{3b} is cut off, the cathodes of D_3 and D_4 are positive with respect to their anodes and, therefore the diodes are cut off. The signal path through them is open and the mono signal is disconnected from the output.

The stereo switching diodes, D_2 and D_5, are connected in reverse polarity, therefore they conduct when the mono diodes are open and vice versa. Thus when no 19,000-cps pilot subcarrier is present at the input to the multiplexer, the diodes D_3 and D_4 conduct, setting up a signal connection between the mono-de-emphasis network and the output. At the same time, D_2 and D_5 are made non-conducting, thus opening the signal connection between stereo de-emphasis networks and output. Similarly, when the 19,000 cps is present at the input, the stereo connection is set up and the mono connection is inhibited.

Conclusion

In conclusion, this multiplex adapter circuit has been in production for some time now. The product has proven itself to be an excellent performer, its stability has been very good, no servicing problems have arisen. Æ

TAPE COPYING

(*from page 36*)

FORWARD when the tape is lying in a pile on the floor. That *doesn't* work. I know.

Final polish on the rig was to purchase an extra tape guide post from Ampex (part no. 21-0004), and mount it in the exact position on the top plate so the original tape could be threaded from the supply reel across the guide post, and in through the head cover retaining screw slot without rubbing against the edge of the slot.

My friend in Quebec has duplicated this set-up with equally satisfactory results. Being a bit handier with tools than I, he has gone one step further and built a motor-driven auxiliary take-up reel for the copy tape. Seems he has an aversion to 2400 feet of tape (neatly?) piled on the floor, but since he hasn't sent me a photograph yet, I can't illustrate it.

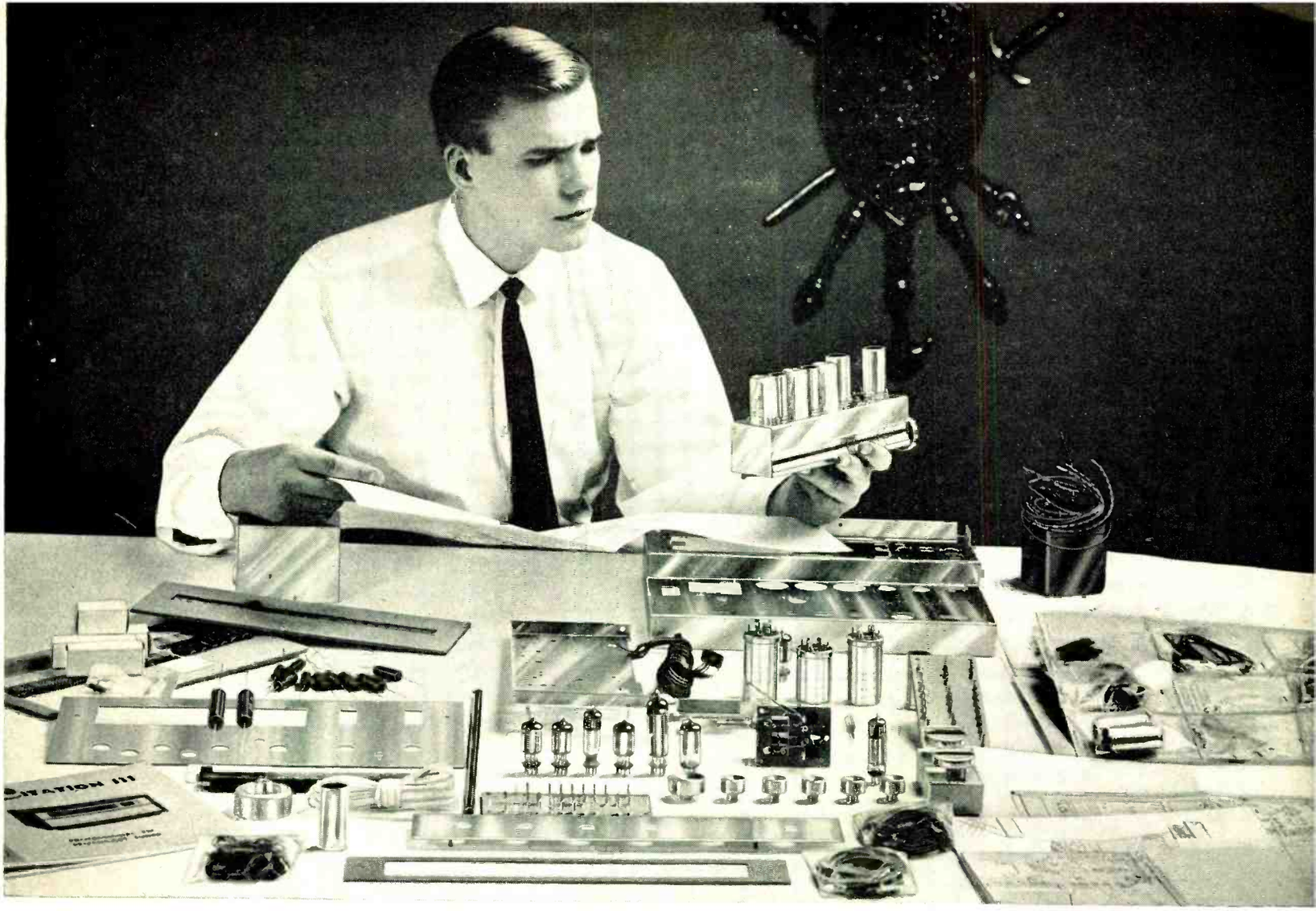
The sharp-eyed reader may have noticed two drawbacks to this scheme:

1. As described, one cannot listen to the original tape when it is being recorded. But even I could solve that one; the outputs from the Ampex were made to feed two inputs each: the record input on the Ampex, and a tape input on a preamp. Thus it was possible to monitor the tape being copied.

2. There is no way to listen to the copy tape as it is being recorded, since it doesn't cross a playback head. That's right, there isn't, and in this technique the Ampex functions like a machine with only *two* heads (erase and record-playback) instead of as a three-head machine. But after all, it's only a *copy* that you can't hear. If it later proves to have something wrong with it on playback, it can always be recopied. I leave to the true electronic geniuses the design of an installation for an auxiliary playback head to monitor the copy tape.

Now what does all this prove? Although the above description is specific to an Ampex 960, the technique is not. With a little ingenuity, the same technique should be applicable to *any* three-head machine with separate record and playback electronics. I await with interest the first description of the technique applied to a Tandberg Model 6!

On the basis of maximum facilities at minimum cost, I think the above scheme has considerable merit. Of course, I'm prejudiced! And what of the poor hi-fi fan who only owns a two-head machine? He had my deepest commiserations. But then we *should* buy at least *semi*-professional equipment, shouldn't we? Æ



Can You Afford 15 Hours to Build The World's Best FM/Multiplex Tuner?

Fifteen hours. That's all it takes to build the world's best FM/Multiplex tuner.

Citation has the "specs" to back the claim but numbers alone can't tell the story. On its real measure, *the way it sounds,* Citation III is unsurpassed. And with good reason.

After years of intensive listening tests, Stew Hegeman, director of engineering of the Citation Kit Division, discovered that the performance of any instrument in the audible range is strongly influenced by its response in the non-audible range. Consistent with this basic design philosophy – the Citation III has a *frequency response three octaves above and below the normal range of hearing.* The result: unmeasurable distortion and the incomparable "Citation Sound."

The qualities that make Citation III the world's best FM tuner also make it the world's best FM/Multiplex tuner. The multiplex section has been engineered to provide wideband response, exceptional sensitivity and absolute oscillator stability. It mounts right on the chassis and the front panel accommodates the adapter controls.

What makes Citation III even *more* remarkable is that it can be built in 15 hours without reliance upon external equipment.

To meet the special requirements of Citation III, a new FM cartridge was developed which embodies every critical tuner element in one compact unit. It is completely assembled at the factory, totally shielded and perfectly aligned. With the cartridge as a standard and the two D'Arsonval tuning meters, the problem of IF alignment and oscillator adjustment are eliminated.

Citation III is the *only* kit to employ military-type construction. Rigid terminal boards are provided for mounting components. Once mounted, components are suspended tightly between turret lugs. Lead length is sharply defined. Overall stability of the instrument is thus assured. Other special aids include packaging of small hardware in separate plastic envelopes and mounting of resistors and condensers on special component cards.

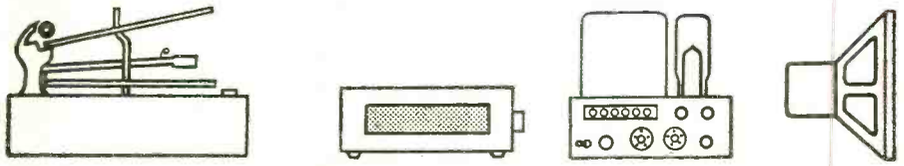
For complete information on all Citation kits, including reprints of independent laboratory test reports, write Dept. A-12, Citation Kit Division, Harman-Kardon, Inc., Plainview, N. Y.

The Citation III FM tuner—kit, $149.95; wired, $229.95. The Citation III MA multiplex adapter—factory wired only, $89.95. The Citation III X integrated multiplex tuner — kit, $239.90; factory wired, $319.90. All prices slightly higher in the West.

The Citation III

Build the Very Best **CITATION KITS** *by* **harman kardon**

EQUIPMENT PROFILE



LUXOR MODEL MP410A STEREO TAPE RECORDER

The introduction of a new tape recorder on the U. S. scene is always the signal for excitement amongst those who are interested in everything in high fidelity. The average audiofan is completely curious about anything new—he wants to know how good it is, what it will do, how much does it cost, and anything else about its performance, reliability, apperance, and background.

The question of appearance is answered by the accompanying illustration, *Fig.* 1. The unit is built with a gray-finished steel top plate, with a darker blue-gray plastic housing over the heads and switching mechanism, with all legends molded into the plastic. The reel hubs are silvered. The mounting case is available in either mahogany or teak, and is very compact—it measures 14¾ × 11½ in., and has an overall depth of 6½ in. including the mechanism. Plastic grilles on all four sides provide ventilation at the back, protection for the two loudspeakers on the sides, and a cover for the panel carrying the connecting jacks in the front, the latter panel being removable to provide access to the jacks.

The Luxor MP401A is a four-track stereo machine capable of either stereo or mono recording at any of the three standard speeds—7½, 3¾, or 1⅞ ips. It accommodates 7-in. reels, giving a range of recording times from 60 minutes on a 1200-ft. reel of tape at 7½ ips in stereo to 8 hours on a 2400-ft. reel at 1⅞ ips in mono.

Operating controls as viewed from the top include: a "joy-stick" lever operating in a trident-shaped slot which turns power on and off and selects the operating speed; speaker selector switch, which permits the use of either internal or external speakers separately or both together; a tone control operating on the internal power amplifier but having no effect on the high-impedance output receptacle; a track-selector switch which permits the use of 1 (and 4) or 3 (and 2) in the mono mode, or tracks 1 and 3 (or 4 and 2) in stereo; an over-all volume control operative in both record and playback; separate-channel volume controls which give complete control over both channels in stereo work; and the second "joy-stick" lever, operating in a T-shaped slot to control the tape motion. In addition, there are four push buttons—three of them select the inputs for recording from either microphone, phono, or radio, and the fourth is the record button, interlocked with the tape-motion lever. Whenever the operating lever is returned to OFF after any recording operation, both the record button and the source button are restored to normal, giving complete protection against possible inadvertent erasure of already recorded material.

Fig. 1. Luxor Model MP410A stereo tape recorder.

The connection panel at the front has five receptacles accommodating the now-familiar Hirschman plugs, (now-familiar because they are used on so many European recorders). Two are for mono microphones, one being wired for a stereo microphone also; one for phono pickup; one for radio tuner output to feed the recording circuits and also feeding the output of the recorder preamp to the input of an external amplifier and speaker system; and one for headphones. In addition, there are two jacks which accommodate banana plugs and feed an external speaker from the left channel, two from the right channel, and two which give a right plus left output. This makes it possible to feed two external speakers for the right and left channels separately, and another for the "center fill" channel when desired.

Recording level is shown by two EAM86 indicator tubes visible through openings in the molded plastic escutcheon.

The microphone input impedance is 1 megohm, and a signal of less than 1 mv gives full modulation; radio input also has an input impedance of 1 megohm, and full recording level is attained with an input of 25 mv; the phono input has input impedances of 1 megohm and 22,000 ohms, with sensitivities of 300 and 2 mv, respectively.

The over-all weight of the recorder is 25 pounds; power consumption is 60 watts at 117 volts, 60 cps—and the frequency of the supply voltage is important with imported recorders, since 50 cps is common in many European countries.

Circuitry

Each of the two channels employs an EF86 in the first stage; one-half an ECC83 in the second stage with equalization supplied to its cathode circuit from the plate of the third stage; and one-half an ECC83 in the third stage which feeds the recording head through a constant-current circuit for recording and feeds the output signal to the radio receptacle in playback, as well as the grid of the output stage, an EL95, to drive the built-in speakers or the external speaker jacks. One of the EL95's serves as the bias oscillator during recording, operating at a frequency of 85 to 95 kcs, according to the specifications, and actually measured at 88 kcs on the machine tested. Plate voltage is supplied by a selenium bridge rectifier, with fuses in both the primary of the power transformer and the a.c. side of the rectifier.

Practically all of the circuitry is constructed on etched panels, with the switching done on these same panels as actuated by various operating mechanisms. The headphone output is at a high impedance, with an output of around 2 volts.

Performance

The first question usually asked about performance is, "What is the frequency response?" This is not necessarily the most important specification about a recorder, but it is often considered so. The Luxor 410A records and plays back from a "flat" input signal within ±3 db from 40 to 17,000 cps at 7½ ips; within ±3 db from 50 to 12,000 cps at 3¾ ips; and within ±4 db from 60 to 7000 cps at 1⅞ ips. Wow and flutter measure approximately 0.1 per cent at 7½ ips, 0.2 at 3¾, and 0.25 at 1⅞. On the particular unit tested the channel separation on stereo was measured

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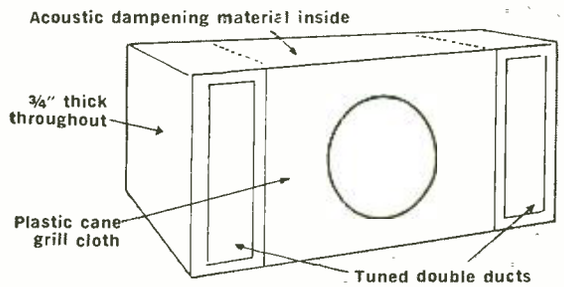

**E. T. Canby says,* "The Cabinart speaker system . . . is really an astonishing piece of equipment *at its price* which is an unbelievable $15 — speaker and enclosure, complete and integrated . . . with an 8" speaker inside of quite extraordinary quality. I am really impressed by the sound and by the simple ingenuity of the entire construction." *In Audio, November, 1961.*

Reprint of Mr. Canby's complete review of Cabinart speaker systems is available on request.

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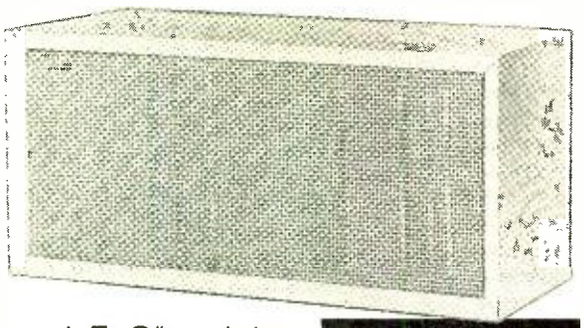

mark I 8"model

11" high x 9½" deep x 23" long
Shipping Weight: 27 lbs.
Genuine Walnut Veneer, Oiled Finish $25.00
Extended range speaker response 45 to 13,000 cps. 8 Ohm imp.

$15.00 Unfinished

mark II 12"model

14" high x 11½" deep x 23¾" long
Shipping Weight: 37 lbs.
Genuine Walnut Veneer, Oiled Finish $36.00
12" coaxial incl. 3" Alnico V PM tweeter. 8 Ohm imp. Speaker response 40 to 15,000 cps.

$22.50 Unfinished

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Please ship the following to be used in my home for 10 full days. I understand unit (s) may be returned and my money refunded within that time unless fully satisfied.

..... Mark I Unfinished $15.00 each
..... Mark II Unfinished $22.50 each
..... Mark I Oiled Walnut $25.00 each
..... Mark II Oiled Walnut $36.00 each

(Please make check or money order payable to Cabinart Acoustical.)

Name_____

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City _____ State _____

at 38 db. Absolute speed variation is less than 3 seconds in 30 minutes.

Tape handling is extremely gentle, and except when the user deliberately attempts to spill tape (by making a fast switch between fast forward and record/play) no evidence of spillage was ever noted.

After making the usual measurements, a portion of a stereo record was dubbed onto the tape; then the record and tape were started at the beginning again and compared in the usual "A-B" fashion with no discernable difference. This test was conducted at 7½ ips. At the intermediate speed, some difference could be heard (the record was a fairly new copy of "Camelot"); even at 1⅞ ips there was much less difference than we have learned to expect from several other machines. If one wanted to copy a collection of 78's, for example, 1⅞ would be perfectly adequate.

The next test was to record stereo off the air, using a Citation III tuner and a Pilot 200 stereo adapter. Results were again satisfactory. We have heard rumors of troubles with beating between the bias frequency and the second harmonic of the subcarrier frequency, 76 kc, but the high bias frequency of the Luxor MP410A apparently eliminated this problem. There is also the possibility, of course, that the Pilot adapter does not have much 76-kc output, but we had no other on hand at the time for a comparison on this machine.

Feeding the output to external speakers gave good performance, although the 2-watt power capability would not be adequate for low-efficiency speakers. With normally sensitive speakers there is plenty of volume.

Background

If the Luxor is more ready for the American market than some other new imports, it may just possibly be the result of the writer's visit to the factory during a European trip last April. The usual recording curve for European machines does not match the NAB curve which is standard in the U. S., and some of the controls differed from those we would have preferred. The early models of the machine had only one built-in speaker, which we felt was a serious limitation to general use. Except for the use of the Hirschman plugs and receptacles, the machine now conforms to U. S. usage quite nicely. And now that the plugs are becoming readily available, this should no longer be any problem at all, particularly since the machine comes equipped with three plugs which should be sufficient.

One interesting feature is the possibility of connecting both the recorder feed and the recorder high-impedance output with only one plug, using four separate shielded cables. This eliminates the need for a number of such cables when the recorder is integrated into a typical home system.

On the whole, we believe this machine to be an exceptionally fine value at its price of under $300. It is compact and relatively light, and it provides all of the basic functions of a tape recorder satisfactorily without being unduly complicated so as to provide a variety of undoubtedly useful, but not really necessary, features. Sorta like the "compact" version of a good automobile—everything you need, no frills, and an economical price. **M-26**

REALISTIC MODEL 210 STEREO POWER AMPLIFIER

The Realistic Model 210 is a stereo power amplifier rated at 70 watts per channel. Actually, we achieved nearly 80 watts (each channel) without clipping over most of the audio range, accompanied by excellent performance in terms of frequency response, distortion, and stability.

Such performance dictates massive transformers. Those in the Model 210, including the power transformer, weigh about 14 pounds apiece. The output transformers are special Acro units. The entire amplifier weighs 47 pounds. Yet all components are neatly organized to form an attractive and relatively compact unit.

Circuity

Most power amplifiers route the incoming signal through a voltage amplification stage prior to phase splitting, while the Model 210 feeds the signal directly into a "long-tail" phase inverter utilizing a 12AX7. This is direct-coupled to a 12AU7 driver, which is RC-coupled—the only instance of capacitance coupling in the entire amplifier—to the KT77 output tubes. The KT77 is a new type similar in its power capability and other characteristics to the EL34 and 6550. Output impedances of 4, 8, and 16 ohms are provided.

The output stage is of the familiar ultra-linear configuration, with the screens of the tubes connected to taps on the primary of the output transformer. The feedback circuit is less familiar. Voltage feedback is taken from a tertiary winding on the output transformer and goes to a grid in the first stage instead of a cathode. No feedback capacitor is utilized across the feedback resistor, which is only 470 ohms.

Current feedback can be switched in and varied in amount to provide variable damping; output remains virtually constant while doing so.

The power supply uses 4 silicon diode rectifiers in a full wave bridge circuit. This witnesses the trend toward solid-state diodes in place of vacuum tubes in power supplies in order to reduce internal resistance and improve regulation. Although such a supply is more difficult and costly to replace when the time comes to do so, the life and reliability of power diodes are today considered such that the disadvantage in replacement is small compared to the advantage in performance. A selenium rectifier provides negative bias for the grids of the output tubes and for the cathodes of the long-tail phase inverter.

The power supply incorporates one choke, which is housed in the same case as the power transformer. A surgistor limits the initial voltage for about 30 seconds, thereby protecting the power supply and output tubes against destructive surges. The amplifier is fused at 5 amps.

Three controls are provided in each channel (six in all) for adjustment and balance of d.c. current through the output tubes and optimum balance of the a.c. signals fed to these tubes. A meter, six-position switch, and 60-cps signal source are incorporated so that the novice can make these adjustments without the aid of special instruments or knowledge.

Construction and Alignment

It took a slow, careful 14 hours to construct the Realistic 210. At that, much time was saved because all the voltage amplifying stages are prewired on a printed circuit board.

While no serious problems were encountered, a few things that came up bear comment. A solder lug called for in an early step could not be located in the hardware package but turned up in the resistor package. All lead-lengths called for in the construction manual were ample except those emanating from Switch 3; these were barely long enough, and an extra half-inch on each would have made construction easier. An 18,000-ohm resistor was substituted for a 15,000-ohm one, which might puzzle the novice in the absence of a resistor color code.

The manual supplies charts showing resistance and voltage to ground at each tube socket pin. The writer found all resistances "on the head" in his completed unit, with two exceptions: (1) Pin 6 of each 12AX7 measured about 227,000 ohms instead of the 360,000 ohms listed in the chart, but a reading of the schematic showed that 227,000 ohms is right. (2) The chart specifies a reading of zero at all heater pins, whereas the reading should be infinity; this is important, because if the heaters are inadvertently connected to ground, this will raise the hum level.

After the various controls were aligned per instructions, the voltages were checked and found to correspond quite exactly with those in the chart, except for negative bias at the control grids of the output tubes. This measured about −35 volts instead of −45 volts as specified in the chart. Reference to the "troubleshooting"

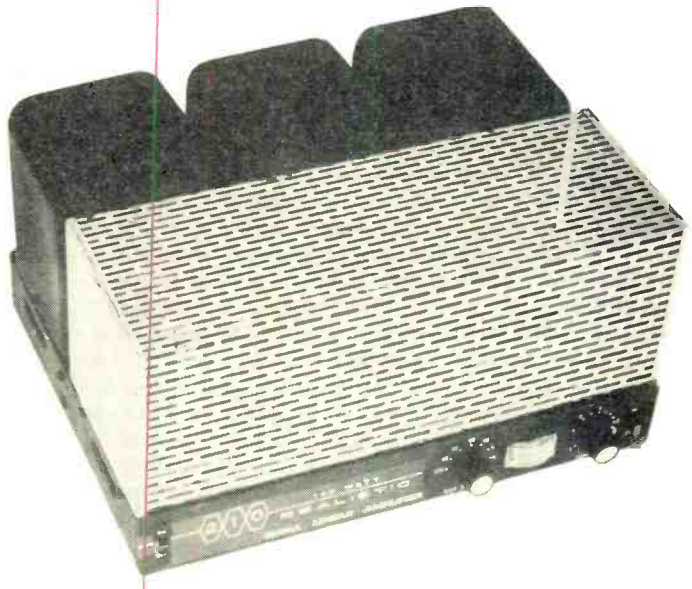

Fig. 2. Realistic Model 210 stereo power amplifier.

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Take one of their medium-price microphones, like the *D 19 B*. This dynamic directional unit has a range of 40 to 16,000 c/s, and a music/speech switch. The front-to-back-sensitivity ratio of at least 15 dB extends well down into the bass, where it's needed most. Baffling of stray magnetic fields is 18 dB. Available for 60 or 200, or 200 Hi, Ohms. Sounds good in print? Well, in use it's even better – far beyond its modest basic price of $52!

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MATERIALS include the noble metals and alloys, and stable plastics, selected for function and life, again as in *C 24*.

APPEARANCE shows quality – in the trim, well proportioned shape (5⅞″ x 1⅜″), and sturdy elegance of the finish.

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section of the manual revealed that normal grid voltage should be −35 volts. Consultation of the Genelex specification sheet on the KT77 showed a recommended grid voltage of −38 volts with 500 volts on the plate and −26 volts with 400 volts on the plate. Inasmuch as the Realistic 210 puts 490 volts on the plate, interpolation indicates a value in the vicinity of −36 or −37 volts to be about right.

The novice may find himself confused because the control called BIAS BALANCE in the manual is labeled BIAS ADJUST on the printed circuit board, and the control called BIAS ADJUST in the manual is labeled BIAS SET on the board. The inner controls on the board govern the amount of bias voltage applied to *both* tubes, while the outer controls govern the balance *between* tubes.

The meter indications are sharp and accurate with respect to d.c. current flowing through the output tubes. But the indication for optium a.c. signal balance is quite broad. If the constructor lacks access to an IM meter, it appears that instead of relying on the meter indication he can do as well or better simply by setting the a.c. balance controls to their physical mid-position. In our unit, this procedure yielded results nearly as good as those obtained with an IM meter.

During the initial hours of operation the current drawn by the output tubes may change appreciably, with a corresponding need for readjustment of the various controls. To avoid the possibility of the output tubes drawing excessive current during this period, it is advisable to let them operate during the first few hours with somewhat more bias than called for. Extra bias is indicated by the meter swinging to the *left* of the point marked "A" on the scale. We made the mistake of letting the tubes draw too much current during initial operation, and one developed a short between cathode and control grid.

Performance

Judged by listening, the Realistic Model 210 is right in with the very top-flight power amplifiers. It has the ease, openness, and transparency conducive to sustained listening, without interposing an indefinable and fatiguing veil as some amplifiers do. While it cannot transmute poor source material into good, it makes it possible to enjoy that which is good.

Measurments showed each channel capable of producing almost 80 watts between 50 and 15,000 cps without clipping. At 20 cps the pre-clipping point was 70 watts; at 20,000 cps, 75 watts. Response at 1 watt was flat between 20 and 20,000 cps, and down 1 db at 25,000 cps, 2 db at 50,000, 3 db at 70,000, and 6 at 100,000. Essentially the same response was obtained at levels through 60 watts, except that the −3 db point moved down slightly to 65,000 cps at 20 watts, 62,500 cps at 40 watts, and 60,000 cps at 60 watts.

The low-frequency limits were not determined because our audio oscillator doesn't go below 20 cps. But examination of 20-cps square wave response revealed very little tilt, so that it is reasonable to assume that response extends below 10 or possibly five cps.

Ringing on square waves was absent through 5000 cps. At 10,000 cps slight ringing was discernible but was sinusoidal and devoid of spikes and other indications of instability.

With the bias controls adjusted properly and the a.c. balance controls adjusted for a compromise between lowest IM distortion at 1 watt and at 10 watts, IM was as follows: Through 40 watts equivalent sine wave power, IM measured about .2 per cent on each channel. On the left channel, IM readings rose to .26 per cent at 50 watts, .32 per cent at 60 watts, and .37 per cent at 70 watts; the corresponding readings on the right channel were .32, .40, and .52 per cent.

Only at high power levels did distortion increase significantly with reduction in damping factor (which improves the bass response with certain speakers). At least through 10 watts, the increase was trivial; at 10 watts, IM rose from about .2 per cent to slightly under .5 per cent as the damping factor was changed from maximum (over 10) to minimum (below .5). At 40 watts, however, IM rose to about 2 per cent at minimum damping.

The signal-to-noise ratio at 60 watts, rated 90 db by the manufacturer, measured 95 db. Yet when connected to a highly efficient speaker system in a horn enclosure, slight hum could be heard within a few feet of the speaker during nighttime quiet. Under prevalent listening conditions, however, the hum was masked by other speaker and room sounds.

Sensitivity is rated at 1.5 volts for 60 watts output, with a maximum difference of 1 db between channels. The writer measured 1.3 volts sensitivity, with virtually no difference between channels.

Crosstalk, rated at 60 db, instead measured about −45 db at 1000 cps and −48 db at 50 cps. It became −34 db at 10,000 cps and −32 db at 20,000 cps. This performance, while below specifications, is still more than adequate for effective stereo separation. The 210 might be inadequate if each channel were used for different program material piped to different rooms. Even so, the writer could hear crosstalk only when the speaker was operated at a level that most persons would probably consider excessive.

To check stability under capacitive loads, a 1 μf capacitor was placed across the 16-ohm terminals, and square waves were fed into the amplifier. No sign of instability was evident with this large a capacitive load. All that happened was a slight increase in response above 10,000 cps, followed by a sharp fall above 30,000 cps.

In these days when presentable audio components, including power amplifiers, are often kept in the open rather than hidden in cabinets or closets, it is important that the power transformer run quiet and not too warm. Mechanical hum of the power transformer in our unit could be heard only within a few inches. After several hours of operation, the transformer remained well below the temperature that would burn a careless hand.

A husky power transformer inevitably produces enough external magnetic field to justify caution. It appears advisable to keep the Model 210 amplifier at least three or four feet away from other components and from signal-carrying cables to the preamplifier. M-27

THORENS FOUR-SPEED TURNTABLE MODEL TD-124

The Thorens Model TD-124 is a four-speed turntable which incorporates an accurate stroboscopic method for checking all speeds, a unique fine-speed adjustment, a spirit level plus means for adjusting level, and a removable (and replaceable) wooden arm-mounting board. In addition, by means of a rather simple device, it is possible to hold the record stationary while the massive turntable continues to rotate. Because of this it is possible to place the stylus at a specific location on the stationary record and, by releasing a lever, have it instantly at proper operating speed. All of these fine features are mounted on an unusually heavy, cast mounting plate. It only takes a brief glance at the underside of this turntable to be convinced of its ruggedness.

In reality, the TD-124 is not a new turntable—in fact it has been widely available for some years. Nevertheless, its features and performance are just as impressive today as they were when it was first introduced. *Fig.* 3 provides an over-all view of the TD-124 with an Ortofon phono arm and cartridge installed on the mounting board. More about them later.

Fig. 3. Thorens TD-124 four-speed turntable with Ortofon SMG-212 arm and Ortofon SPU/GT stereo cartridge.

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Sensational sight, sensational sound, remarkable bass, indetectable crossover, incredible transient response, transparent highs, smoothest wide-angle projection... Every superlative ever used to describe a precision transduction system has been applied to the new JBL Olympus. The system includes a new 15" Linear-Efficiency low frequency unit, the LE15; new high frequency driver, the LE85; new slant plate acoustical lens, exponentially-tapered horn, and new dividing network. All unite to reproduce sound so clean, so smooth, so intact that the Olympus is destined to establish a new standard for this type of system. The free-standing, trim, beautifully-proportioned enclosure is available in all JBL wood finishes and with choice of carved wood or fabric grille.

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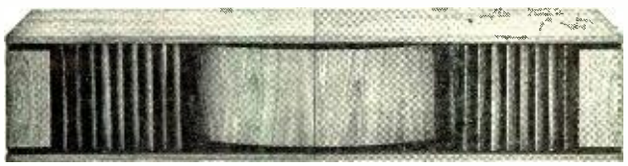
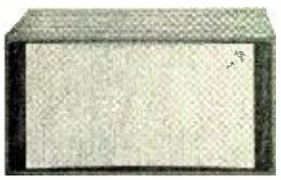
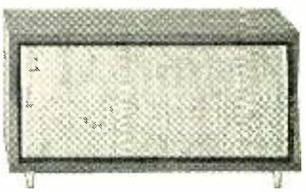


THE JBL MINIGON

Aristocrat of bookshelf-size speaker systems, the JBL Ranger-Minigon provides integrated stereo through radial refraction, the same patented method used in the fabulous JBL Ranger-Paragon. Minigons accommodate either LE8 full-range units or JBL Model S5 two-way systems. Grille may be either the unique louver assembly shown here or fabric.



THE MADISON



THE DALE

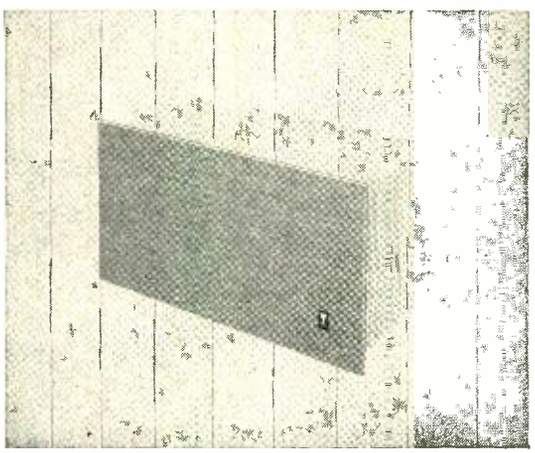
THE JBL MADISON

An exquisitely-styled minimum volume enclosure, the Madison reflects the Danish design influence and is especially popular in oiled teak or walnut finish. Finished four sides and front for vertical or horizontal placement. Takes the LE8 speaker or S5 system.

THE JBL DALE

A timeless, elegant, modern design with removable legs and hangers on back (also on Madison) for wall mounting. Finished four sides and front. All finishes and grille cloths available.

HIGH QUALITY, LOW COST COMPACT LINEAR-EFFICIENCY SYSTEMS



THE LANCER 33

It is possible to offer typical JBL precision response, fine cabinet craftsmanship, and lasting-listening satisfaction at a lower price than ever before by making a simplified enclosure, longer production runs, limiting choice of finishes, using one grille, and providing somewhat less flexibility. The Lancer 33 is a ducted acoustical enclosure with an LE8 eight-inch, full range speaker. Lancer finishes are those most frequently asked for—tawny walnut, oiled walnut, dark mahogany, ebony, and pumice. Grille cloth is beige linen-weave.

THE LANCER 66

Similar in appearance to the 33, the Lancer 66 is a "buttoned-up" enclosure with a two-way, dividing network system with an LE 10 and new high frequency unit. Performance is remarkably smooth and transparent. Lancer speakers are factory installed.

and for building in...

THE JBL WILTON

Unfinished, the Wilton is furnished with either the LE8 or S5 system factory installed. Offered with either a flush grille or overlapping grille for use when built into a wall or partition.

Whatever your choice... exponentially-tapered horn, bass reflex or infinite baffle system... you'll find your ideal speaker in the extensive JBL line. Write for complete catalogue.

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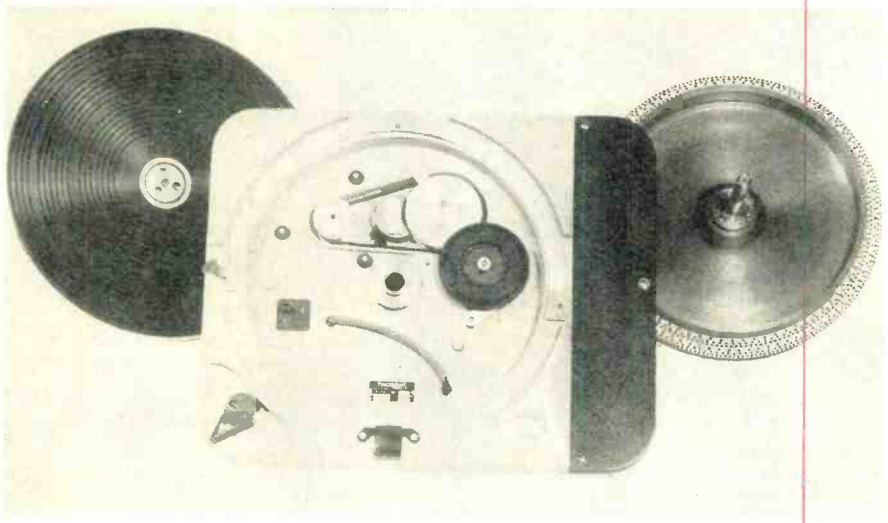

Fig. 4. Thorens TD-124 turntable with platters removed.

The Mechanism

The heavy-duty induction motor is isolated from the mounting structure by means of rubber shock mounts. In addition, it drives the speed-selecting idler by means of a flexible belt. This arrangement prevents the motor from imparting any unwanted rotational or vibrational motions, which means lower wow, flutter, and rumble.

The speed-selector idler, which is driven by the motor, is four-stepped to provide the required four speeds. The appropriate speed is transmitted to the turntable by means of a rubber idler. Speed change is effected by raising and lowering the speed-change idler. When the speed selector knob is rotated, several simultaneous actions occur: (1) A cam is rotated which turns power on, (2) Another cam surface raises or lowers the speed-change idler to the appropriate height, (3) A lever is moved which pushes the rubber drive idler into position against the proper shoulder of the speed-selector idler and the drive surface of the turntable.

Once in motion, fine-speed adjustment is effected by rotating the inner portion of the speed-selector knob so that the stroboscopic pattern remains stationary, as viewed through the window at the front of the turntable. Rotating this inner knob rotates a metal bar within the speed-change idler. This bar, in conjunction with the small magnet just to the left of the speed-change idler (as can be observed in *Fig.* 4), acts as an eddy brake.

The turntable comes in two sections—an eleven-and-a-half pound cast-iron main unit and an aluminum platter on top of it. The aluminum platter is covered with a rubber mat and contains a pop-up 45-rpm spindle. It is because of this light-weight aluminum platter that the previously described cueing function is accomplished; it is lifted up and away from the cast-iron platter and thus remains stationary while the massive platter continues to rotate. In *Fig.* 4 we can observe the shaft, and the ball bearing at the end of the shaft, on which the turntable platter rides. Note also the stroboscopic patterns on the underside of the platter. There are two sets of patterns—one for 50 cps and the other for 60 cps. All that is required to change the set of patterns viewed is to flop over the little black piece of metal screwed over the viewing window shown in *Fig.* 4. In addition, all that is required to change the voltage accommodation of the unit is to unscrew a small screw from one hole and screw it into another hole. It is as simple as that.

The Thorens Model TD-124 is a very fine platform for a record, which after all is what a turntable is supposed to be. Because of the accurate stroboscopic patterns, all speeds are quite accurate. Wow and flutter are less than 0.1 per cent, and rumble was better than – 64 db. All this adds up to an unusually fine turntable for less than $100.00. **M-28**

ORTOFON SMG-212 PICKUP ARM AND MODEL SPU/GT STEREO CARTRIDGE

Manufactured in Denmark by the well-known Danish firm of Ortofon, the SMG-212 Pickup Arm and the SPU/GT Stereo Cartridge are an extremely fine pickup system. The arm is designed to accommodate the European "G" shell, which has become so familiar to us in the SME and Neumann arms. This shell is designed to take standard cartridges of all makes which weigh up to 19.3 grams. The arm features static balance in all planes so that the turntable may be tilted up to 30 deg. before any tracking difficulties arise. The stylus force is adjusted by rotating the counterweight at the rear of the arm. A graduated scale on the counterweight indicates the stylus force in grams. When checked, the stylus-force gauge was revealed to be quite accurate throughout its entire range. Ball bearings are used for both horizontal and vertical pivots. Electrical connections from the plug-in shell are made by means of two pairs of color-coded insulated leads. These terminate in a miniature 7-pin socket in the base of the arm. Two 4-foot long shielded cables with phono plugs for the amplifiers and a common 7-pin plug for the arm socket is supplied. A separate ground wire is connected to the arm ground and may be used to ground the turntable to the preamplifiers. The arm is normally delivered mounted on a wooden panel corresponding to the Thorens TD-124 and TD-121 turntables. Tested with the Ortofon SPU/GT Cartridge, the SMG-212 exhibited no resonance down to 10 cps, the bottom limit of our test record. The manufacturer claims that the resonance with this cartridge is below 8 cps.

The Cartridge

The Ortofon Stereo Cartridge Model SPU/GT is a moving-coil cartridge which is supplied integrally mounted in a "G" type shell. This means it will fit only the Ortofon, SME, or Neumann arms. The manufacturer notes that a universal type will be available shortly. In the shell provided, one need only plug the SPU/GT into the Ortofon arm and adjust stylus force.

In testing this cartridge, we made use of the new CBS Labs test record mentioned by Edward Tatnall Canby elsewhere in this issue (Record Revue). Using this record and a General Radio Graphic Level Recorder, we were able to ascertain that the Ortofon SPU/GT is an extremely fine performer. Using a load of 100,000 ohms and a stylus force of 1.8 grams, the frequency response was within 2½ db from 40 cps to 20,000 cps. In reality, this response is somewhat better than would be indicated by those bare numbers. First of all, the frequency run was continuous. That is, it sweeps continuously from 40 cps to the 20,000 cps limit. It is a decided improvement over the spot frequency method previously used in that a resonance, or sudden peak, between spot frequencies is not concealed. There were none in the SPU/GT. Secondly, the load called for by the manufacturer is 50,000 ohms instead of the 100,000 ohms used. Unfortunately we were not able to rerun the test with a 50,000-ohm load. However, it is reasonable to assume that the frequency response would have flattened out somewhat if that were done. Another interesting facet of this response curve is that the left and right channels produced the same curve within a maximum deviation of 1 db. Channel separation was 25 db at 1,000 cps, 22 db at 10,000 cps, and 15 db at 20,000 cps. At 5 cm/sec the output was 15 mv. Vertical compliance was 10×10^{-6} cm/dyne and lateral compliance was 2.85×10^{-6} cm/dyne. In order to see whether increased stylus force would make any significant difference, we re-ran the test with a stylus force of 3 grams. The only difference we achieved was a slight smoothing out of some of the curves, nothing very significant.

Although frequency runs and the like are very important in evaluating a cartridge, to us the important part of testing is to listen to the cartridge as it reproduces music. Happily, with the SPU/GT, this test bears out the "more scientific" tests. It is an unusually transparent cartridge with no audible idiosyncrasies. At its price of just under $50.00, including a high-quality diamond stylus, the Ortofon SPU/GT is well worth considering by any audiofan. **M-29**

SCHOBER ORGAN AT-1 AUTOTUNER

The interest in kits has developed over the past four or five years to the point where the advanced hobbyist has worked his way through simple amplifiers and tuners up through all the more complicated kits and finally arrived at the point where he feels that his equipment is no longer subject to improvement. If build he must, he is likely to turn to the organ kit as the next logical step.

Assuming that he has completed one of the several kits on the market, he is faced with the problem of tuning the organ. This is not particularly difficult if there is a well-tuned piano in the house, but if such were the case it is possible that the organ would never have been built anyway. One must, therefore, find some sort of device which will permit him to tune the organ accurately throughout its entire range—

THE NEW ELECTRO-ACOUSTIC...

Records show no discernible wear, keep their fidelity through hundreds of playings on this unique player.

Tracks at less than 3 grams . . . the 4-speed Electro-Acoustic 7000 series stereophonic record player with diamond stylus is certified to apply less than 3 grams tracking pressure. Your fine recordings show no discernible wear or tonal deterioration even after years of playing. Its laboratory-tested pickup maintains perfect fidelity and incomparable realism throughout the entire recorded range.

The dynamically-balanced 4-pole, 4-coil motor and turntable, the micro-honed motor spindle, precisely machined bearings, and the custom-fitted turntable drive limit rumble to −40 db, wow to less than 0.15% RMS and flutter to 0.06% RMS (better than NARTB standards). Turntable speed is certified to be within ± 1% of absolute. $69.50 Audiophile Net. *Write today for free illustrated literature and the name of your nearest dealer.*

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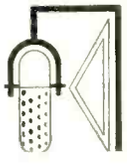

CERTIFIED QUALITY
Each record player is laboratory tested and is sold with a written test report coded to the serial number of that particular record player, certifying that performance is within specification limits.

Fig. 5. Panel appearance of the Schober AT-1 Autotuner.

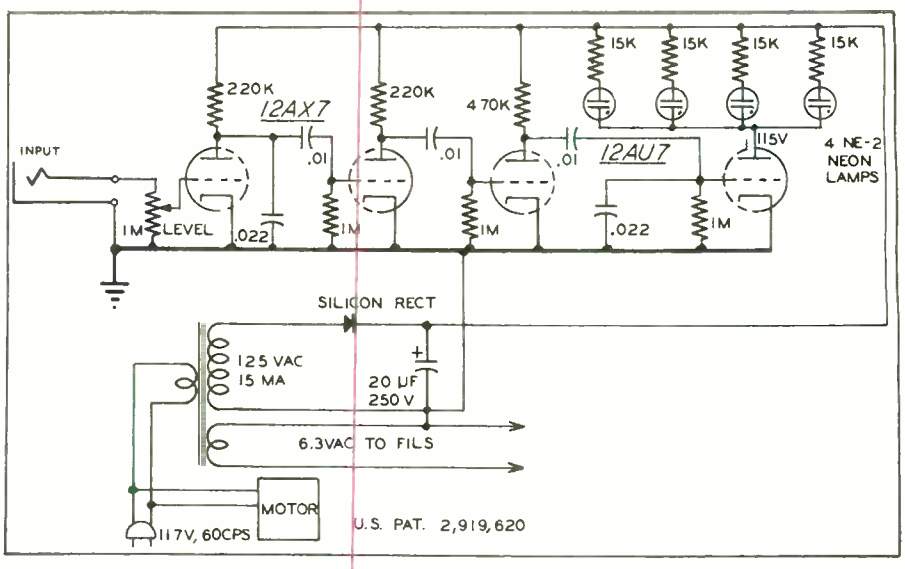

Fig. 6. Complete schematic of the Autotuner.

even assuming that he can get WWV's 440-cps transmission for the A above middle C. This will take care of all the A's, but unless the builder has absolute pitch or a remarkably developed sense of pitch, he is not likely to arrive at a well-tempered instrument.

One can, of course, secure a complete set of twelve tuning forks, but these are likely to be quite expensive. He can use a phonograph record for tuning, but this demands a high degree of accuracy in the speed of the turntable.

The Schober AT-1 Autotuner, *Fig.* 5, provides a simple solution for the organ owner who has just completed a kit and wants to perform the initial tuning. It is also useful to the owner of a factory-built organ that might need occasional retuning. We can also see how it could be useful to the piano tuner who never quite mastered the intricacies of tempering in the traditional manner.

The Autotuner is an accurate stroboscopic device which enables anyone, with no skill or previous experience, to tune a frequency-divider type of organ in a minimum of time. Schober, Baldwin, Lowrey, Kinsman, Minshall, Estey, some Electro-Voice models, and a few others are of this type. Organs of the Conn, Allen, and Artisan type can be tuned with the Autotuner, by somewhat more time is required. The accuracy remains the same, however.

Principle of Operation

The Autotuner works on the principle outlined in Mr. Herlocker's article on page 30 of this issue, although it differs in detail. The Autotuner consists of a stroboscope disc revolving at a speed of one revolution per second, neon lamps to illuminate the disc, and an amplifier to drive the lamps. The schematic is shown in *Fig.* 6. The input may be obtained by a suitable electrical connection to the organ output amplifier, or a signal may be picked up from the organ's loudspeaker by a microphone, which is furnished, and fed into the amplifier.

In operation, the signal is fed into the Autotuner amplifier and one note—the second G below middle C—is tuned to make the outer stroboscope pattern stand still. This pattern, marked G, has 98 lines, and when illuminated by a tone having a frequency of 98.00 cps, the pattern will be stationary. Because of the ratio between adjacent notes on the tempered scale, it is impossible for a stroboscope disc to have patterns for each of the basic twelve notes on the scale if the speed of the disc is constant. For example, for middle C the disc would require 130.8 lines; only the G's and A's have frequencies of integral numbers.

However, if two notes are sounded together, the resulting beat note between them is of such a value that stroboscope tuning can be made feasible. For example, the G above middle C has a frequency of 392.0 cps and G♯ is 415.3 cps, giving a beat-note frequency of 23.3 cps. The stroboscope disc has 23 lines, the pattern will stand still when the G♯ is in tune. There is an error here of 0.3 cps, which at this frequency is less than 0.1 per cent. The next ring on the disc has 25 lines, while the beat note between G♯ (415.3 cps) and A (440.0 cps) is 24.7 cps, again giving an error of less than 0.1 per cent. However, the two errors are opposite, so that A is tuned exactly to 440 cps. Continuing up the scale, the error varies plus or minus less than one cycle per second for every note in the octave, and this is better than 0.14 per cent maximum.

With a frequency-divider organ, therefore, the entire instrument can be tuned accurately in less than 5 minutes, with complete assurance that the tempering is correct. With other types of organs, the higher and lower octaves must be tuned against the one that is now known to be correct, using the beat notes between octaves.

Kit Construction

The Autotuner is a simple two-tube amplifier intentionally designed to overload and clip so as to generate the beat notes between the adjacent frequencies. The amplifier drives the neon tubes—four of them being used to illuminate the disc uniformly, and the disc is driven by a 1-rps synchronous clock motor, so that the accuracy of the organ tuning is equal to that of the power line frequency, which is well controlled by the power company so they can interconnect power systems between cities as necessary to distribute loads —and so they can sell electric clocks.

The disc itself has twelve bands—the outside one for the first G, and the remaining eleven for the beat notes between adjacent notes. The amplifier is assembled on an etched-circuit panel, and the job of construction should be done easily in two hours, with time to spare. The entire assembly is mounted on an etched aluminum panel and enclosed in a plastic case which measures 5¼ × 7 × 2½ in. deep.

This is undoubtedly the simplest and most inexpensive tuning device available —some of the really elaborate ones run into the hundreds of dollars—yet the accuracy is as close as could possibly be desired.

M-30

OTL AMPLIFIER

(*from page 21*)

R19	100,000 ohms	*C15*	0.1µf
R20	5100 ohms	*C16*	125µf, 250v
R21	470,000 ohms	*C17*	0.1µf
R22	1000 ohms	*C18*	0.1µf
R23	560,000 ohms	*C19*	50µf, 6v
R24	1000 ohms	*C20*	0.02µf
R25	470,000 ohms	*C21*	0.02µf
R26	1000 ohms	*C22*	0.1µf
R27	1000 ohms	*C23*	0.002µf
R28	51 ohms	*C24*	0.004µf
R29	match pickup	*C25*	0.008µf
R30	2700 ohms	*C26*	0.02µf
R31	100,000 ohms	*C27*	0.05µf
R32	100,000 ohms	*C28*	0.03µf
R33	130,000 ohms	*C29*	0.02µf
R34	2700 ohms	*C30*	220pf
R35	130,000 ohms	*C31*	0.002µf
R36	2700 ohms	*C32*	0.002µf
R37	100,000 ohms	*C33*	0.02µf
R38	100,000 ohms	*C34*	0.1µf
R39	250,000 ohms	*C35*	0.1µf, 600v
R40	250,000 ohms	*C36*	0.1µf, 600v
R41	250,000 ohms	*C37*	125µf, 350v
R42	250,000 ohms	*C38*	20µf, 350v
R43	1 megohm	*C39*	20µf, 350v
R44	100,000 ohms	*C40*	20µf, 150v
R45	1 megohm	*C41*	20µf, 150v
R46	47,000 ohms	*F1*	3 amp
R47	10,000 ohms	*L1*	UTC S-30
R48	2700 ohms	*T1*	22R34
R49	27,000 ohms	*V1*	6AU6
R50	Compentrol	*V2*	6AU6
R51	68,000 ohms, 2w	*V3*	NE-2
R52	68,000 ohms, 2w	*V4*	6AU6
R53	1 megohm	*V5*	6AS7
R54	1 megohm	*V6*	6AS7
R55	1 megohm	*V7*	12AY7
R56	1 megohm	*V8*	12AY7
R57	1 megohm	*V9*	6.3v pilot
R58	1 megohm	*V10*	6X4
R59	30,000 ohms, 2w	*V11*	OB-2
R60	30,000 ohms, 2w	*CR 1–6*	SD-94
R61	8200 ohms, 2w		

Model SM-Q300

SUPERB TONE QUALITY!

17W+17W STEREO AMPLIFIER with AM-AM-FM TUNER

It is derived from the new circuits

A new stereo amplifier with powerful output and wonderful distortion-free tone quality is now offered with pride. SM-Q300 is provided with a number of new circuits. For example:

1. Switching from stereo to monaural and vice versas has been made continuously variable. Switching from one purpose to another and the adjustment of the stereophonic sense have become possible with a single knob.
2. The phase reversible circuit is entirely unique to the PIONEER; it has reduced distortion to minimum.
3. The use of silicon diodes with superb regulation for the power supply circuit has greatly stabilized the output.
4. The adoption of high-characteristic scratch and whistle filters has made it possible to reduce unpleasant noise without in the least sacrificing hi-fi tone.

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

Specifications:

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

5 Otowacho 6-chome, Bunkyoku, Tokyo, Japan

PIONEER ELECTRONIC CORPORATION

AUDIO ETC

(*from page 14*)

gers and what-not. I find the compliance ratings in the new third-generation cartridges interesting. Given the compliance figure applied to each type of cartridge in a line, you can practically infer the major thinking of the cartridge designer, both as to the innards of his cartridge and as to his expectations in the way of probable use in the public domain.

The new third-generation cartridges have upped compliance by a whole order. That is, what used to apply only to the delicately de luxe models of the second generation cartridges now appears in the "regular," non-integrated third-generation models. The new basic standard is no longer 5–6 but 9 and higher, the former top figure. Just look at our ads and you'll see for yourself. Amazing. I'd be scared to touch one of them with my big, crude forefinger. And yet you'll find that this ultra-complaint stylus is going to be everywhere on the better cartridges during the third generation's coming span of existence.

We are only at the beginning, so far, however. The ads have had their say, now the production is talking big, but in most cases, probably hasn't got very far yet. (It always happens this way. We outtalk our own abilities in sheer enthusiasm and wind up with huge ads and no production in sight for months! Good sign of faith in the future, anyhow.) And so, while the second-generation cartridge still holds its sway almost unchallenged except in the ads, let me note briefly my experience with a couple more of these, offering quite different philosophies within the breed.

Fairchild SM-2

Now here is a typical second-generation cartridge, if I may say so, showing the general characteristics of the breed and yet offering its own peculiar latitude of individuality. There's plenty of room for that within each generation. Like most lines, this one appears in several variants and allows for differing stylus types, as per above. I got two SM-2 models from the generous Fairchild people, the cartridge itself on the loose and its alternative integrated form—in this case an identical cartridge but ready-mounted and wired in the special anti-skate arm (Fairchild 500). I've been using both, and indeed have compared my own arm-and-wiring (via professional help) with Fairchild's. No important difference in electrical effect, I found to my relief. I didn't do too badly.

Sound? Let me say at once that whereas among the first-generation stereo cartridges, for all their claims, there were sounds which left me distressed and amazed, among these second-generation items there is only a remanent micro-factor to be considered, at least among those I have tried. Differences—yes. But micro-differences, all things considered, where there were clear macro-differences between the earlier models. Nasty, ugly, unaccountably poor sounds. Not now.

Thus from the beginning I have not had the slightest musical complaint to make concerning the Fairchild SM-2 sound. It is indeed silky, smooth and unobtrusive. Maybe a compliance of 10 instead of 5 might improve a few ultra-loud inner-groove passages here and there—but for that we'll have to wait a bit. I will, anyhow. At least within the range of my own ears, which mercifully do not hear the non-musical highest tones up to that famed 20,000 cps top, there are no audibly unpleasant peaks or shrillnesses, nor any soggy bass, an effect noted on a few other cartridges once it had been specifically pointed out to me. For the time being, until a generally higher standard comes along, this sound is a practically-achieved current perfection, and that is that. Perfection for the musical listener, anyhow.

As for the anti-skate feature, the sidewise outward pull on the 500 arm which compensates for the known drag inwards as the arm tracks the record, I'm not too good a judge of its effect since my equipment—like so many people's—tends to be wobbly and on the loose, of the sort where you put a match book under one corner to level things up. Don't get me wrong—my styli *very* rarely skip grooves. But, if Fairchild is right, I probably do wear one side of the groove worse than the other and get more distortion on my right channel than on my left, due to drag. That is, when my table is approximately flat on its base. Matter of micro versus macro again, I guess.

Anyhow, the 500 acts very properly for me, undoubtedly aiding that right channel response all the while, and I notice the anti-skate factor mainly when the stylus is lowered onto the outer edge of the record—then, it tends to slide outward under the fingers a bit. Odd feeling. I also found one over-cut record in which the 500 jumped grooves backwards (i.e. repeated) at several points. Just out of curiosity, I tried tipping the whole table in the other direction. I had to lift it two or three inches before the stylus would consent to move onward. Probably didn't prove anything except that the record was defective.

One important point of interest which I am sure can be honestly stated here. The Fairchild design philosophy is idealistic in a professional way, assuming that a top-quality cartridge should be used only with top-quality associated equipment and should be so designed throughout. We've run into this rock-solid attitude many times before, and it can elicit nothing but professional approval. Standards. Therefore I cannot criticize Fairchild's cartridge when it picks up a certain amount of hum from a low-priced and somewhat elderly turntable on which I mounted it. Technically, I had no business doing so. But the hum was there, particularly at the spot right over the motor—no doubt about the source, or most of it. Solution! Go get a decent motor.

However, I must note that another and equally fine cartridge placed in the very same spot picked up no hum at all. Cynical designer! *That* one obviously put no trust in the dopey human beings who buy expensive pickups, and prepared himself for the very worst! Fairchild could easily say—and will say—why design a beautiful cartridge and then smear it all up with record-changer-type crudities? In this respect, I really do agree with Fairchild and, in fact, I have continued to use the 500 arm for some time now in spite of that slight hum, being too preoccupied with other matters to do a change of tables and yet wanting to keep the Fairchild going strong on my review records.

Just get yourself a good stereo table before you buy your SM-2 or 500 arm, and you'll he in the clear.

Stanton 381

Speaking of micro and macro, I wish to note a brief experience with the flexibility of those self-inflicted terms on my own personal listening. How great is great? How small is small?

For a good while I had been using a Pickering 380 cartridge (another second-generation model, its "V-Guard" stylus assembly succeeding the Pickering T-Guard arrangement and its associated cartridge design). When the alternative Pickering—or should I say, Stanton—Calibration Standard model came out, the 381, I figured I'd be curious to see if I could notice the difference, by ear and in casual listening. Given the micro-tolerances of the second-generation cartridges, I didn't really expect to be able to tell. After all, I'm basically a musical listener, who forgets most of the time to watch for peaks and dips and IM in favor of musical things like *appogiaturas* and dominant sevenths.

Well, the difference is clearly micro. But I heard it—clearly. That is, I heard it on a quick A-B. No question at all, the 381 sound was noticeably cleaner, sharper, more limpid, the bass crisper (so it seemed to me), than via the 380 used in identical circumstances. But, to preserve the micro aspect of this, I must note that after five minutes of interesting stereo music, well played and well recorded, I doubt very much if I could possibly tell you off the bat which of the two cartridges might be in use. Micro, definitely. (A macro-difference shows up clearly and continuously *in spite* of the music. Clearly for me, that is. It's a very personal world, this one.)

A lovely cartridge, and it is now one of my standard all-use work-horses, with grateful thanks to the maker. Virtually impossible to damage, these 380 models, easily re-stylused, quickly installed, working well in practically any environment. Only two further points of interest.

First, I note the claimed channel separation *chez* Pickering as 35 db. No qualifications in the way of tolerance, nor of frequency, but that claim is really high. Impressive. Now, Fairchild puts it a different way. 20 db separation, but specifically within plus or minus 2 db and from 20 to 15,000 cps. Having seen a General Radio run on another rival cartridge, which showed an immense loss of separation above 10,000 cycles, I can see that Fairchild isn't talking doubletalk. On the other hand, Pickering clearly has something pretty good, to be able to put down that high figure of 35 db. Separation *is* important in stereo, to put it mildly.

My shrewdest guess: both of these cartridges are unimpeachably excellent in this respect and there just ain't no problem. Not until a fourth-generation model appears with 100 db separation, 0 to 50,000 cps, plus or minus .01 db.

Second, an interesting side-note. The earliest of the three Japanese viscous-damped arms that I converted to dynamically balanced stereo some years ago (with the damping mostly removed, plus adjustable sliding weights) happened to be the arm into which I first plugged the Stanton 381, in my standard interchangeable mount. Immediately there was a terrible oscillation, down in the bottom bass—an arm-resonance coupling of some sort. Oddly enough, the 380 had not produced it, nor had any other pickup. I tried the 381 quickly in another arm, a later model: no oscillation at all.

So out went arm #1, for ever. The other two, no doubt with slightly different masses and resonance points, still serve me well and without this particular oscillation. Curious how improvements in one area introduce, or show up, previously untroublesome factors in other equipment!

(*Continued on page 85*)

SINGULAR, INDEED

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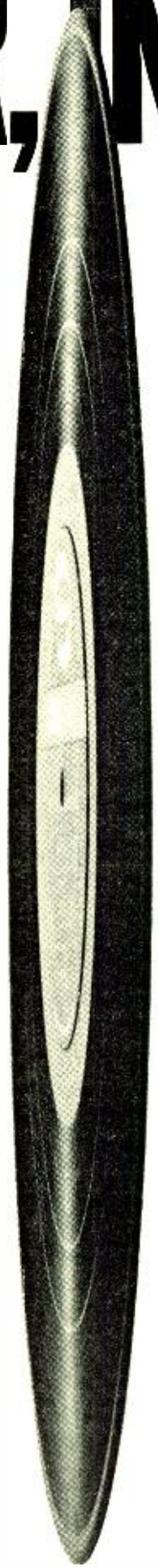
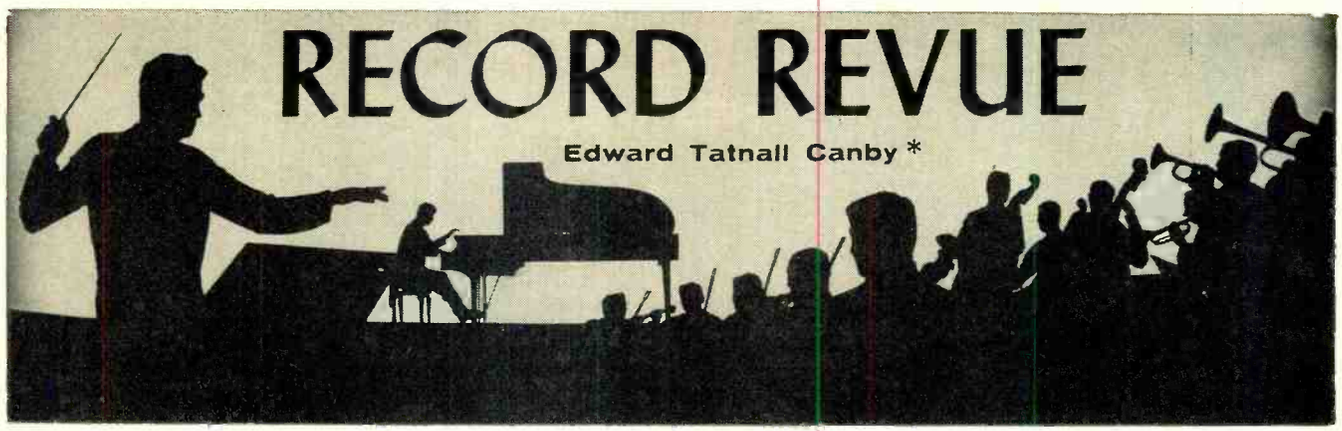




RECORD REVUE

Edward Tatnall Canby *

High Test

Stereophonic Frequency Test Record
CBS Labs and Columbia Records STR 100

The most important thing about this new stereo test record, at least for the professional audio man, is that it is synchronized to operate with the General Radio Type 1521A Recorder, to make possible almost instantaneous (well instant, anyhow) running of complete frequency response curves on pickups. Takes about a minute for each channel: just play the proper bands on the record into the recording instrument and the movable pen traces out a complete curve from 40 to 20,000 cps, continuously, I watched it (as did visitors to the AES Convention in New York) and I was impressed. You can check out any pickup within minutes and with quite remarkable accuracy. Devastating, I've heard tell, in some cases. Brings out those hidden peaks.

The record contains mainly sweep and spot frequency runs, made with unusual accuracy and labeled as to exact levels. (Innovation: a lady CBS telephone operator announces the spot tones). Left and right, for most of them, with a cutting separation of better than 30 db throughout "most" of the frequency range. There's a tracking-compliance test, precise 100 cps tones of varying amplitudes, vertical and lateral; you can determine compliance by measuring least tracking force required, multiplying the given band amplitude in centimeters and dividing by stylus force in dynes (grams times 980). Haven't tried this interesting arithmetic yet, but it ought to work.

There's a set of low-frequency glide tones, 200 down to 10 cps, to determine arm resonances—also synchronized with the General Radio pen recorder, in case you want a quick automatic curve. With this machine (or via meter readings) you can also check separation at any of the recorded frequencies, allowing for the separation on the record itself. You can check your stylus tip via comparison of output between the same glide frequencies on inner and outer bands, which should read the same if all is well.

The record, by the way, was not made from a tape but was cut directly from the tone generator's output, an operation that puts in mind the old 78-rpm waxings. The voice track, from tape, was played into the recording during the actual cutting session. Result: A very clean, very steady set of tones, remarkably low on distortion and probably better than any tone derived from tape, no matter how good. Tape isn't always king, remember. For low distortion and low noise, disc is still best.

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

IN MEMORY OF . . .

Mozart: Piano Concerto #20 in D minor, K. 466; Concerto #24 in C minor, K. 491. Clara Haskil; Orch. des Concerts Lamoureux, Markevitch.

Epic BC 1143 stereo
(mono: LC 3798)

Clara Haskil, a wisp of a woman with gray hair and fingers of steel, died last December on the way to perform a concert in Belgium, after a fall on the railway platform. It was the last straw for a woman who, strangely like the other wisp of frail strength, the Baroness from Denmark with the pen-name of Isaak Dinesen simply would not spare herself for mere physical rest. Great ladies both of these, both of them tiny, frail beyond belief, both with an immense and soaring spirit sufficient to make any man quail! Where Dinesen went hunting lions in her own Africa and wrote about them, Clara Haskil sought mainly Beethoven and Mozart, and played them. There is not a greater pianist alive, for these and other composers, nor has there been for a long time.

I don't know when these two recordings were made nor whether they are her "last"—that being a meaningless word in this day of tape recording. But they have the Haskil beauty, and no doubt about it. Such power—but much more, such perfect phrasing, such incredibly knowing and polished architecture, every tone shaped to fit, beyond the imagination of the mere technician—even the greatest. An experience to hear her. And Markevitch's men, with whom he has lately been at odds, seem to be plenty cooperative. They couldn't be less, with Haskil on the scene.

Rameau: Ballet Suite. Gretry: Ballet Suite from "Cephale et Procris." Gluck: Ballet Music from the Operas (arr. Felix Mottl). Hartford Symphony, Fritz Mahler.

Vanguard VSD 2098 stereo

These three little orchestral suites would seem to memoralize three Eighteenth century composers. They are actually a memorial to a once-familiar name in "old" music, Felix Mottl. He was the man who assembled these suits and who orchestrated them in "modern" style, as of roughly the turn of the century.

There was a time, not so far back, when virtually all the music we ever heard from this period, aside from some Mozart and a bit of Haydn, was in Mottl arrangements; he brought the "old" music to us for the first time (in retouched form), just as later on Stokowski first brought retouched Bach to the symphonic multitudes.

Now, we get Bach, as well as Gluck and Rameau and even Grétry (of the French Revolution), in their semi-original form, authentic. And so, nowadays, these sweetly delicate evocations by Felix Mottl sound decidely old-fashioned, as indeed they are, along with ancient airs by Fritz Kreisler and the like. Even so, in his day Mottl was an excellent and knowing musician, the famous conductor of the opening concert at Wagner's Beyreuth in 1876 and of the first performance of "Parsifal" outside of Germany, in New York in 1903. A real guy, and his period-piece suites are nicely played by the Hartford orchestra. You'll enjoy them.

XMAS CORNER

Christmas Songs. The Obernkirchen Children's Choir, Edith Moeller.

Angel S 35914 stereo

I practically *never* review Xmas records in time for Xmas, on the solid theory that if they are good enough to spend money on in December, they ought to be even better come January. (Most of them aren't—so why bother). But now that each year, the record companies issue their Xmas offerings further back towards summer (they are recorded, mostly, in July or before), I sort of can't help being curious, once in awhile. This one arrived *chez moi*, ready to play, on a hot day in October. My Christmas spirit hadn't yet been worked up to the proper pitch, but I played it anyway. just to see.

Nice kids, very German (not Austrian), with sweet little tremulos—and they speak German so naturally! Some great big boys with bass voices occasionally intrude in the background. All the singers have excellent pitch and sing most musically. I was bored with the inevitable *Jingle Bells* and *Go Tell It On The Mountain,* and so forth in English, stemming from the group's American tours, but their German and Austrian music is, properly, excellent. The lady conductor and organizer really knows her stuff.

"Behold! Three Wise Men Came Out of the East" Music from the Epiphany Office and Mass of the Christmas Season. Trappist Monks, Abbey of Gethsemani.

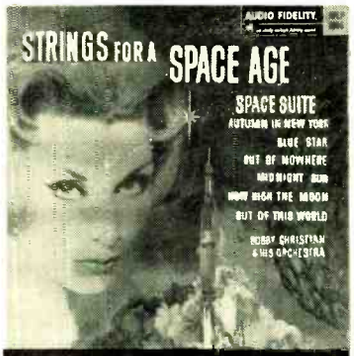
Columbia MS 6289 stereo
(mono: ML 5689)

The oddity in this continuing Columbia series of Gregorian chant recordings is that the Abbey of Gesthemani is in the Kentucky mountains. But, other than an occasional hint of American accent in the Latin and a few examples of American-style trained-voice vibrato, one could as easily imagine these sincere and musical monks in France, Jerusalem, or the high Alps. Thus is Gregorian chant still universal, within the Catholic (and the Anglican) church.

The music is, as always, of a sort to sound monotonous, or monotonously lovely, to the beginner; yet it involves, as always, an immense and complicated detail, as described in the elaborate booklet. In truth, dedicated religonists of this sort can spend every moment of their lives keeping up with the infinites of ritual available, musically and otherwise. With such single-minded and purposeful concentration. It is no wonder that the chant is so extraordinarily expressive, and that these monkish singers put such heartfelt energy and expertise into their singing.

Stereo is a great addition, with gorgeous stonework echoes to reverberate from side to side, and inspired musical give-and-take from solo voices and choir, within the space.

STRINGS FOR A SPACE AGE



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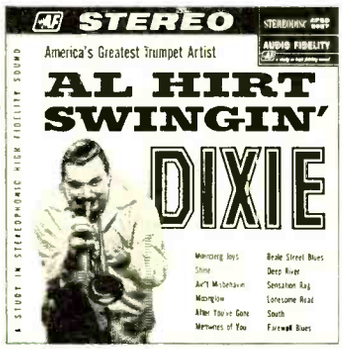

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Christmas Carols Around the World. Mormon Tabernacle Choir, Condie.
Columbia MS 6284 stereo
(mono: ML 5684)

Listening to these healthy, outgoing carolers in their large forces, I'm reminded of pictures of extrovert West Coast kids doing surf riding, or football, or cheerleading, handsome, brash, strong, with pleasantly blank faces, boys and girls alike. They aren't exactly weighed down by the world's problems, those kids; nor are these carol singers concerned much with the world of music outside of their home bailiwick, in spite of the record's fine title.

True, the music comes from all over Christendom. There's a carol suite by Gustav Holst, a bit of Benjamin Britten, *"It Came Upon . . ."*, the prayer from *"Hansel und Gretel"* (sounding like some old *Saturday Evening Post* cover), a piece by Saint-Saëns, some Tyrolese-type stuff and so on. But if you will just listen, without looking at the titles, you'll find that it all bursts out with the same lusty, brash, not very subtle enthusiasm, American to the core.

Surely, I'll have to admit, this is a *lot* better than those dreadful "department store carols," sung by unctuous commercial-type vocal quartets, that people are dopey enough to buy in the millions each Christmas. A thousand, a million times better, this! It's honest and sincere Christmas singing, if on the bouncy side.

MULTIPLE-UNIT

Shakespeare: Hamlet. The Marlowe Society and Professional actors (anonymous). Auspices the British Council.
London OSA 1503 (5) stereo

An enormous pile of Shakespeare has been growing in my waiting room these last months, dozens and dozens of LP's, until I am desperate to know what to do about them. It's an appalling extensive output (for a reviewer, that is), soon to cover virtually everything the Bard ever put down on paper, and in several versions at that. I grabbed at this "Hamlet" before it joined the pile and took an evening off from music to listen.

Excellent! Didn't stop once until six sides had gone past the needle. This seems a very full version, too, perhaps even more uncut than most "uncut" readings—there were lengthy sections I scarcely remembered at all from earlier experience. Evidently the recorded versions now restore, for these evening-size albums, many a common cut made for public performances in the theatre. Never was it more clear, I'd say, that when Shakespeare got hold of an audience he expected to make a long night of it, unto the small hours!

The start here isn't so good, but it's Shakespeare's fault for a beginning (as in many an opera, later) with a brace of minor characters, inevitably played by second-rate actors. After these opening actors have mumbled the usual Shakespeare soup through their thick, unintelligible lips, the recording picks up excitement with every turn. And when Hamlet appears, things really begin to move—he is a vigorous, young-sounding, forceful Hamlet, modern and ultra-clear in his diction, without a trace of actorish affectation. I have never heard a Hamlet so easy to understand, so convincing in his dilemmas of the spirit, and yet so subtle as well. The other major characters are also excellent, and notably the old fool Polonius, who here takes on a credible guise as a silly but sympathetic and well-meaning oldster.

The recording is conservatively stereo with little motion (just as well) but a good deal of contrast between voices at different locations. There is somewhat of an off-mike sound, hardly noticeable after a few moments. Like TV.

I should note that these mammoth Shakespeare LP's are, paradoxically, best for solitary listening, by one's self. Even the slightest stir of conversation, between two or more auditors, immediately kills the play's continuity, and it becomes simply an unpleasant background noise, senseless voices out of a loudspeaker. Solitary or no, this is a splendid

way to lose one's self in another world of staged reality. Worth an evening of vocal silence on anybody's part.

In my Shakespeare pile I find in this same London edition some seven other enormous albums—"Romeo," "Macbeth," "Henry IV Part I," and Henry IV Part II" (both of these full-length plays, four LP's apiece), "Winter's Tale," "Two Gentlemen From Verona," and "Measure for Measure"; probably I've misplaced a few more around the house. Enough here to keep you busy for years, but even so I heartily recommend *all* of them, every last one, for I haven't the slightest doubt that each can stand up to the very high level of entertainment reached in this "Hamlet."

Now, I'd better get back to music—a couple of hundred LP's of it.

Beethoven: The Five Piano Concertos. Leon Fleisher; The Cleveland Orchestra, Szell.

Epic BC 1136/39 stereo (separately)
(mono: LC 3788/91)

Leon Fleisher's recording of the Brahms "Concerto No. 1" with Szell of awhile back was one of the greatest performances I'd ever heard. Fleisher, relatively young but of an older generation than the many brilliant new-style newcomers who now play so Romantically, so eccentrically, was a student of Artur Schnabel and is the youngest in the great line of Schnabel-influenced pianists who still carry on Schnabel's serious, profound, classically pure, architectural approach to German music. A man to keep watching, Fleisher, whatever he plays—and here, at one fell swoop, are all of the five Beethoven concertos.

Well, time allows me to sample them, merely, before the never-ending deadline that always seems to be around. The co.ner for me. Sound, from Epic: Big, but a bit muzzy, the mikes (for my ear) placed perhaps a shade too far from the orchestra for sharp definition. One of those mike set-ups where you want to keep turning the volume louder, for more clarity. Not distortion, just slightly miscalculated miking. In contrast with Columbia's own (and perhaps more recent) close-in mike techniques, as reviewed elsewhere in this department.

Music: Definitely, this is in the spare, no-nonsense Schnabel tradition, the principal tradition of fine Beethoven right up to yesterday, though the ultra-newest trend is, as I say, towards a renewed and eccentric romanticism. Szell is somewhat mercurial as a conductor—here he is crisp, rapid, very business-like, has the music precisely in hand for his orchestra, allows no sentimental schmalziness, no play for superficial effect to creep in. And as for Fleisher, he does the same, but with a warmer feeling than Szell's.

A good combination for a concerto. Business-like orchestra, business-like but warm pianist.

The works are spaced in the usual awkward way necessary with Beethoven, who didn't write for LP's. No. 1 is spread all over the first record; No. 2 and No. 4 are compressed into the second disc, one to a side; No. 3 has its own disc, well spread out, and the big "Emperor," No. 5, fills out the last disc for a close fit. Not much better can be done, unless you start breaking up the concertos on fractions of a side, or splitting the movements down the middle.

Benatsky: The White Horse Inn. Lehar: Paganini. Kalman: Countess Maritza, Kalman: Czardas Princess. Strauss: Die Fledermaus. O. Straus: Waltz Dream. Abraham: Victoria and Her Hussar. Abraham: Flower of Hawaii. Lehar: Merry Widow. Lehar: The Count of Luxemburg. Ensemble and Chorus Vienna State Opera, Opera Orch. Assorted conductors.

Westminster WST 14144/48 stereo
(separately)

This is like going to Howard Johnson's and ordering all 27 kinds of ice cream in one big

dish. Better make it a king-size tray, and don't eat too fast or you'll be sick.

'Course you can buy each of these platters separately, each with a condensed version of one Viennese operetta on each side. They'll all sound more or less alike (though you'll notice some superb music buried among the lesser items—"Die Fledermaus," for example), and all umpty-umph of them will be beautifully performed in the true Viennese style, as practiced in current repertory. Somehow, the Viennese never get tired of their own past music and somehow, they always manage to put it on in a musicianly way, no matter how often. Why not try one of these and if it hits the spot, you can keep right on going.

(London has a similarly endless set of Spanish Zarzuela music, the Spanish version of light opera, if you want another open-ended show for yourself).

Melodies of the Masters. (Seven Volumes). Assorted performers.

Capitol SG 8563/69 stereo
(separately)

These are the discs that drive reviewers nuts—but why review? I merely mention them, since all seven LP's were sent to me, an armful that includes just about the entire conventional semi-moodish range of classical excerpts you'll ever listen to without having to think. "Songs of Romance" (vol. 1), ranging from Gershwin's *You is My Woman Now* (for instruments only) to Schubert's *Serenade"* (choral arrangement) to the famous theme from "Romeo and Juliet," the inevitable *Barcarolle* from "Tales of Hoffman;" then "Rhythms of Spain" (vol. 2), with the *Ritual Fire Dance,* a bit of "Carmen," ending up with the Ravel *Bolero*; "Dances of the Old World" (vol. 3), "Portrait of the Waltz" (vol. 4), . . . but why enumerate the details? Obviously, one isn't supposed to fuss about the why and wherefore of these items; they are for listening only. Half-listening. The most outright set of background stuff I've yet seen.

That must be the idea. Why didn't I think? Just buy yourself a chic restaurant, install a bit of a hi-fi, somewhere near the cash register, put these seven discs on your changer and you've got yourself an evening of discreet musical decor for eating and polite conversation. Just remember to keep the volume *very* low.

Stereo? Don't ask me why they bother. Nobody's ever going to notice the difference.

THE VOICE

George London as Boris Godounoff. Columbia Symphony Orch. and Chorus, Schippers.

Columbia MS 6273 stereo
(mono: ML 5673)

Here's a great recording, in more ways than one.

Surely, "Boris" is the most impressive music ever to feature the bass voice in all its glory. Somehow, this music magnifies the essence of bass quality into an enormous presence, far bigger than the sound of a mere man singing. This is primeval masculinity, like Moses, like Zeus—but Boris is even more poignant for his weakness: this Czar, this all-father, is a man torn by doubts and falseness who dies horribly on the stage by their sheer power over him from within. It is a terrifying thing to see, as it is to hear.

There are other great bass roles, but they are largely balanced by equal power elsewhere. Boris sings alone. Hans Sachs in "Die Meistersinger" is a great basso set off against a tenor and a soprano. Walther in that opera, sings the *Prize Song*; but the tenor sound in "Boris," thanks to Moussorgsky's own deliberate musical magic, is made a weak thing, servile, ordinary in an exalted sort of way, to set apart the enormous bass sound.

The recording is remarkable for more than just the gorgeous voice of George London, for his impeccably sincere musicianship and dramatic force. (Also the good backing of chorus and other solos, as well as excellent drama from Mr. Schippers' orchestra.) There is, here, more of Columbia's latest "new sound" in stereo, born of sheer recording

technique, purely for the medium, unlike any imaginable opera-stage sound. It is tremendously significant in terms of this music.

Columbia works close-up now, for a big, clear, ultra-realistic sound-spread. "Boris," on the other hand, is opera on a grand scale, with huge mass-scenes and immense stage-spaces, in which the music moves and lives. Yet the story is in essence that of one man in agony, done with almost grotesquely realistic musical descriptiveness.

It works on the largest stage—a distant voice is brought close to the mind by sheer musical magic, as though but a few feet away. But here, on records, Boris is literally close—terrifyingly so. He breathes down your neck, he groans into your face. And the very realism that haunts the stage version, a hypnotically physical sort of music power, is just as potent in this new medium as it is upon the traditional stage, at a distance.

True, the big backdrops of chorus and orchestra and other minor solos are close, too, and lose some of their majesty in favor of too-sharp detail; no matter. Boris is the man who counts here. He dominates the recording.

The Cruel Mother and other English Ballads and Folksongs. Alfred Deller, the Deller Consort, Despond Dupre, lute.

Vanguard VRS 1073 mono

Alfred Deller is ever the superb musician and the wonderfully accurate countertenor voice, making these traditional English songs into art works of top quality, as the tunes themselves surely merit. But as folksong, this music needs a bit of explaining, in case you are an American folksongist.

This is "art" folksong, a tradition that, though fairly recent, is quite as subtle and as style-conscious as any "authentic" folksong—or as the German Lied. Indeed, these composed folksong settings are a cross between those two, and so is the singing style, which is wholly with a trained, "classical" voice-quality but, nevertheless, preserves the essential "dead-pan" reserve, verse after verse, of almost all true English and American folk song.

The arrangements are beautifully harmonized in modal style, with much counterpoint, with canons and imitations, learned but melodious. The lute is somewhat of an afterthought I suspect, taking over for the expected guitar but in a very classic and lute-like manner. Deller even sings one song wholly unaccompanied—I don't know another "classical" singer of stature who would dare try that, and stay on pitch for a dozen verses, though plenty of good folk singers do it. Superb music, of its special art-form sort, and you'd better try it out.

Wolf: "From the Italian" Song Book. Elizabeth Schwarzkopf; Gerald Moore, pf.

Angel S 35883 stereo

Hugo Wolf, who died in 1903 at the age of 43, was the last of the real German song writers—Richard Strauss doesn't really hit the *Lied* form in its true sense. Wolf was also the most complicated thinker of them all in his harmonies and the most concentrated in the inner content of his short pieces in this style, as many a bewildered (or blissfully unaware) singer has found out, trying to negotiate his astonishing changes of key and quick alterations of mood and theme. Generally, Wolf is pretty painful from any but a very superior and knowing singer. Schubert can be messed up badly enough, but *Wolf*—ugh!

Try this gal, then, if you want the impeccable German *Lied* style in all its perfection, together with a 100 per cent understanding of the musical and emotional subtleties involved. Her voice is a bit big for solo song—she is a superb opera singer—but she has the Lotte Lehmann approach, the Elizabeth Schumann approach, already as they did before they quit the physically more demanding opera scene. Schwarzkopf can look forward to retiring into years of superb *Lieder* after opera begins to be too much for her voice. AE

CHARLES A. ROBERTSON*

STEREO

Charlie Mingus: Pre-Bird
Mercury Stereo SR60627

Now that Charlie Mingus enjoys a reigning position in the vanguard of jazz composers, he can afford to flip over the pages of his early workbooks and return to several projects he planned so ambitiously twenty years or so ago. During this formative period around the start of the 40's, Mingus finished growing up in Los Angeles, developed rapidly as a bass player, and picked Duke Ellington as a model to emulate. His first creative steps were taken with the music of Ellington and the gospel church as guiding influences, before the new ideas of Charlie Parker became a predominate factor in his thinking. In placing seven youthful efforts on exhibition here, however, Mingus brings into play the light of his total experience, and the entire display comprises a timely and revealing present-day "Portrait of the Artist as a Young Man."

Mingus picked durable materials to work with from the very beginning, and the basic outlines of his sketches are drawn so as to hold a lasting appeal for jazz musicians of all persuasions. One reason why his Ellington pieces remained fallow so long is because they approach the subject from the inside. Apart from small gatherings of alumni and working members of the Ellington organization, few groups are equipped to tackle such an assignment and most leaders limit themselves to paying token tribute in arrangements that rarely go beneath the surface. Mingus was more interested in testing the master's methods and finding out what makes them tick, and he still practices much that was learned through writing exercises like *Bemoanable Lady*, or tracing the genesis of *Take The A Train*.

But for the fact that Mingus now commands his own dynasty, many of his early works would still lack an exhibition place. There are enough loyal present and past members of his Jazz Workshop to form the nucleus of the 22-pieces assembled for three numbers, and the nonet heard on the remainder is completely manned by the faithful. Although Workshop groups usually are bent on extending jazz boundaries, Jimmy Knepper, Eric Dolphy, Danny Richmond, Ted Curson, Clark Terry, Roland Hanna, Yusef Lateef, Richard Williams and John La Porta also prove to be equally adept at retouching these early pastiches. With the interpolation of *Exactly Like You*, a new sense of urgency propels *Take The A Train*, and the two melodic lines interweave in a stunning stereo effect. Similar treatment is accorded *Do Nothin' Until You Hear From Me*, through application of the complementary colors of *I Let A Song Go Out of My Heart*.

The young bassist was practical enough to write plump parts for the instrument of his choice, attracting most attention with the aptly named *Mingus Fingus*. While working for Lionel Hampton in 1947, he was featured in the only other big band recording of the work. The large Orchestra plays a brand new version here, and stereo makes the refurbishing job complete. A fervent gospel sound fills *Prayer For Passive Resistance*, but the title seems to be a recent afterthought. Mingus also tries his hand at joining voice and orchestra in the Ellington manner, with Lorraine Cousins adding rich pastel shadings in vibrant vocalese on *Eclipse*, and *Weird Nightmare*.

All the elements which went to form the embryonic composer are tellingly combined in *Half-Mast Inhibition*, a long, reflective opus written when Mingus was only eighteen. Easily the highpoint of the program, its success as a concert work may well be the direct result of youthful sincerity and an unawareness of any differences between jazz and symphonic writing. As the next three or four years were spent in the groups of Louis Armstrong and Kid Ory, perhaps Mingus will reminisce about this stage of his career in future chapters.

Billie and DeDe Pierce: Blues In The Classic Tradition
Riverside Stereo RLP9370

This is the first time Billie and DeDe Pierce have filled more than bits and pieces of an album by themselves, and some estimates of the couple's respective merits are likely to be reversed as a result. As vocalist, pianist and extrovert of the team, Billie always takes the lead and seems to be responsible for most of the ideas, while her husband stays in the background and blows soft, introspective blues obbligatos. Billie is also a creature of impulse, however, and a song title to her is just a means of getting underway on a series of ad-lib verses. This method is often effective and probably pleased the crowd at Luthjens, a New Orleans dance hall where the Pierces worked for more than twenty years, but it becomes repetitious when stretched over an entire LP. The blind DeDe and his new cornet are constantly inventive though, and the catalogue of blues phrases grows considerably during such numbers as *Gulf Coast Blues*, *Brickhouse Blues*, and *Careless Love*. Billie takes credit for four songs, including the strange *Algiers Hoodoo Blues*, and delivers what must be the only example on record of *Love Song Of The Nile*. Albert Jiles assists on drums, and Dave Jones handled the date with the same care as the rest of the Living Legends series.

Louis Armstrong & Duke Ellington
Roulette Stereo SR52074

What might have happened if Louis Armstrong came to New York to join Duke Ellington instead of Fletcher Henderson is often a subject for idle conjecture among jazz fans. While this meeting comes too late to provide the answer, it does show how much Ellington's music is loved and respected by all the Armstrong clan. As the honored guest, Ellington seats himself at the piano, calls the tunes, and starts the party swinging with a striding left hand. Armstrong knows all the themes as well as Barney Bigard, who spent many years with the composer playing clarinet parts on *Mood Indigo*, *Black And Tan Fantasy*, and *The Mooche*.

Although the lyrics were carefully written out in advance, Armstrong appears to be making up half the words by the time he gets around to singing *Drop Me Off At Harlem*, *Do Nothing Till You Hear From Me*, and *Just A Lucky So And So*. The vocal peak, however, occurs on *C Jam Blues*, which producer Bob Thiele fitted with lyrics to transform into *Duke's Place*. Finally, everyone gets together on an ad-lib blues, with Trummy Young intoning solemly through Bigard's beret, which Ellington personally placed on the trombone bell for the right sound. Mort Herbert, bass, and drummer Danny Barcelona complete the gathering, and Armstrong's trumpet gleams brighter than ever in stereo. Next time, perhaps Earl Hines will be invited to drop around.

Bill Smith: Folk Jazz
Contemporary Stereo S7591

Folk music is a continuing source of inspiration in jazz, and the latest in a series of exploratory probings comes from Bill Smith, a clarinetist who matriculated jointly at Julliard and 52nd Street's late lamented Kelly's Stable. Now an Assistant Professor at the University of Southern California, Smith has definite views on the subject: "Contributing to the enjoyment of making these sessions was the freedom of interpretation inherent in folk music. It's a freedom which expects each generation to recreate the tunes in terms of its own musical style." In this day and age any use of the singular in referring to matters of style is dangerous. Nevertheless, Smith's own personal style is highly lyrical and in the best of taste, and his experience as a composer extends to contemporary classical works as well as jazz.

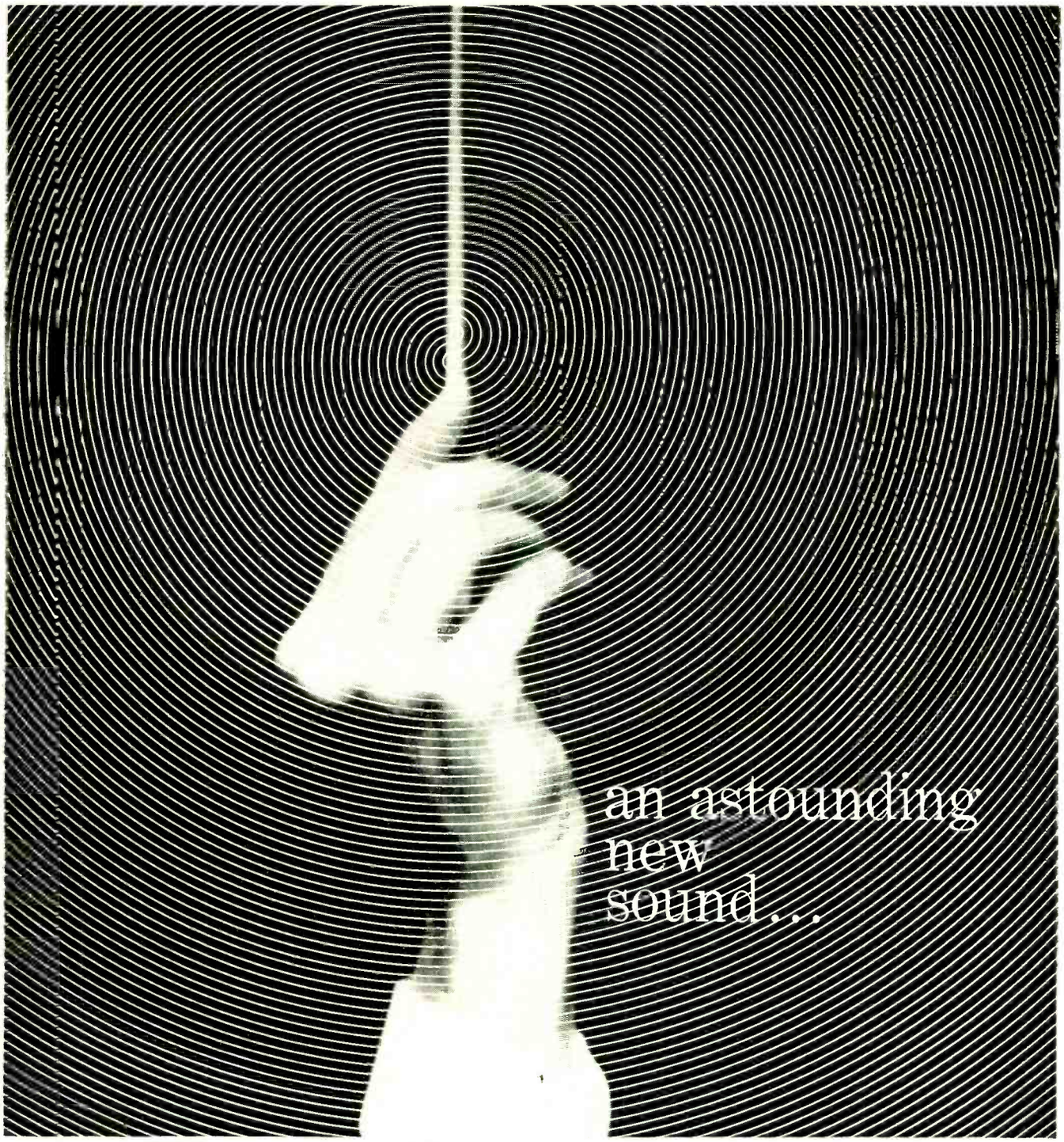
Enlisted as a second voice in the project is Jim Hall, who had the same assignment as guitarist with Jimmy Giuffre Three when it was trying a hand at the folk idiom. Guiffre enjoyed one outstanding success in *The Train And The River*, but was never able to reach quite the same level again. Unlike Guiffre, Smith plays clarinet in high as well as low register, and his skills as arranger are more thoroughly developed. His ideas are uniformly excellent on *Greensleeves*, *John Henry*, and *Wayfaring Stranger*. Hall makes an ideal companion, and Monty Budwig, bass, and drummer Shelly Manne assist rhythmically. Especially worthy of note are the jaunty, swinging chantey *Blow The Man Down*, and the jubilee treatment of *Nobody Knows The Trouble I've Seen*.

Bill Evans: Sunday At The Village Vanguard
Riverside Stereo RLP9376

When the many admirers of the Bill Evans Trio learned of Scott LaFaro's tragic death, this album became something of a jazz classic even before it was released. Ten days after the session was held at the Village Vanguard on June 25, 1961, the twenty-five-year-old bassist died in a highway accident near his family home in upstate New York. LaFaro touched all the bases in his short career, working in California, Chicago and New York, and his powerful tone and fund of fresh ideas earned the respect of such opposite employers as Benny Goodman and Ornette Coleman. His youthful brilliance was directed along substantial channels during two years with Evans, and he soon became a creative voice, along with drummer Paul Motian, in the trio. LaFaro's two originals in this memento of his last appearance with the trio show how well his early promise was being fulfilled. There are few examples of three musicians improvising together more graphic than *Gloria's Step*, and the expert tracery of an Oriental print illuminates *Jade Vision*.

Purchasing one Bill Evans album usually develops a taste for the others, and the Vanguard audience acts as though it was converted long ago. The pianist thrives in the club atmosphere of his first live date, and there are spontaneous, extended treatments of Gershwin's *My Man's Gone Now*, Cole Porter's *All Of You*, and a thorough reworking of

* *732 The Parkway, Mamaroneck, N. Y.*



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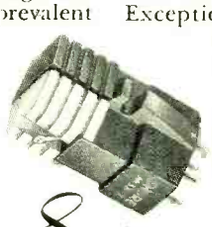

SHURE

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Alice In Wonderland. After a recent trip to record the living legends of New Orleans, Dave Jones is fully prepared for a location job in the wilds of Greenwich Village, and the stereo version throws the trio's inner works into bold relief.

Stanley Turrentine with The Three Sounds: Blue Hour

Blue Note Stereo ST84057

Not so long ago only the jazz chamber groups would consent to manufacture mood music, but now nearly every soloist of stature is being cajoled into turning out an album or two for the witching hour. Stanley Turrentine specializes here in the blues ballad, designed for the hours after midnight, and his full-bodied tone is a comforting sound in the night. In this subdued and slow-tempo context, his tenor-sax style is very close to that of Coleman Hawkins and Don Byas when they pioneered this sort of number in the '40s. One each set was all they would play though, and record companies began making them by the yard only recently. Among the titles are *I want A Little Girl, Since I Fell For You,* and *Gee Baby, Ain't I Good To You.* The Three Sounds are also specialists in creating a mood, having fashioned several similar albums, and they keep the lamps turned low behind Turrentine. Gene Harris, pianist and leader of the group, shares the solos and contributes *Blue Riff.* In the stereo version, engineer Rudy Van Gelder spreads a deep carpet of blues wall-to-wall.

Count Basie: Basie At Birdland

Roulette Stereo SR52065

Aside from being the first recording of Basie at home in Birdland, this on-the-spot album is the band's first since recent changes in personnel were made. Budd Johnson is securely settled in the sax section, forming a tenor-sax triumvirate with Frank Foster and Frank Wess that is one of the most formidable ever. Al Grey's place is filled by Quentin "Butter" Jackson, a trombonist whose growls and plunger-mute solos were once a feature of the Duke Ellington band. As is the case with so many live dates, the program consists of the band's most popular numbers, all previously released on one record or another. The excitement of Birdland is present in full force, however, and the band at its best. Jon Hendricks sits in as guest vocalist on *Whirly Bird,* and everyone rides out again on *One O'Clock Jump.* The version is spacious enough for both band and audience to feel at home.

Martial Solal: Europe's Greatest Jazz Pianist

Capitol Stereo ST10261

If European musicians are hopeful of attaining the jazz stature of Django Reinhardt, who never forgot his Gypsy upbringing, they had better take heed of their own surroundings and spend less time looking across the Atlantic. Before protesting that the soil is too exhausted to nurture jazz, they might examine musical impressions touring American jazzmen have brought back home from foreign lands during the last twenty-five years. And should further proof be necessary, there is the example of Martial Solal, an Algerian-born pianist of truly international disposition.

Solal, who learned from listening to Bud Powell, Art Tatum and Thelonious Monk, made his debut in this country on Contemporary seven years ago. What makes the difference this second time around is the wholly Gallic flavor of his own compositions, five of which complete one side. Supported by Guy Pederson, bass, and drummer Daniel Humair, he conveys the movement, sounds, smells and moods of Paris more vividly than many writers of sentimental ballads about the city. His ability to stand astride two worlds is best described by the title *Middle Jazz,* a work which wittily combines the earthy and urbane. On the reverse side are fine two-handed solo performances of standards, Monk's *Round About Midnight,* and Tadd Dameron's *The Squirrel.* France can keep its Michel Legrands and Andre Hodiers, provided a few more Solals come this way.

Stan Kenton: Kenton's West Side Story
Capitol Stereo ST1609

Leonard Bernstein's musical analysis of the folk mores found on Manhattan's teeming West Side presents ideal subject matter for the romantic Kenton approach and the fiery arranging talent of Johnny Richards. The team is perfectly suited to depict the contrasting emotions expressed in the score. Tender love scenes are set in motion by the leader's persuasive piano, and such practiced amorists as Conte Candoli, Sam Donahue, Marvin Holladay and Gabe Baltazar heighten the lyric moments which pass all too quickly on *Maria, Tonight,* and *I Feel Pretty.* An enlarged percussion section is employed to furnish exciting Latin rhythms as the neighborhood gangs engage in fraternal byplay, and Richards skillfully increases the tension when opposing factions prepare for battle. Both men share a flair for dramatic effects and take delight in dynamic climaxes, and the story affords every excuse for indulging in excesses of this sort. Except for a bit of Kenton concertizing at the opening and close, they both exercise admirable restraint, and Richards adopts the pleasant custom of offering several themes in reprise.

The new thing in the Kenton band is the mellophonium, and every follower of the group by now knows the distinctive sound four of these renegade French horns add to the ensembles. The section fills out the range in between trumpet and trombone, but Kenton also subdues the volume and attack of the other brass to favor his latest plaything. This season, and for as long as the romance lasts, the band will be operating at mellow and relaxed levels. All three sections are something to hear, especially in stereo, and Gene Roland's ominous solo on mellophonium provides a memorable introduction to the big rumble scene. Another stereo treat is the lively Latin beat of drummers Jerry McKenzie, George Acevedo, Lou Singer and Larry Bunker.

Ted Heath: Big Band Percussion
London Stereo SP44002

All the big guns on the London popular list received instructions to center in on Phase 4 stereo, and Ted Heath is one of the really big ones to sound off as the new series gets underway. When it comes to snappy exchanges between sections and colorful stereo action, the band hits the target every time. The much heralded fourth dimension depends upon an arranger's ingenunity at dramatizing a score by "incorporating true musical use of separation and movement". The idea works best when applied to tunes that create a mood, tell a story, or introduce such entertaining personalities as the mad drummers on *Drum Crazy,* a happy *Peanut Vendor,* and the persistent *Johnny One Note.*

The label's American branch is reported to have instigated the series after noting the large and growing market for stereo spectaculars in this country. Much planning was done over here, and quite possibly the unidentified arranger also hails from these shores. At least, the writing seems more appropriate for the faceless inhabitants of some New York studios than Ted Heath's band. By the time xylophones, maracas, ocarinas, triangles, bongos and scratchers have their say, little space is left for Heath to express his own personality. Worst of all, most of the jazz soloists are shunted aside for atmospheric noodlers on piccolo, flute and bass clarinet. The job of a jazz arranger, whatever the phase of his career, is still to write for a band and the individuals in it. Heath should be able to pick the pockets of one or two of his regular arrangers and find better versions of *Blues In The Night,* and *Mood Indigo.*

Heath's wide popularity among record purchasers in this country was established largely because of the concert hall realism London engineers gave the band. Dancers delighted in the natural sound, which often contrasted sharply with the compressed studio recordings produced here. Phase 4 places listeners right inside the band, and dancers will undoubtedly enjoy the lively

action on *Poinciana, Thou Swell,* and *Taking A Chance On Love.* Just how much armchair relaxing will be done is open to question, as anyone who remains seated during this production may still feel like one of the band boys chasing a fly in and around the music stands. Perhaps next year will usher in Phase 5, or super concert hall realism, which will take Heath fans right back to where it all started.

The Slightly Fabulous Limeliters
RCA Victor Stereo LSP2393

Now that the Limeliters are competing with the Kingston Trio on singing commercials as well as record stands, the question is which group will be the first to preserve these present-day broadside ballads in an album. Although the Limeliters pass up the chance this time, they come close on a daring opus titled *Gunslinger,* which gamely satirizes television westerners. The performance took place before an enthusiastic audience of 3,000 San Franciscans, and Lou Gottlieb is heard making humorous remarks to keep the crowd at bay between numbers. Nothing scares a crowd quite so much as brains, and Gottlieb is quick on the draw with the intellect. Alex Hassilev and Glenn Yarbrough are no slouches either, and the trio soon has everyone cowed into submission with a rapid-fire delivery of international folk ditties. Only Al Schmitt, who came up from Los Angeles to engineer the job, manages to escape unscathed as he faithfully records the event for posterity in wide-screen stereo. Soon every college group in the country will be trying its hand at the tricky arrangements of *Hard Ain't It Hard, Western Wind,* and *Aravah, Aravah.*

Edmundo Ros: Bongos From The South
London Stereo SP44003

Quite a bit can be learned by slipping into the New York High Fidelity Music Show on the day set aside for dealers, and keeping an eye open for reactions to anything new. Seeing the quizzical expressions of audio salesmen turn to beams of approval at this year's London exhibit is reason enough to believe that Phase 4 stereo has a brilliant future in store. At this stage of the game, however, reasonable doubts might be entertained as to what, if anything, lies ahead for bongos. But anyone so bold as to venture an opinion that nothing new can be done with the instrument must first take into account Edmundo Ros and his fellow drummers.

Latin percussionists are an inventive lot and always have something simmering on the back burner. When the time seems right, another set of rhythms is brought to a boil, and the dancing public usually heads for a course of lessons at Arthur Murray's or his British counterpart. Ros serves familiar tunes in a new guise on the Phase 4 menu, adding a conga beat to *Deep In The Heart Of Texas,* and a dash of cha-cha to *My Old Kentucky Home.* Ros refuses to leave the finishing touches to an arranger, preferring to create improvised bongo passages at the last moment himself.

Ray McKinley: Glenn Miller Time
RCA Victor Stereo LSP2436

Last summer's television series featuring Ray McKinley's new Glenn Miller orchestra kept the arranging staff working overtime to supply all the fresh material required. As bringing back summer programs for winter reruns is a rare occurrence, Miller fans must try to weather the snowstorms with this batch of encores and hope that the band will be on view again next year. The trusted Miller recipe of mixing the new with the old is followed, and the arrangers make certain each ingredient measures up to standard. The famous Miller sound gives new songs a familiar touch, and the old ones become crisp and vital. Lorrie Peters is everything a charming band vocalist should be on *Make Someone Happy,* and *I Could Have Danced All Night.* McKinley's antic drum figures enliven *Stumbling,* and Miller himself would approve of the danceable tempos and sharp stereo picture of the sections working together on *Misty, Satin Doll,* and *My Wonderful One.*

Eric Rogers: The Percussive Twenties
London SP44006

Some poor excuses for dance bands were around in the 20's, but few were as bad as recent attempts to recreate the era would lead television viewers to believe. Coon-Sanders, Ted Weems, Paul Tremaine, Ben Pollack and Jean Goldkette headed great bands, and all played better in person than on records or radio. In addition, many good regional bands made dancing in this country a pleasure. Things were different in England, where London kept the best bands to itself, and groups performing at the local dance Palais invariably sounded pretty awful. The worst practices of name leaders were imitated along with the good, and the resulting hodgepodge is being resurrected and peddled today.

Eric Rogers recalls the dear old Palais days, in the full sonic clarity and separation of Phase 4 stereo, as though they are among the fondest memories of his youth. A ruddy, low-sounding tuba growls instead of a trombone on *Tiger Rag,* and the whole band vocalizes on *Chicago.* A boy and girl sing sentimental duets on *Tea For Two,* and *Who?* A lone tap dancer is shadowed by a soft-shoe expert on *Me And My Shadow.* Some dispatches would have us believe this type of band is currently popular with smart Londoners, while the provinces now demand more recent fare.

Jack Teagarden: Mis'ry And The Blues
Verve VSTC257 (4-track stereo tape)

Stereo tape turns the burnished brass in this mother lode to pure gold, and Jack Teagarden's trombone never glowed with a more mellow sound. And no trumpeter more reliable and steady than Don Goldie

has partnered Big T since brother Charlie was a constant companion. If anything, Goldie is a performer of even greater versatility, with the exciting tone of Bix Beiderbecke, the blues cry of King Oliver, and the reserve strength of an Armstrong. Goldie matches the trombonist to perfection, and his featured solo has all the romantic warmth of a Billy Butterfield on the lazy *Afternoon In August*, a melodic interlude written by the sextet's clarinetist, Bill Stegmeyer.

Sharing honors with the brass team are two pianists, one a working member and the other guest arranger and composer, Don Ewell, who heads the rhythm section of Stan Puls, bass, and drummer Barrett Deems, shines brightly on King Oliver's *Froggie Moore*. Charlie La Vere, who once guided the notorious Chicago Loopers gang, met Teagarden when they both worked for Paul Whiteman, and the attractive title tune is entirely his doing. Among his other goodies unwrapped during the reunion are arrangements of Willard Robinson's *Don't Tell A Man About His Woman*, and Terry Shand's *Love Lies*. The lovely Shand melody receives unusual treatment, with organist Shay Torrent suppling a firm underpinning of sustained organ chords. The instrument is right at home in a jazz context for once, and the stereo effect infinitely enjoyable. The leader's voice is in fine form, especially during a reprise of *Basin Street Blues*.

MONO

Robert Johnson: King Of The Delta Blues Singers

Columbia CL1654

The Folk Lore Of John Lee Hooker

Vee Jay LP1033

The existing information about Robert Johnson is barely enough to constitute a legend, and blues collectors will be amazed to learn that he was born about the same year as John Lee Hooker. That both men grew up in the same part of the Mississippi delta country was known, but most experts thought the forty-three-year-old Hooker to be at least a decade younger than Johnson, whose death at twenty allegedly came about when a jealous woman poisoned his drink in 1938. The authority quoted on the liner is Don Law, who recorded the singer in 1936 and 1937 for the American Recording Company, and the news makes previous comparisons of the two men obsolete.

Johnson attended only five sessions in San Antonio and Dallas, recording a total of twenty-nine sides, and he died just before John Hammond was about to bring him to Carnegie Hall for the first "Spirituals to Swing" concert. Including six alternate masters and three titles never issued before, this new adidtion to the "Thesaurus of Classic Jazz" series supposedly accounts for twenty-two sides. As this writer has in his possession eight titles not listed, somebody's arthmetic is wrong.

Regardless of whether Johnson recorded more or less than two dozen blues, the total is still slight when stacked up against the hundreds of songs credited to Hooker, Big Bill Broonzy and others. But a quarter century has only added to Johnson's laurels, and his achievement is all the more remarkable for being over and done before his twenty-first birthday. Hammond calls him the greatest primitive blues singer of all time, and the LP is an essential primer of the blues. Apart from women and trouble, Johnson loved to sing of locomotion. The old Hudson comes to life on *Terraplane Blues*, and one of the best train blues ever is *Last Fair Deal Gone Down*.

Hooker is at the peak of his career, enjoying success on the folk music circuit and as a rhythm and blues performer. Although Vee Jay still assembles his LP's from assorted single sides, the sessions are no longer held in the back of a store. Except for two numbers from last year's Newport Folk Festival, the singer recorded his present offering at Chicago's Universal Recording Studios. There is enough variety to satisfy both audiences, and Jimmy Reed plays harmonica on four songs. Blues collectors will long conjecture what might be if Johnson were still alive and Hooker started recording in 1936 instead of 1949.

Eric Dolphy: Out There

Prestige/New Jazz 8252

Although Eric Dolphy is the only horn player on this test flight, the presence of Ron Carter in the quartet guarantees that there will be someone else able and willing to share solo duties on the first journey out there. Neither man is ready to break through the stratosphere just yet, but they both soar high enough to become acquainted with the risks involved. George Duvivier, bass, and drummer Roy Haynes provide a firm rhythmic base to depart from, keep the track clearly defined, and bring everyone back to earth safely. With all restrictions removed, Carter is free to indulge in unusual plucked or bowed passages, and the cello often pulses with a guitar-like throb behind Dolphy. Regardless of whether the cello belongs in jazz or not, bassists may lose their claim to the instrument if they keep on imitating guitarists. Perhaps the ire of a few guitarists will be aroused before long, and any battle for possession between the two groups should be exciting to watch.

Dolphy shifts smoothly from alto sax to flute or clarinet, checking his performance at various speeds and levels of atmospheric pressure. Unlike many of his contemporaries, Dolphy never becomes so rushed as to neglect quality of tone, and the bass clarinet shadings are delightful to hear on his own *Serene*, as well as a portrait of Charlie Mingus titled *The Baron*. And his ideas on alto sax manage to be challenging without sounding angry on the title tune, and Hale Smith's poignant *Feathers*.

ABOUT MUSIC

HAROLD LAWRENCE*

Passenger Or Back-Seat Driver— The Composer At Rehearsals

MOMENTS BEFORE he was to conduct the Brahms First Symphony, a celebrated European maestro paused in a backstage corridor, knelt before a bust of the composer, and whispered a short prayer. The gesture was straight out of the Romantic Era. Without bending a knee over it, most of this conductor's contemporaries also feel a profound reverence for the master musicians of the past. But relations between conductors and *living* composers have not always been as harmonious since the rise of the conductor in the second quarter of the nineteenth century.

In Imperial Vienna, composers were not allowed to be present during trial performances of their music by the venerable Philharmonic. Hugo Wolf, whose first orchestral opus was to be played on October 15, 1886, disobeyed the ruling. He furtively tipped a hall attendant to let him in, and slid into a seat in the darkened gallery. He should have stayed home. The performance, he reported later, was "Babel itself." Unaware that Wolf was in the auditorium, Hans Richter, the conductor, provoked an outburst of laughter at the conclusion of the run through when he remarked to the orchestral players: "Gentlemen, I should not have let the piece be played to the end, but I wanted to see for myself the man who dares to write in such a way about *Meister* Brahms." (A reference to Wolf's sneering criticism of the older composer in the *Salonblatt.*) The hot-tempered composer had to be restrained by his friends from challenging Richter to a duel.

So exalted was the reputation of the late Wilhelm Furtwaengler that not only the living but the dead were made to defer to him. Some of his German admirers went so far as to describe Beethoven as the "ideal Furtwaengler-composer." Berta Geissmar, who was Furtwaengler's secretary during the Thirties, illustrates the enormous influence the conductor wielded over living composers. Richard Strauss, who was present at a rehearsal of his latest opera, "Arabella," in 1933, suddenly left the hall, beckoning Dr. Geissmar to follow him. At a safe distance from the podium, Strauss now ventured the opinion that the winds seemed too loud throughout the session. He had hesitated to tell the conductor, however, because he "wanted to keep him in a good temper." "Couldn't you convey this to Furtwaengler?", he asked Dr. Geissmar.

It is interesting to note that Strauss had been an internationally recognized composer for some four decades when this incident took place. It is easier to appreciate Rachmaninoff's timidity at a rehearsal of his opera, "Aleko," in 1893. Tchaikovsky, sitting beside the young composer, asked him whether he approved the tempo at a certain point in the proceedings. Rachmaninoff confessed that he thought the pace rather slow but was afraid to tell the conductor. Tchaikovsky then rose and announced: "Mr. Rachmaninoff and I think that the tempo here might be taken a little quicker."

Without a Tchaikovsky at his side, what is a young composer to do when something goes wrong during a rehearsal presided over by a "star" conductor? In most cases, there is no problem, for the conductor will generally follow the composer's suggestions faithfully. Occasionally, however, difficulties arise from the way in which the latter frames his comments. One American composer, for example, was told unceremoniously to leave the hall when he had criticized the conductor's handling of the brass dynamics. Another left voluntarily, in a state of utter dejection, after he had attempted in vain to convey a point on rhythm to the maestro. Many young composers will agree with a charge levelled by the British composer, Richard Arnell, against "young conductors who analysed every bar (of your score), told you how badly you had written it and then went on to change all your tempi for the worse."

A composer's tempo, however, is a sometime thing, as performers have discovered over the years. Franz Kneisel, having performed the Brahms Violin Concerto for the composer, asked him whether his tempi were correct. Brahms shrugged off the question with the advice: "Just play beautifully." After hearing a rehearsal of his Quartet in G Minor, Debussy remarked to the instrumentalists, "You play the third movement twice as fast as I thought it should go . . . but it's so much better that way." It is a well known fact that age and tempi are closely interrelated. Brahms, for example, slowed down noticeably in his later years. So did Saint-Saëns who, in the words of Sir Thomas Beecham, "imbibed a taste for somnolent tempi." Knowing that the French composer was to attend a rehearsal of the Symphony No. 3 in C Minor, Beecham conducted it in a very deliberate style. After the performance, he asked Saint-Saëns for his opinion. "My dear young man," came the enigmatic reply, "I have lived a long while, and I have known all the *chefs d'orchestre.* There are two kinds; one takes the music too fast, and the other too slow. There is no third!"

Toscanini, on the other hand, neither asked for tempo indications nor accepted the composer's recommendations when he performed *Boléro.* Ravel was present during a Toscanini concert at which his orchestra *tour de force* was presented, and was horrified at the conductor's choice of tempo. True to form, the Maestro had taken the work at an unusually brisk pace. Ravel rushed backstage after the performance to register his vehement disapproval but apparently made no impression upon the willful conductor, who did not alter his future performances of this work.

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

It is bad enough for a conductor to ignore the composer's wishes, but he is hitting below the staff when he claims that his interpretation of a work is better than that of the composer. Such was the case when Angelo Mariani spread the word that he had conducted a *Forza del destino* superior to the one Verdi himself had directed at La Scala. For that display of vanity, Mariani lost the composer's friendship and, out of pique, stopped conducting Verdi operas and began to promote Wagner instead.

The Verdi-Mariani episode to one side, composers have learned much from experienced conductors when their works were being test-piloted at rehearsals. Rimsky-Korsakov recorded his musical indebtedness to Napravnik, who rehearsed and gave the first performance of the opera, "Maid of Pskov:" "The recitatives he led in (normal) time, and that angered me greatly. Only later did I grasp that he had been right and that [they] had been written inconveniently for free and unconstrained declamation, as they were overburdened with various orchestral figures."

There are times when a conductor is given more latitude than he would like. Sir Henry J. Wood was rehearsing Delius's "Eventyr" when "there occured a debatable wood-wind chord. . . . Turning to the composer by my side," Wood wrote, "I asked him if the note on the chord in the second beat was a G Sharp or a G Natural. Delius's reply was: 'I don't know. I'll leave it to you.'"

The conductor of a Stravinsky work need never fear encountering this snag with the composer present. Stravinsky's meticulous approach to his craft embraces not only the printed score but such peripheral details as the acoustical setting in which the music is performed. During a rehearsal of "Apollon Musagète" in Berlin with Otto Klemperer conducting, Stravinsky "was struck by both the confusion of sound and the excessive resonance. Far from standing out in the ensemble, the various parts merged in it to such an extent that everything seemed drowned in an indistinct buzzing." The orchestra under Klemperer's direction comprised the following instruments: 16 first violins, 14 second violins, 10 violas, 8 celli, and 6 double basses. Stravinsky reduced these forces to 8-8-6-8-4, and "the alteration immediately produced the desired effect;" he reported. "Everything became sharp and clear."

It was Stravinsky who may have summed up what every composer looks for in the ideal conductor, when he praised Monteux's "clean and finished execution" of the "Rite of Spring." "I ask no more of a conductor, for any other attitude on his part immediately turns into *interpretation*, a thing I have a horror of." Æ

NEW PRODUCTS

● **Battery Operated Fully Transistorized Tape Recorder.** The Norelco "Continental 100" (Model EL3585), a portable, fully transistorized, battery operated, high fidelity tape recorder, has been announced by the North American Philips Company, Inc. Weighing only 8 lb. and using 6 "D" flashlight batteries the "Continental 100" records speech and music, making it ideal for use by music lovers as well as by many others. The "Continental 100" operates at a constant 1⅞ ips and will provide up to 2 hours of playing time on a single 4-in. reel. The unit incorporates an erase head and a 2-track, record/playback head, and has a frequency response of 100–6000 cps. Distortion is extremely low, due in part to the push-pull output stage and the push-pull bias oscillator. The "100" is provided with a transparent lid which fits over the tape reels and can be kept on

while the unit is in operation, eliminating dust and offering protection against wind, rain or snow. A removable carrying handle enables the user to record and playback while on the move. Completely self-contained, the "Continental 100" includes recording and playback preamplifiers, power amplifier, and loudspeaker. The unit is also equipped with a Norelco dynamic cardioid microphone which fits into a recess in the recorder. To insure constant speed, the tape transport mechanism is capstan flywheel driven, and the motor speed, regulated by a special governor, is independent of battery voltage. Accessories, which are available separately, include: special connecting cables, shoulder strap, and carrying case. North American Philips Company, Inc., 230 Duffy Avenue, Hicksville, L.I., N. Y. **M-1**

● **Transistorized FM Stereo Tuner.** Featuring 20 transistors and diodes, the TEC FM-15MX FM-Stereo tuner receives either monophonic or stereophonic program material and matches the TEC S-15 Stereo amplifier. The multiplex section occupies

a space 2½-in. × 6-in. × 1-in. inside the FM-15MX. It incorporates 8 transistors and is completely automatic in operation. All circuits are factory aligned and pre-set and the inherent stability of transistors virtually eliminates any more adjustments in the future. The current drain is only 20 ma. The self-powered stereo adapter is available as a separate unit, the TEC Model 400. Sensitivity of the FM-15MX is 2.5 μv for 30 db of quieting. Frequency response is within 1 db from 20 cps to 20,000 cps. Output level is 1 volt at 100 per cent modulation. Price of the TEC FM-15 MX FM-Stereo tuner is $179.50. The TEC 400 self-powered Stereo Adapter is $79.50. Transi-Tronics, Inc., 1601 West Olympic Blvd., Santa Monica, Calif. **M-2**

● **Transistorized Multiplex Adapter.** A compact, transistorized stereo multiplex adapter which, it is claimed, will convert any conventional FM tuner or receiver to stereo reception has been designed by ABC Electronics, Inc. The self-contained and self-powered adapter converts FM broadcasts into the right and left channels or a compatible mono signal. The front panel stereo balance control knob provides optimum balance between channels. The Model #611 Multiplex Adapter is quickly and easily attached to all discriminator-type multiplex tuners or to any

other FM unit. The adapter features a simple, yet effective switching arrangement. In addition to the balance control knob, there is a two-way switch for FM and Multiplex. Special low-loss input cables prevent serious loading of the FM or tuner—whether discriminator or ratio detector type—as well as reducing overall distortion. Separation is at least 20 db over the entire audio range, with frequency response from 30 to 15,000 cps on both channels with full separation. Carrier insertion is achieved by means of a self-contained 19,000 cps oscillator and doubler which insures lock-in of pilot carrier . . . even under fringe area conditions. The ABCO #611 Multiplex Adapter contains four transistors and requires no warm-up or outside power source. All units are factory adjusted and aligned and measure 3-in. wide × 4-in. high × 5-in. deep. Retail cost per adapter is under $40. ABC Electronics, Inc., 611 Brookhaven Drive, Orlando, Florida. **M-3**

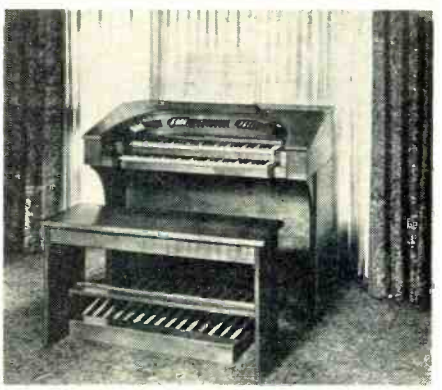
● **All Transistor 50-Watt Stereo Amplifier Kit.** Employing 20 transistors and four diodes, the Knight-kit KX-60 incorporates a full complement of stereo features. Among advantages listed by Allied are virtually no hum or noise, no microphonics and no

warm-up period required. Cool running and compact dimensions allow easy installation with very little ventilation required. The unit provides 25 watts per channel for a total 50 watts IHFM output. A special "Thermal Feedback" circuit stabilizes the amplifier OTL output stage. Frequency response is given at −1 db, 20–20,000 cps. Harmonic distortion rating is less than 1.0 per cent at full output. Hum is stated as −90 db at the tuner input, −60 db at the phono input. Because the KX-60 uses no tubes or output transformers, it weighs only eight pounds. Miniaturized components permit compact size: 2¾-in. high, 11-in. wide and 9¼-in. deep. Five pairs of stereo inputs accommodate a variety of sound sources—including tape head. Control is provided for separation, plus dual-concentric, clutch-type bass and treble controls. Easy-to-follow, step-by-step instructions are provided. No electronic or kit-building experience is required. Priced at $79.95 less case, the KX-60 is listed under Allied No. 83 YU 994. Optional metal and oiled walnut cases are available. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Illinois. **M-4**

● **FM Stereo Tuner.** Designated the 3457-MX FM-Stereo Tuner, this new Eric unit combines the low silhouette design features of the Eric Gold-Line FM tuners plus built-in multiplex circuitry. A Foster-Seely discriminator circuit assures low noise levels and minimum distortion. Sensitivity of the 3457MX tuner is less than 1.0 uv for 20 db of quieting, producing extremely low interstation levels. Response is 20 to

20,000 cps and an automatic frequency control, plus defeat, prevents station drift. General Electric "3-in-1" Compactron tubes are employed and the unit features the exclusive Eric "Stereo Announcer" which automatically lights up when FM stereo is being broadcast. The 3457MX is available with walnut or metal enclosures. Dimensions are: 13¾-in. × 4-5/16-in. × 8¼-in. deep. Weight is approximately 9 lb. Price in the West is $119.95, slightly higher in the East. Eric Electronics Corp. **M-5**

● **Two-Manual Organ.** Artisan Organs, a division of Dorsett Electronics, Inc., has introduced a new two-manual theater-styled organ. Known as the York, it features full 61-note manuals, a 25-note concave-radiating pedal board, and a curved "horse shoe" stopboard with 40 multi-colored stop tablets. The compact console,



ideally suited for homes, offers an impressive stoplist of authentic theater voices characteristic of the great romantic theater organs of the 1920's. Other features include dual expression pedals, separate vibrato on each manual, and independent oscillators for each note. As accessories,

SUPERB NEW SCOTT MULTIPLEX TUNER KIT

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The new LT-110 Scottkit features a pre-wired and tested multiplex section plus the famous silver-plated factory-built and aligned front end. Sensitivity of this magnificent new tuner is 2.2 μv (IHFM). There are special provisions for flawless tape recording right "off-the-air."

Scott multiplex circuitry has become the standard of the industry. Scott Wide-Band multiplex tuners have been chosen by leading FM stations from Boston to San Francisco. Here is a proven, accepted multiplex tuner you can now easily build at home. Choose the finest . . . choose H. H. Scott.

Outstanding features of this easy-to-build Scottkit include:

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Sensitivity 2.2μv, IHFM. 10 Tubes, 11 Diodes. Switchable AGC. Separate Sub-Channel Noise Filter; Illuminated Precision Tuning Meter; Special Front Panel Tape Recorder Facilities. Five Front Panel Controls. Logging Scale. Exclusive Copper-Bonded Aluminum Chassis.

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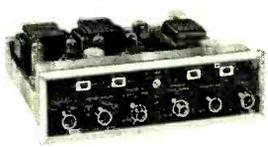
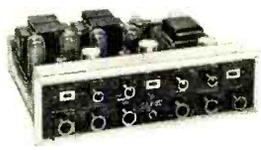


New LK-48 48-watt Stereo Amplifier Kit. A real best-buy in kits. All the features you need. **$119.95***



LK-72 80-watt Stereo Amplifier Kit. Enough power for any system. Famous H. H. Scott quality. **$159.95***

New LM-35 Multiplex Adaptor Kit. For use with any H. H. Scott tuner. Pre-wired multiplex section. **$79.95**

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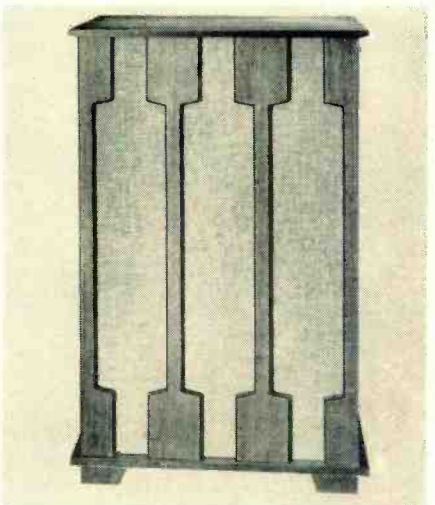
*Case extra. Slightly higher west of Rockies

Artisan offers the Band Box and Orchestra Bells, which add a variety of instrumental effects commonly found in theater organs but as yet not successfully duplicated electronically. The York is available in either finished or kit form. Artisan Organs, 4949 York Blvd., Los Angeles 42, California. **M-6**

● **Professional Recording Lathe.** Of interest to the recording industry is a new professional recording lathe from Fairchild, the Model 740, recently introduced at the Audio Engineering Society professional products show. Designed along the usual Fairchild robut design concept lines, the 740 includes many outstanding and unique features including: a three-speed belt-drive unit, with a two-speed hysteresis synchronous motor designed to eliminate belt stretch; low noise characteristics, –65db below a 5 cm/sec signal, wow and flutter, .03% peak-to-peak; variable pitch, 100 to 1000 lines-per-inch, continuously variable; LPI unit driven separately by a hysteresis synchronous motor permits automation of LPI with minimum expense; suction hold-down disk—no suction noise in disk hold-down design; turntable weighs 35 pounds; microscope travels on its own feedscrew allowing "standing still" images of the groove being cut, the microscope is

provided; fast changeover from one cutter to another through the use of an exclusive mounting for the cutter. The Model 740 is priced at $2575 (without recording head) as illustrated. Fairchild Recording Equipment Corp., 10–40 45th Ave., L. I. C., N. Y. **M-7**

● **Stereo Speaker System.** A specially designed stereophonic speaker, known as Symphony No. 1, Model B-4000, is claimed to overcome the difficulties encountered in



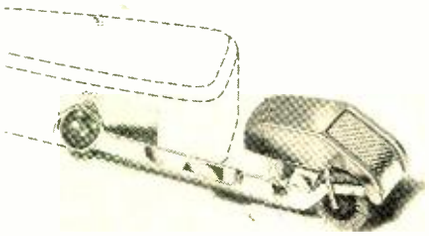
attempting to reproduce music stereophonically in large rooms—a "hole in the middle" of an orchestra with speakers spaced normally for the room dimensions or a "compressed orchestra" if the speak-

ers are close enough together to fill the hole. Through a new speaker configuration employing eight tweeters in a column, a special mid-range unit and two woofers, the Symphony No. 1 achieves even distribution of highs throughout a room in the horizontal plane and concentrates the highs in a narrow vertical beam at listening levels. The effect of the arrangement is that "perspective is maintained not only in width, but also in depth. Instruments sound in their proper places, not just left, right or center, but closer to or farther from the listener." Symphony No. 1 is housed in a cabinet designed to blend with contemporary, traditional or Far Eastern decor. Measuring 44-in. in height, 27¾-in. in width and 16-in. in depth, it is available in certified walnut, mahogany, ebony or fruitwood finishes. Specifications for Symphony No. 1 include frequency response from 35 to 20,000 cps with cross-over points at 200 and 1500 cps and impedance of 8 ohms. To attain the full dynamic range available from the units, Bozak recommends amplifier power of not less than 30 watts per channel. The R. T. Bozak Manufacturing Co., 587 Connecticut Avenue, South Norwalk, Connecticut. **M-8**

• **New VTVM Kit.** Production of a new vacuum tube voltmeter providing entirely electronic, direct-reading measurements of a.c. and d.c. voltages up to 1500 volts in five ranges, and of resistances of 0.2 ohms to 1000 megohms in five ranges, has been announced by EICO. The new Model 222, available in both kit and wired form, is the latest in EICO's new series of test instruments. Featuring calibration without removal from cabinet, the new unit also has complete electronic overload protection (plus fuse), 1 per cent ceramic resistors

throughout, and zero center scale. Input impedance is 11 megohms on d.c., 1 megohm on a.c. Voltage ranges on both a.c. and d.c., designed for maximum usefulness, are 0–3, 15, 75, 300, and 1500; up to 30 kv may be measured using EICO's HVP probe with 1090 megohms Multiplier Resistor. Frequency response is 30 cps to 3 Mc; frequencies up to 250 Mc can be read with EICO's PRF probe; peak-to-peak readings directly on the d.c. scale are possible with EICO's PTP probe. Resistance measurements of 0.2 ohms to 1000 ohms can be made using only the 1½-volt battery supplied, eliminating danger to delicate apparatus. Supplied complete with EICO's exclusive, time-saving, patented Uni-Probe (which can be used for measuring a.c. volts, d.c. volts, or ohms, simply by turning the probe tip) the new unit sells for $27.95 in the kit, $42.95 fully wired and tested. EICO, 33–00 Northern Blvd., L. I. C. 1, N. Y. **M-9**

• **Dust Bug For Changers.** A completely redesigned changer model of the famed Dust Bug developed with STEREO requirements in mind, is now being marketed by Electro-Sonic Laboratories, Inc. Like the standard model, the new Changer Dust Bug sweeps each record clean just before the stylus plays the grooves. Both models utilize a brush of individually pointed soft nylon fibers in conjunction with a cylindrical plush pad. Both are dampened with a special, antistatic fluid which collects groove dust and lint and neutralizes electrostatic charges on the record. Features of the new Changer Dust Bug include instant installation on any tone arm, no vertical stylus loading on the cartridge, and



user replaceable brush and pad. The Changer Dust Bug sells for $4.75. Removal of dust enables the groove to better control the stylus, reduces tracking distortion, and assures maximum tonal quality from fine recordings. Electro-Sonic Laboratories, Inc., 35–54 36th St., L. I. C. 6, N. Y. **M-10**

NO. 8 — "THE AGE OF THE SCREAMING BRASS"

Most of us get up in the morning with a tired heavy feeling. This is our morning lethargy.

It is perhaps 7 a.m. You dial a radio station for news or weather, but only insolent jazz claws at you. Station after station spewing its salvo of sound and noise which later in the day you might recognize as third on the hit parade or a twangy hill-billy song. Do the stations believe there are hotcha parties going at full swing at this hour? What kind of persons direct these programs?

Here we are, the first fifteen minutes of the day, suffering the universal morning sickness, with an aching back, with foul breath and clammy eyelids, and a slight nausea in front of the bathroom mirror, with our physical and psychotic maladies not yet repressed for the day. What we need is mollifying music until we have adopted our personalities like a cosmetic with which to enter life this day. But instead, there is only music with a STING . . . like a spike driven thru one's eardrum. There is only discord like a sustained toothache.

What manner of fiend directs these early morning programs? How can he lack compassion for the awakening world?

The trumpets screech, the saxes and horns shriek, the bursts of brass and "Tiger Rag" give vinegar and salt to our raw wounded morning nerves. How better to jar the nerves than with this metallic discord, or with three sisters singing off-key, or a bandleader with a cannabalistic throat throbbing with coarseness and suggestiveness? These are perversions of melody, desecrations of emotions. These are tunes with warts, songs with canker and rash, sounds with a quick life . . . like a firecracker. These are cannonades of cacophony shot at us when our resistance is lowest.

I can accept a blues or a ballad even tho it sounds like a calf mooing for its mother, if it was pitched toward some degree of aural comfort. But the brasses rupture the basilar membrane, cut thru bone and blast the brain.

There is more disruptive power in these sonic bombardments than the FCC is aware of. Take WXYZ-AM which "blankets 25 million" with more noise, commercials, music blasts per second than the mind can follow. I once counted seven commercials of "WXYZ" in forty seconds, and there was room between them for wise cracks, bursts of brass, screams, thunder, shatter of glass and heinous blood-curdling sonic stings.

One of our laboratory tests for loudspeaker endurance and power handling capacity is to drive the speaker from a radio program thru an elapsed-time clock with the volume set to a carefully adjusted average power level. The object is to determine the hours of operation at high levels before failure. Because of the intense sound the speaker is placed in a large padded box located in a pit in our boiler room as otherwise the sound can be heard thruout the entire plant and probably into the next county. The same program may feed the plant's music distribution system.

We can manage a meaningful test on any 24-hour station except WXYZ-AM. It seems their radiation is unique. We can always count on burning out the voice coil when tuned to this station. There is more heat quantity, more mechanical stress, greater transient peaks than on any other station in the same short period of time. There are no pauses in their modulation. There are no gaps between energy bursts, transients follow each other before the preceding one has decayed, the energy is belted out at machine gun rate.

A keen human mind can assimilate about 5 bits of information per second, but this comes at one like a shower of white hot sparks and our brain is riddled with confusion and our nerves are left jumpy and torn. We have a law in our plant: anyone tuning in WXYZ-AM is summarily fired.

Perhaps I have indulged in some exaggeration here. It is the season. Merry Christmas and happy New Year. And do write for literature on our speakers. We have tremendous quantities of it.

AUDIOCLINIC

(*from page 4*)

Some of what I have already outlined you have already done. I merely wish to impress upon you the need for maximum refinements of these techniques.

You are now ready to try the tuner to see if the problem has been reduced or eliminated. Since it may not be eliminated even now, procede to the next step.

An antenna of the type we have discussed possess considerable apparent gain. Therefore, the signal from the wanted path may have sufficient strength to overload the receiver. Thus, a booster located on the mast near the antenna (as described in your letter) might add to your difficulties even though the booster would increase the ratio between the signal supplied to the tuner by the antenna to that of the unwanted signal supplied to it by the line. Even if the overload does not occur, it is wise to reduce the amount of signal entering the tuner. You must keep decreasing the amount of signal until the reception of the unwanted signal path is attenuated to a point where the a.g.c. of the tuner will act to eliminate it.

Let's look at it this way. Let's say that the original signal with the conventional antenna connected functioned so that the wanted signal path was equal to 100 per cent and that the unwanted signal path was equal to 80 per cent. The yagi just discussed will change this ratio so that the original wanted signal will equal 300 per cent and the unwanted signal strength will have the same strength as formerly or perhaps somewhat less. We now have a ratio of 15 to 4. When the receiver's gain is attenuated to a sufficient degree, this ratio will be sufficiently great to ensure reception of the wanted signal path only. (We hope for even better rejection from the beam, which will improve the ratio of wanted to unwanted signal path still further than the figures stated here.)

Attenuation is accomplished by means of an H-pad in balanced systems and a T-pad in unbalanced systems. Unbalanced systems are usually employed in tuners having 72-ohm input impedances.

Once installed and adjusted, the antenna should be rotated so that it points exactly to the desired station's transmitting antenna or perhaps in a direction which is opposite to the direction from which the unwanted signal path is coming. In other words, if the desired station is coming from the north and the unwanted path is coming from the northeast, it might be advisable to point the beam slightly northwest to set the unwanted signal further into the null portion of the array.

Now that the general idea has been discussed, a further word should perhaps be said about antenna adjustment. Adjusting a yagi or other parasitic array—colinears, long Johns, etc.—is not an easy thing to do, especially when the right equipment is not available. Therefore, if you do not have facilities for adjusting such an antenna system, obtain advice from a radio amateur who is experienced in VHF work and procedures. If you are unable to locate such a person, write to the American Radio Relay League, West Hartford, Conn. Request the names of people in your locality who might be in a position to help you. Æ

THIS MONTH'S COVER

In honor of Sweden's Christmas present to the U. S. market, the ribbon is adorning the new Luxor 1 MP410A Magnefon. The remainder of the system, which was photographed in the new Manhasset, Long Island, showroom of Audio Exchange, are Harman-Kardon Citations I, III, and V, as preamp, tuner, and power amplifier, respectively; a Thorens TD124 turntable equipped with a Grado arm and an Audio Dynamics ADC-2 cartridge; and the two speakers shown are Bozak bookshelf models. The equipment is mounted in a Danish Modern shelf assembly.

Photography by Mort Weldon, who used a Hasselblad 500C (which is Swedish) and three of the new Sylvania Sun Guns (which aren't) to provide the even illumination by bounce lighting.

TRANSISTOR PROTECTOR

(*from page 40*)

ment is not trying to take too much current.

Of course, you cannot expect the protector to think for you. Suppose you have two transistors in the equipment, one taking 10 ma and the other 900 ma. You just must not hope that this system will prevent the 10 ma transistor running up to 20, 30, 40, or 100 ma. That ought to be looked after in the circuit design anyway. Usually it is the big transistor which is the problem and it is not easy to think of normal circuits where the special difficulties arise.

There is one extremely important point to be watched when using a protector of this kind. The whole object of the exercise is to provide a constant current by using the very high collector impedance of the control transistor. If, therefore, you attach a simple amplifier to the terminals you have the protector trying to keep the current constant while the object of having an amplifier is to produce a varying current, the amplified signal. You will see that the results you get can only be thoroughly confusing. I do not think that this is at all a bad thing because I find that transistor circuits get designed on the bench with short connections to a good battery and used with long wires to an aging battery. This produces in a mild form the troubles which the protector highlights. We had all this long long ago with tubes when power supply units first came in and the magazines were full of articles on motorboating. When did you last see one of those? The answer is, as you well know, proper decoupling by means of a good big capacitor across the supply ter-

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AUDIO, published Monthly at Lancaster, Pa., for October 1, 1961

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher: Charles G. McProud, 204 Front St., Mineola, N. Y.; Editor: Charles G. McProud, 204 Front St., Mineola, N. Y.; Managing editor: David Saslaw, 204 Front St., Mineola, N. Y.; Business manager: Henry A. Schober, 204 Front St., Mineola, N. Y.

2. The owner is: Radio Magazines, Inc., 204 Front St., Mineola, N. Y.; Henry A. Schober, 204 Front St., Mineola, N. Y.; Charles G. McProud, 204 Front St., Mineola, N. Y.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue). 26.338

(Signed) HENRY A. SCHOBER, Business Manager.

Sworn to and subscribed before me this 14th day of September, 1961.

(Seal) Julius B. Korn, Notary Public.

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minals. Just how big depends on the circuit and the easiest procedure is to put an oscilloscope across the capacitor and check that the ripple voltage is small enough. The other simple test is to double the value you have and see if there is any effect: if there is, you have not enough capacitance. If there is no effect you can try a smaller value.

Using the Spacesaver transistor we saw that overheating would limit us to about 1 amp at 12 volts, less at higher voltages and more at lower voltages in proportion. If you need more current you must use a bigger transistor. I do not think you can rely on going to better than 2.5° C/W between junction and air and I should like to allow more than 50°C temperature rise at the junction. The limit is then 20 watts of dissipation which with a 12 volt system and a short-circuited output, which puts it at its worst point, means you can allow 1.6 amps. To handle more current in this arrangement you must use more transistors in parallel.

One way round this limitation is to modify the indicator circuit so that it has a relay in it. Once the indicator transistor starts to take current the relay pulls in and locks through one of its own contacts. At the same time another contact opens the supply to the device which is demanding too much current. In this arrangement you need a capacitor across the relay to make sure that it has time to lock in before it disconnects the supply. I would expect the first hook-up of this arrangement to give you the usual relay chatter trouble. My own needs for high current systems are met rather differently, which is why I cannot give details of the relay circuit. When you are using transistors a good deal and taking large currents it is worth-while changing from batteries to power supply units. Stage two brings in transistorized smoothing and regulation and in no time at all you reach stage three, with an automatic overload trigger which can be set to cut off the supply on overload. You put this in originally to protect the power supply but it also works well to protect the equipment. The design of a big power supply unit with full protection is something I hope to describe in a later article. *Æ*

FAILURE ALARMS

(*from page 44*)

the input and output connections are made to the equipment to be monitored, and both controls turned to their full off position. With the amplifier operating at its normal level, adjust *R2* so that the relay pulls in and operates the alarm. Next adjust *R1* so that the alarm

stops. If both sections of *V2* and *R12 R13* are closely matched, these settings will hold for a wide range of operating levels. The minimum input and output signal required for reliable operation is about 50 mv.

The power supply shown in *Fig.* 4 is suitable for use with any of the failure alarms described.

PARTS LIST
(*Fig.* 1)

R1	500,000 ohms, audio taper pot
R2	6800 ohms, ½ W
R3	820,000 ohms, ½ W
R4, R6	470,000 ohms, ½ W
R5	2.2 megohms, ½ W
R7	220,000 ohms, ½W
R8	1000 ohms, 1 W
R9	22,000 ohms, 5 W
C1	20 μf, 25 V elect.
C2	0.5 μf, 400 V
C3	.002 μf, 400 V
C4	30 μf, 150 V elect.
S1	s.p.s.t. toggle switch
K1	s.p.d.t. plate circuit relay, 8000 ohms, 1.6 ma (Sigma 4F-8000-S-SIL)
V1	6AU6
V2	12AT7

PARTS LIST
(*Fig.* 2)

R1, R4	470,000 ohms, ½ W
R2	1800 ohms, 1 W
R3	100,000 ohms, ½ W
R5	100 ohms, ½ W
R6	20,000 ohms, 5 W
R7	50,000 ohms linear pot
C1	1.0 μf, 200 V
S1	s.p.s.t. toggle switch
K1	s.p.d.t. plate circuit relay, 8000 ohms, 1.6 ma (Sigma 4F-8000-S-SIL)
V1	12AT7

PARTS LIST
(*Fig.* 3)

R1, R2	500,000 ohms, audio taper pot
R3, R4	4700 ohms, ½ W
R5, R6	470,000 ohms, ½ W
R7, R8, R9, R10	1.0 megohm, ½ W
R11	470,000 ohms, ½ W (see text)
R12, 13	10,000 ohms, 1.0 W (matched pair)
C1, C2	20 μf, 25 V elect.
C3, C4	.068 μf, 400 V
C5, C6	.1 μf, 400 V
C7	.5 μf, 200 V (see text)
C8	1.0 μf, 200 V
D1, D2	1N34
S1	s.p.s.t. toggle switch
K1	s.p.d.t. plate circuit relay, 8000 ohms, 1.6 ma (Sigma 4F-8000-S-SIL)
V1	12AX7
V2	12AT7

PARTS LIST
(*Fig.* 4)

R1	270 ohms, 2 W
C1	20 μf, 250 V elect.
S1	s.p.s.t. toggle switch
T1	Power transformer 125 V secondary at 50 ma; 6.3 V at 2 amp. (Stancor PA 8421 or PS 8416 using half of 250 V secondary)
SR1	Silicon rect. (Sarkes Tarzian M-150)

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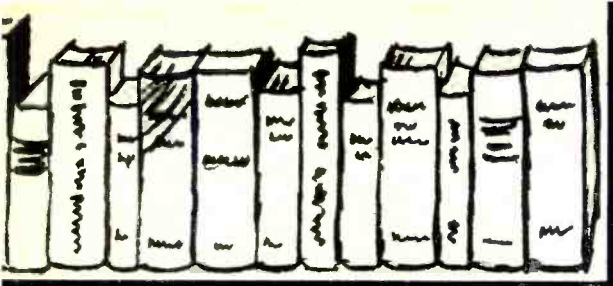

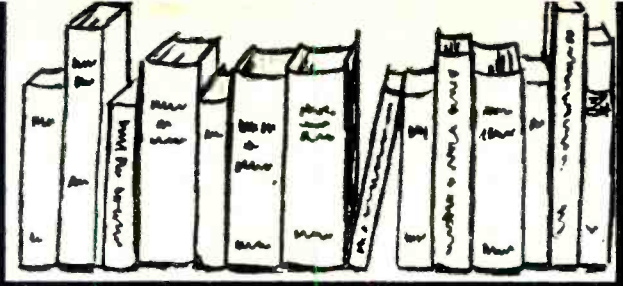

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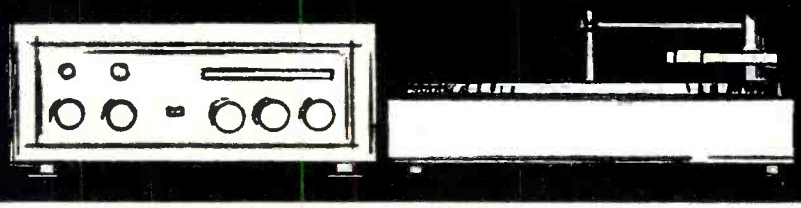

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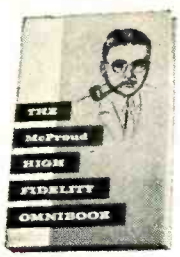

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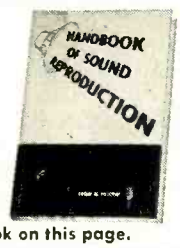

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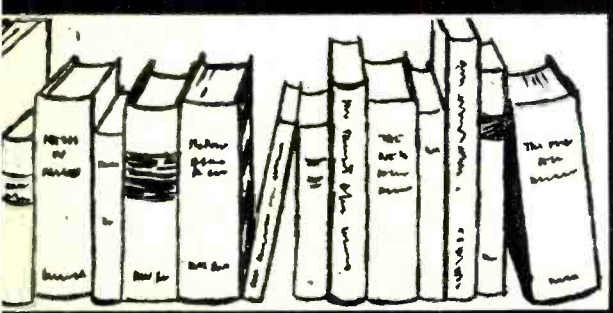

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AUDIO ETC

(*from page 60*)

Evidently, something in the 381, more compliant, differently tuned than in the 380, more delicately poised, just couldn't stand up stiffly against this arm's movements. No point in tracking the disease further, but it is well to note how crucial is the arm itself along with these newly delicate cartridges. I'd say, looking ahead, that the day of the all-purpose independent arm must be about over, as once was the all-purpose independent stylus, the old steel needle.

7/8 PRICE

I recently ran into a devastating bit of arithmetical sales logic while buying some soap which could apply neatly to somebody's upcoming promotion for, say, stereo speakers. HALF PRICE SALE was the statement I read on the wrapper around four bars of this soap. Great big letters. Then, in tiny letters, it said *"Buy 3 bars at regular price GET ONE AT HALF PRICE."*

Technically it was unimpeachable. You did, indeed, get one bar at half-price. But as most bright kids of eight could figure out, the sale itself was actually a seven-eighths price sale, at a 12½ per cent discount, off list. You had to buy all four bars—they were wrapped into one package.

Admittedly, this was merely a new dodge on the old 1 cent sale and an improvement, because the 1 cent sale left the discount wide open and it got liberaler and liberaler as the "list" price moved up. Here, the discount was safely fixed at the 12½ per cent figure, regardless. I suppose you could risk a one dollar sale in the hi fi area, but even so things might get a bit steep—for the seller. Say, a $99.95 FM tuner at regular price and a second for $1 . . . Ouch!

My diabolical thought is this. Why not use the soap approach and combine it, for one better, with the old "chicken in every pot and two cars in the garage" idea? Aren't we already trying to sell a second set of stereo speakers for the bedroom, or the patio or the kitchen? Didn't Plymouth sell *two* Plymouths in its ads last year?

So my scheme goes like this. Big ad. NOW—*DOUBLE* YOUR STEREO—BIG HALF PRICE SALE! (Boy, isn't that a whizzer! You get *four times* the value, maybe.) Then, in type of a somewhat more circumspect size, I would go on to explain that all you have to do is buy three stereo speakers at the regular price and you have the fourth at HALF price . . .

Thus can our fair English language be put to work to confuse the issue in a favorable sort of way, for sales. Needless to say, I do not really approve of my own scheme, nor of the slightly more innocuous soap scheme which, after all, involved only a few silly pennies. I don't know where we ought to draw a line between enhancement of the truth and exaggeration, or between exaggeration and straight distortion. I know only that people, even today, aren't as dumb as some people think they are. Especially when money is involved. **Æ**

ORGAN TUNING

(*from page 30*)

backs of the keys and pedals. Suitable wedges for use on the keys could be cut from a piece of ¼-in. wood. ¾-in. stock should be used for pedal wedges. If weights are used, a piece of ½-in square steel bar 4- to 5-in. long makes a good weight for the keys, while for the pedals, a piece of maple about 2-in. thick and as long as necessary to provide a weight of about three pounds will hold the pedal contacts closed. One of the 2-in.-wide faces of the block should be cut out in a "V" shape, so that the block will sit on the rounded top of the pedal without falling off. Covering both wedges and weights with lightweight felt is recommended to minimize the danger of scratching the organ.

The first step in the actual tuning process is to tune A below middle C to 220 cps. Use a flute tone if possible, as it has less harmonics than reed or string tones to confuse things. Tuning the A may be done by matching against a standard, such as a tuning fork or the WWV 440-cps tone, if either of these are available. Otherwise, it may be done by beating against the 60-cps power line frequency. Since the frequency ratio here is eleven to three, and is apt to be a bit difficult to spot, especially if the organ tone is not relatively free of harmonies, this is most readily done using an oscilloscope. By this method, connect the vertical input of the 'scope to the organ amplifier at any convenient point beyond the tone changers of filters. Feed the 60 cps line current to the horizontal input of the 'scope. (Usually, this can be done internally.) Block down the A-220 key to give a continuously sounding tone. Adjust the A-220 oscillator on the organ to 240 cps, which will show up on the 'scope as four vertical peaks for each complete horizontal sweep. Then reduce the oscillator frequency to the next point which gives a well-defined stationary pattern. This should be 220 cps, with the trace showing eleven vertical peaks to three horizontal. Don't go too far with the frequency reduction, or you will come up with a pattern at 210 cps, which is better defined than the 220-cps pattern but having a vertical to horizontal ratio of only seven to two.

When the A has been tuned to 220 cps, the remaining notes are to be successively tuned in the order shown on the chart. The A-220 and the E-329.63 keys are held down simultaneously. The E oscillator is adjusted to zero-beat, which may be either observed on the oscilloscope or determined by ear. This gives a 330-cps tone to which a small correction must now be made. The E oscillator must have its pitch lowered by 0.37 cps, which will cause ten beats in 27 seconds against the A-220. This can be seen on

the oscilloscope, but is probably easier to judge by ear, since then the clock is the only thing that needs to be watched. After the E-329.63 note is tuned, tune E-164.81 by zero-beating against its octave, just previously tuned.

The next note to be tuned is B-246.94, which is zero-beat against the E-164.81. It is then corrected by lowering its pitch by 0.27 cps, as indicated by ten beats in 36 seconds, when the two notes are held down together.

Tuning of successive notes is continued in the sequence indicated by the arrows on the chart. Octaves, of course, are to be zero-beat, but in every case of matching fifths, the upper tone is to be flatted, or lowered in pitch, by the amount equivalent to the number of seconds for ten beats shown over the corresponding arrows on the chart.

When the "finish" is reached, A-440 and A-220 should zero-beat with no further adjustment. If there are beats faster than about ten in twenty seconds, the procedure should be checked through again to eliminate the error.

If the instrument is one in which twelve master oscillators are used with frequency dividers, the above procedure completes the tuning of the entire organ. However, in an instrument with independent oscillators for each note, the remaining notes above and below the octave-and-a-half range must now be tuned to synchronization with those notes already tuned. This, although somewhat time consuming, is quite simple. Taking G as an example, synchronize or zero-beat G-784 against G-392, then G-1568 against G-784, and G-3136 against G-1568. Then going to the low end, zero-beat G-98 against G-196, and pedal G-49 against G-98.

One final precaution: Be very careful not to disturb any of the oscillators already tuned. A little carelessness on this point can undo everything previously accomplished. It would be a good idea to mark each oscillator as its tuning is completed, though I wouldn't recommend sealing the adjustments. That could cause considerable trouble the next time the organ has to be tuned. Æ

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FOR SALE: Fisher 101-R AM-FM stereo tuner, brass escutcheon, mahogany cabinet, $135.00; Altec Lansing model 830A Laguna speaker system, mahogany, $325.00; each used fifty hours. Stephen Leberer, 2232 South Clermont St., Denver 22, Colorado.

BACK ISSUES OF AUDIO. Have all. 50¢ each, prepaid. M. E. Boyd, 903 Salmon Drive. Dallas 8, Texas.

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SELL: Jensen 15" triaxial speaker model G-610B. Perfect new condition. Shipped from factory October, 1961, $150.00. N. E. Heinz, Hillcrest Park, Valparaiso, Indiana.

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SELL: Marantz amplifier model 9, monophonic 70 watts, one month old, $160.00; McIntosh AM-FM tuner model MR-55, $120.00; Electro-Voice tweeter model T350, $25.00; James B. Lansing 10" woofer model LE-10, $25.00; Jensen 8" woofer model PS-QF, $10.00. All good condition and perform like new. George Duenow, 725 W. 11th Avenue, Gary, Indiana.

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Industry Notes . . .

• **Omega Appoints Dickman.** Charles V. Dickman has been named Sales Manager for the **Omega Electronics Corporation** according to **Robert L. Scott**, President. Omega Electronics is a newly formed corporation which specializes in transistorized high-fidelity equipment. Administrative offices and production facilities are located at 10017 North 19th Ave. in Phoenix, Arizona. In his new post Dickman will guide the national sales of the Omega line. Co-founders of Omega are Robert Scott and **James W. Schwartz. Mr. Schwartz** has nearly 40 patents issued or pending in the electronics field.

• **Matthew Stuart to Market Korting.** Formation of a new division of Matthew Stuart & Co., Inc. to handle sales of the Korting line of tape recorders was recently announced by **Robert Pfeffer**, President. The new division is called the **Korting Recorder Sales Corp.** and is located at 346 West 44th St. in New York City. The new division is under the direction of **Arnold Damsky** and **Warren Weiss.** National marketing will be through a network of distributors who will provide local warehousing. The 300 authorized Matthew Stuart service stations will service the line.

• **"Altec's Big A."** A new promotional brochure entitled "Altec's Big 'A' Advertising and Sales Promotion Guide for 1961–1962" is being sent to all Altec authorized high-fidelity distributors. The 12-page brochure offers many proven advertising and merchandising aids to assist Altec distributors in improving local promotional activities in order to move stock faster. Some of the topics covered in the brochure are: How Altec's national advertising can work effectively at the retail level; Using local newspapers, radio, and TV effectively and economically; "Yellow Pages" advertising; A "Stopper Shopper" section offers display drapes, fluorescent illuminated signs, wall plaques, speaker racks, the Big "A" stereo demonstration display, and the new wide screen "Theatre Sound" banner. Included in the brochure is a selection of newspaper mats, counter displays, product mailers, loudspeaker enclosure brochure, catalog, and so forth.

SUBJECT INDEX

1961

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ADVERTISING INDEX

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