AUDIO

SEPTEMBER, 1962
50¢

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CDC

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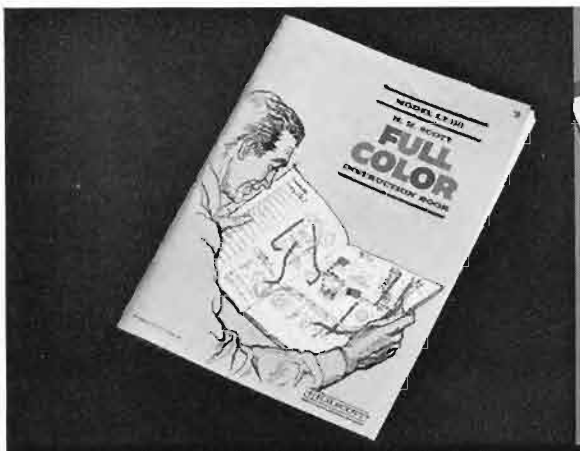
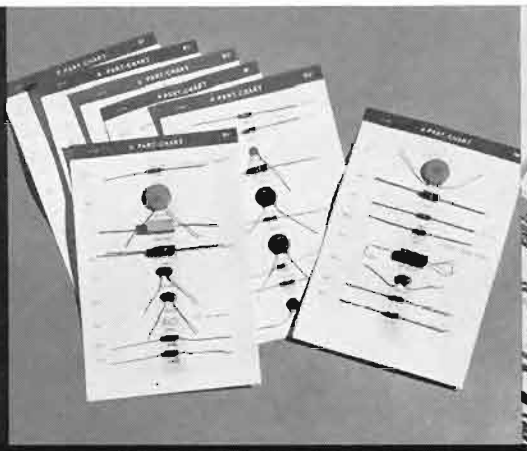
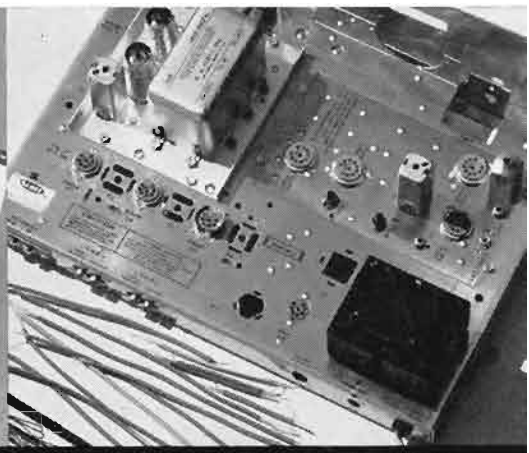


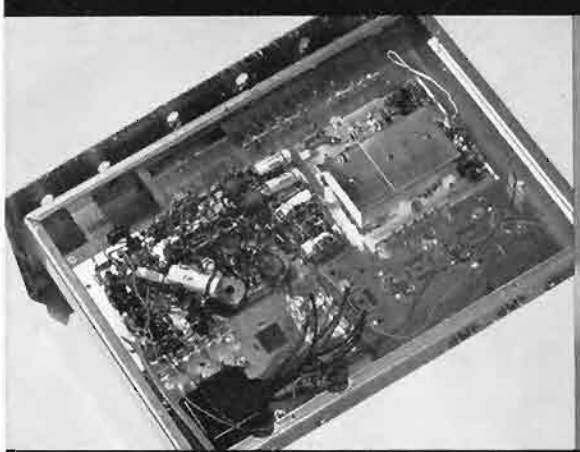
The exclusive Scott full color instruction book shows every part and every wire in natural color and in proper position. To make the instruction book even clearer, each of the full color illustrations shows only a few assembly steps. There are no oversized sheets to confuse you.



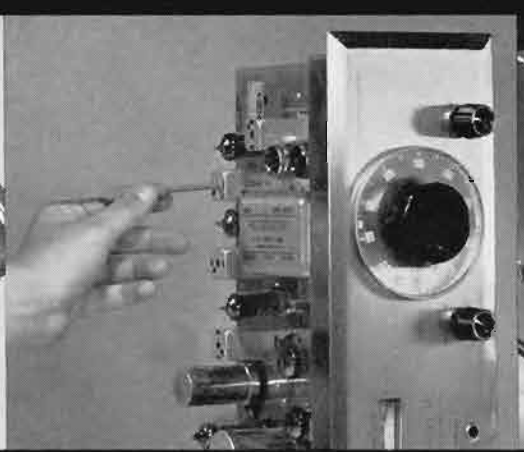
Each full color illustration is accompanied by its own Part Chart . . . another Scott exclusive. The actual parts described in the illustration are placed in the exact sequence in which they are used. You can't possibly make a mistake.



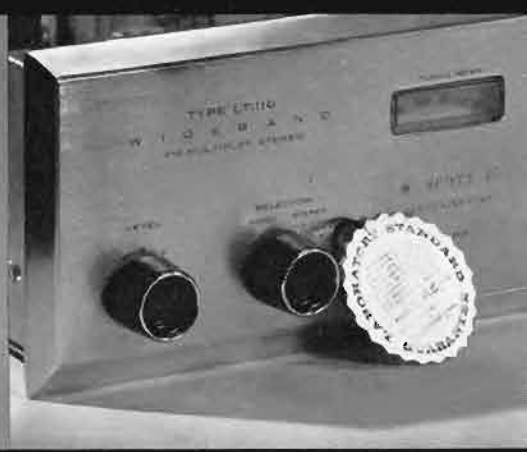
Much of the uninteresting mechanical assembly is completed when you open your Scott Kit-Pak. All the terminal strips and tube sockets are already permanently riveted to the chassis. To insure accuracy all wires are pre-cut and pre-stripped to proper length.



There are certain areas in every professional high fidelity component where wiring is critical and difficult. FM front ends and multiplex sections are an example. In Scott Kits these sections are wired at the factory, and thoroughly tested by Scott experts, assuring you a completed kit meeting stringent factory standards.



Tuners are aligned with the unique Scott Ez-A-Line method using the meter on the tuner itself. This assures perfect alignment without expensive signal generators. Amplifier kits require no laboratory instruments for perfect balancing.



The new Scott Warrantee Performance Plan guarantees that your kit will work perfectly when completed. If you have followed all recommended procedures and your kit fails to work Scott guarantees to put your kit in working order at the factory at minimum cost.

When you finish your kit you'll be delighted by its handsome good looks. And when you turn your Scott Kit system on you'll know for yourself why the expert editors of leading high fidelity magazines like Audio say . . . "only the most sophisticated engineering thinking could design a kit as simple and foolproof as this . . ." *

*Audio — February 1961, Pages 54-56

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AUDIO

SEPTEMBER, 1962 Vol. 46, No. 9

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Production Manager

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Business Manager

SANFORD L. CAHN
Advertising Director

EDGAR E. NEWMAN
Circulation Director

Representatives
Bill Pattis & Associates,
4761 West Touhy Ave., Lincolnwood 46, Ill.
James C. Galloway,
6535 Wilshire Blvd., Los Angeles 48, Calif.

Contributing Editors
EDWARD TATNALL CANBY
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AUDIO CLINIC

Joseph Giovanelli

Send questions to:

Joseph Giovanelli
3420 Newkirk Ave.
Brooklyn 3, N. Y.

Include stamped, self-addressed envelope.

Phantom-Channel Stereo

Q. At the present time I have a stereo system, each channel having its own 60-watt amplifier and speaker. I would like to add a center channel, consisting of half of the signal from channel A and half from channel B, but my stereo preamplifier does not have a center-channel output with a blend control as some others have. I'm going to use the same model amplifier and speaker for the center channel as I am now using for A and B.

My TV repairman—a hi fi expert according to his shop window—says that I should use a 50,000-ohm potentiometer with a linear taper after amplifiers A and B and take the center-channel output from the arm of the potentiometer and feed this to the third amplifier. I can control how much of signals A and B am mixing by turning the potentiometer shaft. An article in one of the hi fi magazines also says that the center signal should be created in this way, but it states that a 100,000-ohm potentiometer be used.

I feel that it would be better to mix the A and B signals directly after the stereo preamplifier, ahead of the power amplifiers. Because the preamplifier has less distortion than the power amplifiers, it would seem wiser to mix signals which are less distorted and feed these signals to the three amplifiers. In this way distorted signals from the A and B amplifiers would not be mixed and sent to a third power amplifier which would distort the mixed signals even more. It seems ridiculous to send a signal of but a few milivolts from a magnetic phono cartridge to a preamplifier which amplifies it to some two volts and then send this amplified signal to a 60-watt amplifier which amplifies it to some 20 or 30 volts, and then decrease this amplified signal with a potentiometer so as to be able to feed a third amplifier without overloading it. It seems like a very inefficient method of creating a third channel. Can you suggest another possibility by which this can be done? Stanley Alekman, Brooklyn, N. Y.

A. As you have described, it is possible for you to take the signals from the two power amplifiers by means of 50,000- or 100,000-ohm potentiometers and feed the resulting signal into a third amplifier. Remember that the power amplifiers do not have much distortion. Hence, little overall distortion will be apparent in the output of the third amplifier.

Actually, of course, you can create a third channel—better termed a phantom channel—by mixing at the outputs of the two preamplifiers. To do so, connect a 10,000-ohm resistor across the input of the third power amplifier. One side of each of the preamplifiers is grounded to the amplifier. Each of the "hot" outputs of the preamplifiers goes through a 100,000-ohm resistor to the "hot" input of the third amplifier. The resulting three-resistor network serves to isolate the signals of the two preamlifiers from each other so that crosstalk is reduced. This network, however, also reduces the gain by 20 db. If your power amplifier for the center channel does not have sufficient gain to make up for this loss, this system cannot be used. In addition, unless the third amplifier possesses a level control this arrangement provides no means of balancing the phantom channel with respect to the main channels. To overcome this difficulty a 10,000-ohm potentiometer can be substituted for the resistor. The low side of the potentiometer is grounded, the high side is connected to the junction of the two 100,000-ohm resistors, and the arm is connected to the input of the phantom-channel amplifier.

Still another approach to this problem would be to use a 12AU7 with both halves wired as cathode followers. The grid of each section is fed from one of the preamplifiers. The cathodes can be tied directly together and fed to the third amplifier. If desired, a small amount of isolation can be provided between the cathodes. The power for these circuits can be obtained from the amplifier serving as the phantom chanel. If the phantom-channel amplifier has no level control, a potentiometer may be substituted for its input grid resistor as described for the preceding arrangement.

Of the three schemes outlined here, I prefer the last arrangement as it offers maximum channel separation, minimum insertion loss, and minimum distortion.

Cartridge Orientation

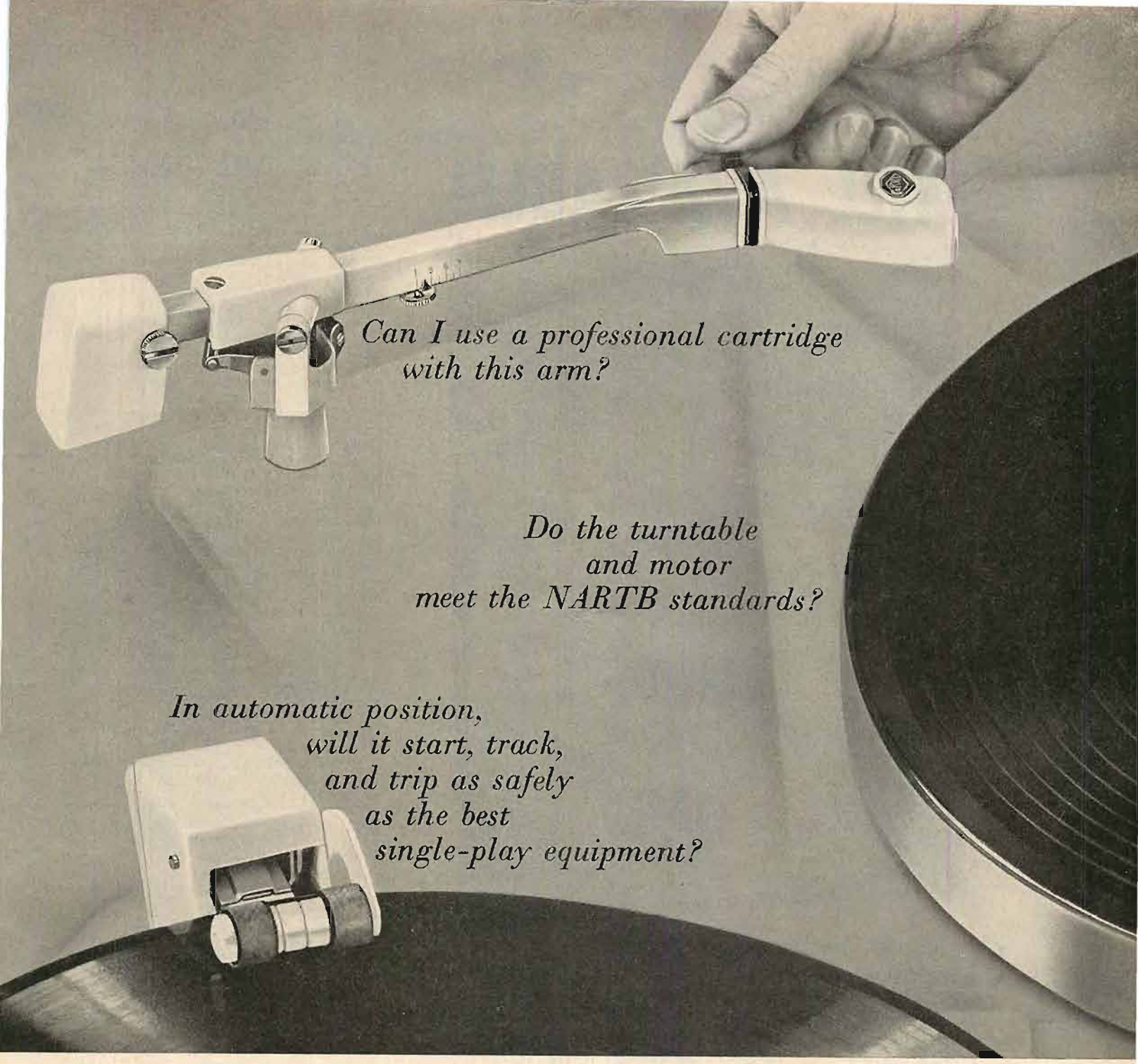
Q. I would like to know what the correct method of adjusting a cartridge for 45–45 operation is. As I see it, if the cartridge is properly mounted, the sound balance will be correct and surface noise caused by vertical components will be minimized. Is this a correct assumption? I make these statements because my stereo cartridge was not perpendicular to the record's surface. After bending the shell, the surface noise seemed considerably less and the sound balance more accurate.

If there is any lateral drag on the tonearm, would this also tend to unbalance the channels?

Which side of the record is the left channel? Edgar F. Keene, FPO, San Francisco, California.

A. You are quite right that the cartridge must be oriented correctly with respect to the record if the best sound reproduction is to be realized.

When I am confronted with the need to readjust the tilt of the cartridge—right to left azimuth—I assume that the shell and cartridge are both properly made. All that is needed, therefore, is to make certain that the cartridge is truly parallel



THE ANSWER: *Absolutely Yes!*

These are some of the questions people ask their dealers when they learn, to their surprise, that the Garrard Type A Automatic Turntable costs only $79.50. Some have assumed this must be the price of the turntable alone... certainly not the complete unit. These are intelligent questions, since a few dollars do not really matter when you are investing hundreds in a high fidelity system, expecting to be able to enjoy music free of distortion, and to protect your substantial investment in records. ☐ Chances are, for example, that you may want to use one of the ultra-sensitive cartridges developed originally for separately-sold tone arms because of their high compliance. Now, Garrard has integrated precisely such an arm into the Type A. It is counterweighted and dynamically-balanced... will bring out the best in the cartridge of your choice... tracking at the lowest stylus force prescribed by the cartridge manufacturer. Best proof of its capabilities is that the Type A tone arm is on the recommended list of every important manufacturer of professional-type pickups. ☐ The Type A turntable and its double-shielded motor were designed for each other. The cast turntable itself is something special... full-size, heavy (6 lbs.), balanced and non-magnetic. You will hear no wow, no flutter, no vibration. ☐ Many people consider Garrard's pusher platform the most important exclusive Type A feature. This is unquestionably the gentlest device ever designed for its purpose, and gives you the incomparable convenience and pleasure of automatic play whenever you want it. ☐ With all this to offer, it is small wonder indeed that Garrard's Type A, in a single year, has become America's number one high fidelity record playing unit. It is proudly owned by a growing legion of discriminating people who, originally amazed at the price, have come to realize this superb instrument could have been expected only from the Garrard Laboratories.

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to the surface of the record. Mount the shell but do not mount the cartridge. Next, place a record on the turntable—one which you don't mind scratching—and place the shell against the record. Adjust the arm assembly so the right and left edges of the shell are in contact with the record. This fact can be ascertained by trying to slip a piece of paper under the shell along each side. When the shell is truly level, or parallel to the record, the paper cannot be passed under either side of the shell. When making this test, make certain that the paper is placed under the shell at the front. If this is not done, the vertical angle between the arm and the shell will make it harder for you to obtain accurate adjustment.

After level has been achieved in this manner, mount the cartridge.

You are correct in the assumption that the drift of the arm will unbalance the channels to some extent. (However, I suspect that this is a function of the cartridge design.) With a changer this problem can be overcome to a great extent by leveling or raising the left end of the changer slightly above the horizontal. However caution is recommended in this procedure for this may impair the operation of the changer in terms of the automatic features. Further, some changers have provisions for balancing the tonearm, and this will enable the user to compensate for this drift to some extent. Many modern transcription arms are so balanced that they will play in almost any position, so the inward pull caused by tracking error and centripetal force is hard to eliminate completely.

With the arm in normal playing position, the left channel is represented by the material recorded on the left side of the groove and the right channel is carried by the modulation on the right wall of the groove. *Æ*

Audio Engineering Society
FOURTEENTH ANNUAL CONVENTION

Following is a list of the technical sessions to be held at the theater of the Hotel Barbizon Plaza from Monday, October 15 through Friday, October 19.

Registration takes place Monday through Friday, 9 a.m. to 8 p.m., in the mezzanine of the hotel.

Monday, October 15

9:30 a.m. MICROPHONES AND EARPHONES
1:30 p.m. AUDIO ELECTRONICS
7:30 p.m. LOUDSPEAKERS

Tuesday, October 16

9:30 a.m. DISC RECORDING AND REPRODUCTION I
1:30 p.m. DISC RECORDING AND REPRODUCTION II
7:30 p.m. RECORDING TECHNIQUES IN EUROPE
7:30 p.m. MUSIC AND ELECTRONICS (This session only held at McMillin Theater, Columbia University)

Wednesday, October 17

9:30 a.m. MAGNETIC RECORDING
1:30 p.m. REQUISITES OF MODERN TELEPHONY
7:30 p.m. STEREOPHONICS

Thursday, October 18

9:30 a.m. SOUND REINFORCEMENT AND ACOUSTICS
1:30 p.m. FM-STEREO BROADCASTING I

Friday, October 19

9:30 a.m. FM-STEREO BROADCASTING II
1:30 p.m. BROADCAST AUDIO AND STUDIO EQUIPMENT
7:30 p.m. PSYCHOACOUSTICS

Exhibit hours Tuesday through Friday noon to 6:45 p.m., except Thursday and Friday to 5:00 p.m.

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19. "Gorgeous colors." —Hi Fi Review

28. "Packed with rowdy gusto."—High Fidelity

5. The Rain in Spain, Show Me, 16 in all

2. I'm Always Chasing Rainbows, 12 in all

34. Also: The Boy Next Door, Bewitched, etc.

3. Also: How High the Moon, etc.

47. Isle of Capri, Siboney, Say Si Si, etc.

31. A Wonderful Guy, I Love Paris, 12 in all

4. Moonlight Bay, Avalon, 16 hits in all

13. "Fabulous sound." —Washington Post

30. Also includes: April in Paris, etc.

27. "Exquisite, glitters throughout."—Playboy

18. "A super soprano." —The New Yorker

46. Caravan, In a Persian Market, 9 more

8. "A glittering performance..."-Billboard

48. Rib Joint, With a Song in My Heart, etc.

20. "...perfect in stereo."—High Fidelity

45. Too Darn Hot, Bewitched, 43 hits in all

35. "Rich, bellowing sound."—Hi Fi Review

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4	18	31
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8	22	45
9	24	46
10	25	47
11	27	48
13	28	

35-WC

LETTERS

Low Power Amplifier

SIR:

After reading Mr. Giovanelli's excellent article on his stereo amplifier in the July issue, I feel compelled to forward some comments: 1. The 7189 tube may be considered an improved EL84/6BQ5, for it will allow an additional 75 volts on screen and plate—the limit is 375 volts. In my article in AUDIO (July, 1960) I covered the 7189A, an improved 7189, and new at that time. This tube will handle 415 volts, giving a bit more safety margin and power. Since then, RCA has released the 7868, and this Novar tube will handle 440 screen volts and over 500 plate volts. With a good 6600-ohm transformer, a pair will deliver over 20 watts at extremely low distortion. 2. I like Mr. Giovanelli's power supply; however, it should be noted that the Triad R63B is no longer in their catalogue. Also the R63B weighs 11 lb. whereas the R93A at 9 lb. may be connected for a 400-volt doubler supply at 250 ma. I should like to repeat my oft-made statement that, given a balanced push-pull pair and a good transformer, capacitor-only filtration has many advantages, and no hum. The choke and protective resistor are unnecessary. As to bias, a doubler circuit fed from a 6.3-volt filament winding will furnish a nice negative 18 volts, which is most satisfactory for the tubes covered above (7189, 7189A, 7868). 3. I am puzzled at the use of measuring resistors in the anodes. Marantz was the first to use the cathode resistors in class AB output, so far as I can find, and Hafler has covered the advantages of a single resistor in reducing residual distortion, especially low-frequency high-power "notch" problems. This is the reason I advocate the tying of the cathodes in the operating mode, for I follow Marantz's idea. The anode resistor acts as a nice current shunt, but what's the real advantage? The protective resistor and fuse in the 7189 cathode circuit are superfluous, for a fuse in each B lead would do.

L. B. DALZELL
1162 Fleetridge Dr.,
San Diego 6, Calif.

Silent Starts

SIR:

In reference to Mr. Canby's comments in your July issue of AUDIO on the EICO RP-100 Tape Deck: "Silent Starts" are not only possible, but quite easy if a loop is left between the friction filter and the capstan roller at the start of recording. The loop keeps the tape away from the record head during the time that the transient "pop" would normally be recorded. Even though there is a slight pull on the tape when the loop is pulled through, it is not sufficient to cause tape stretch or excessive wear on the heads if the recommended tapes are used. "Pops" may be eliminated from the finish of a "take" by allowing about a foot of tape to pass before pushing the stop button and then rewinding this foot by hand, so that the ending "pop" passes over the erase head when the loop for the next "take" is pulled through. For the tinkerer, a worthwhile addition is a second pair of tape lifters which are operated manually and accomplish the same functions as the above involved process. These can be fashioned from a small piece of metal (such as leftovers from chassis work) and two chrome plated (or any hard smooth material) spaces. I used wafer switch spacers.

JOHN R. O'NEILL,
Doherty, Clifford, Steers & Shenfield, Inc.,
530 Fifth Avenue, New York 36, N. Y.

Multipath Distortion

SIR:

It was quite interesting to read the problem of multipath distortion in FM reception presented by Mr. Westmoreland of San Francisco to the AUDIOCLINIC in the December issue of AUDIO. I really admire the efforts made by Mr. Westmoreland to try to clear up the problem, and want to add a few lines to Mr. Giovanelli's excellent advice. Multipath reflections in VHF possess both *horizontal* and *vertical* components (we are not talking about the polarization of the wave, but merely the direction of the wave propagation). Therefore, if a strong reflected signal comes from almost the same direction as the source signal (in the case of the reflecting surface such as a building), and if you are adjusting a directional antenna in the horizontal plane only, you may not be able to reject the noise, no matter what you do. Thus, you may have to adjust your antenna both horizontally and vertically. Sometimes it is very worthwhile to investigate where the strongest reflection comes from. By careful study of the local building orientations, you may be able to pin-point the trouble.

YOHAN CHO,
179 Hunnewell Ave.,
Newton, Mass.

More Single-Speaker Stereo

SIR:

In reference to the article "Single-Speaker Stereo" by L. H. Garner in the April AUDIO, as a mechanical engineer, I am rather disappointed at Mr. Garner's lack of attention to detail. In his circular track configuration he has forgotten to give the method for calculating the centrifugal force, and the selection of a suitable safety factor. Without due attention to this, the listener is likely to get a very real feeling of "bass, right in the stummick."

I am thinking of designing a modification of this idea even superior in performance. It will incorporate both the lateral and the circular track methods. To this end I am entering negotiations with our local gas station owner for the use of his grease-pit hoist. In addition to this, I am thinking of a pneumatic pressure system (servo-controlled from Mr. Garner's sync system) to raise and lower the hoist, thus adding, at last, the long awaited 4th dimension to stereo.

A. FULTON
118 Cartier St.
Ottawa 4, Ont., Canada

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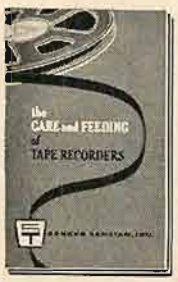
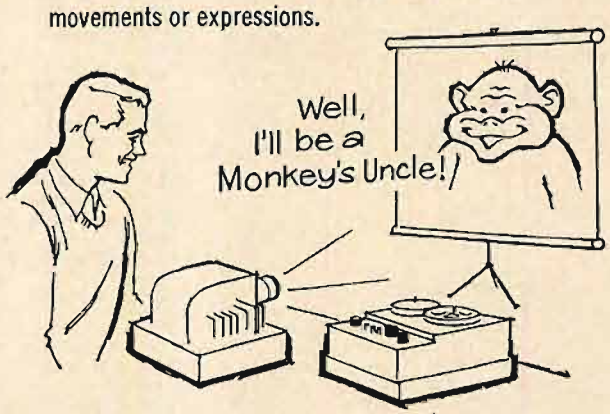


Talking Monkeys

Tape recorders and Tarzian Tape pep up your movie and slide shows just as Rodgers worked with Hammerstein—good separately, outstanding together. In addition to straight commentary and music, other voices and sounds can be taped from radio and TV for use as needed—traffic, machinery, applause, and so on.

For something different, try filming house pets or zoo animals—then synchronize, on tape, the voices of family and friends to match the animal's movements or expressions.



*DuPont trademark for polyester film

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Steam Railroading Under Thundering Skies — Mobile Fidelity MF 8
Interurban Memories — Mobile Fidelity MF 7

With about thirty recordings of railroad sounds being kept under constant steam in the current LP catalog, no one can complain that his interests have been shunted by the railroad or recording industry. Steam buffs have been fortunate that stereo arrived before all the colorful personalities among the nation's steam engines went into a mute retirement at static exhibits. Even more fortunate are those sound fans who can now acquire steam railroad records that have been issued on pressings made of Polymax. Astute record fans are already familiar with the significant advantages of Polymax pressings—harder groove surface, better mold ability and freedom from static. When these features are placed at the disposal of a clean master recording of the imperious transients of a steam locomotive, you've got a recording that's entitled to ride at the head of any LIGHT LISTENING column. These two releases on the Mobile Fidelity label (P. O. Box 336, Burbank, California) owe a good part of their success to the Polymax formula. The first one combines the sounds of a major thunderstorm with the usual sounds of the Bonhomie and Hattiesburg Southern Railroad. Engineer A. J. Lee is featured in the cab in a display of the "Whippoorwill Whistle" style that Casey Jones was supposed to have made famous.

Album MF 7, dealing with interurban electric lines in the cities of Los Angeles and Chicago, offers more bustle and subtle detail of sound than the record on steam railroading. The electric cars, also known as "Blimps," hurtle past the recording mikes at speeds up to 75 or 80 miles an hour. The whistles, horns, and crossing bells mix with the whine of motors to form a souffle of sound over a resonant four-track roadbed. The sudden charge of the cars is the major stereo attraction although some listeners may find the sounds picked up onboard the train a more subtle challenge to their playback system. As the train makes its station stops during the 7½-mile run from Los Angeles to Watts, the faint breathing of the motor of the stationary car may not be picked up by every stereo cartridge. These are very carefully-made records and sound engineers Brad Miller and Stuart Plummer deserve an extra long whistle salute from all three railroads involved.

Montenegro in Italy — Time S 2051

There used to be a time when the record buyer could foretell the sound quality of his purchase according to the label on the record. No matter what the relative standing of a given record company might be in matters of technical quality, there was ample assurance that reasonably consistent sound was available on releases bearing that label. In recent months, the struggle for the ear of the consumer has led to some strange situations within the output of a single label. A manufacturer may issue a batch of stereo discs during the same month yet the philosophy underlying the engineering may not be the same. To make matters even more confusing for the record buyer, the "newer" philosophy does not automatically give one a better sounding product. Two months ago in this space, I had occasion to consider one of Time Record's new "Process 70" releases. This month's batch of discs from Time included a conventional no-name-process release by Hugo Montenegro as well as a "Process 70" record. The conventional release sounds better than the one with the fancy process. There is no reason why the frequency range shouldn't be the same in both releases yet the far more open sound in the top end of this album of Italian tunes leaves the impression of a frequency response that is better by approximately twenty per cent. Following the procedure so popular nowadays in almost every album devoted to European music, each selection is an individual production. In addition to sound effects associated with the country in question, a cast of actors chatters away in Italian. Most of the well-known Italian ballads appear in arrangements for a fifty-piece orchestra . . . "Torna a Sorriento," "Ah Marie," "Core'ngrato" (one of Caruso's favorite ballads), and a wild "Tarantella." A fish peddler's song introduces an instrument called a baby mazimba whose tiny curved steel springs produce notes when tapped. A somewhat corny element of American-style humor is injected into the foreign sounding proceedings when they get to "Funiculi Funicula." Trumpeter Mel Davis holds a high note until percussionist Phil Kraus puts an end to it with a resounding pistol shot.

Pins and Needles — Columbia OS 2210

Old Broadway musicals seem to have a better chance of revival on records during their anniversary years. Twenty five years have sped past since *Pins and Needles* was brought to Broadway by an amateur cast drawn from the ranks of the International Ladies' Garment Workers' Union. After a year of rehearsals, this revue began business on November 27, 1937, playing to an opening-night audience that didn't include a single member of New York's corps of critics. Several reasons could be found for the slowness with which attention came to the show. The wiseacres saw little or no promise at the boxoffice for a musical that concerned itself with commentary on the social and economic issues of the times. A more "pressing" reason was the fact that the cutters, embroiderers, and dress finishers could get away for their stage roles only on weekends. Considered a quarter century later, the show is an extremely lively museum piece that throws a vast quantity of new light on the talents of composer-lyricist Harold Rome. This was his first Broadway show and its subsequent four-year run in New York was ample clue that Rome was bound to make the grade he did in later years. While only one song in the *Pins and Needles* score, "Sunday in the Park," succeeded in reaching the Hit Parade, the show established Harold Rome as the working man's Cole Porter. Like Porter, Rome had the gift of directness in his lyrics that caught the mood and outlook of the militant union member of the '30's just as vividly as Porter reflected the sophisticated set of the same period. Despite the increase in the working man's leisure time, it's difficult to imagine a show as saucy as this one being put together today.

The original production saved costs by doing away with an orchestra. In place of the two pianos used in 1937, Columbia Records has put a larger group of union hands to work. Stan Freeman, piano; Allan Hanlon, guitar; Dick Romoff, bass; and Al Rogers, drums make up the lighthearted ensemble that paces "Sing Me a Song of Social Significance," "One Big Union For Two," and "Sitting on Your Status Quo." The top comedy numbers have been assigned to Barbra Streisand who scored a personal triumph on Broadway this season in the show *I Can Get It For You Wholesale*. She brings just the right bite to "Not Cricket to Picket" and "Nobody Makes a Pass at Me." Rose Marie Jun, a name new to me, shows considerable promise for a singing career on Broadway on the basis of the sparkling job she turns out in her featured songs. If Broadway musicals continue the batting average they've displayed in the past few years, we may see a revival on records of other shows now known only by reputation to many of today's theatregoers.

Peter Nero: For the Nero-Minded — RCA Victor LSP 2536

Not the least rewarding feature of handling a column such as this is the chance to make early acquaintance with performers of star potential. One soon discovers, however, that new stars do not crop up in each month's releases on an assembly-line basis. When a promising talent does come along, part of the interest provided by the recording lies in the element of discovery and the chance to point out the performer's attributes without the risk of having one's arm broken in the rush of the fellow's admirers. When pianist Peter Nero made his first appearance on records a little more than a year ago, it was immediately apparent that the piano-with-orchestra field in popular music was due for fresh stimulus. As labels other than RCA Victor have discovered in the past, a versatile pop pianist can be a very lucrative attraction because he's bound to appeal to a broad section of the record buying public. In his fourth RCA release, Nero turns out one of his strongest jobs with the experienced help of Marty Gold's flexible orchestra. The first of several plus factors is the solid lineup of tunes ranging from a recent show score (*Milk and Honey*) to an undisputed jazz classic—"Don't Get Around Much Anymore." The record introduces its most commercial note of the entire progam as Nero demonstrates the lush side of his style in "Moon River." The quotations from the classics (the most ingratiating wrinkle in his bag of tricks) soon come into play as "Dancing on the Ceiling" opens with an excerpt from the second movement of Tchaikovsky's 6th Symphony. The keyboard arrangement of "My Man's Gone Now" employs chromatic octaves to achieve the wailing effect of a typical blues singer in Gershwin's well-known tune from Porgy and Bess. Nero's most ambitious contrapuntal development is reserved for the last item on the record. In "Love is a Simple Thing" from *New Faces of 1952*, the piano is lashed into a race with the orchestra and almost succeeds in subduing it by sheer speed of tempo. Stereo placement of the piano avoids too obvious a spotlighting of the instrument yet loses no opportunity to point out the many examples of keyboard virtuosity.

Moods Two — UST Sampler Series RSL 408

The last few years have seen an increase in the number of methods used by dealers in merchandizing of recorded tapes. Some tape outlets still adhere to their original policy of withholding from the customer any chance to audition tapes before making a purchase. Other dealers have encouraged tryout of tapes under a variety of plans providing some control of the transaction until the final sale is made. In some stores doing a large volume of business in tape, playback of selected reels is handled by clerks. Some of the more progressive and enterprising dealers have worked out rental plans that include the playback unit as well as the recorded tapes. In view of the fact that United Stereo Tapes is continuing the release of sampler reels, it is safe to assume that audition facilities are still few and far between in the national distribution of recordings on tape.

This second sampler volume of mood music, one hour and twenty minutes in length, makes no attempt to cover a cross section of the labels represented on tape in the UST catalog. Despite the wide variety of music and artists offered here, the entire reel is made up of material taken from only four labels—Kapp, ABC, Secco, and Warner Bros. While this speaks well of the diversity offered by these particular labels it is surprising to finish the twenty other labels in the UST group being bypassed in this way. Future samplers may

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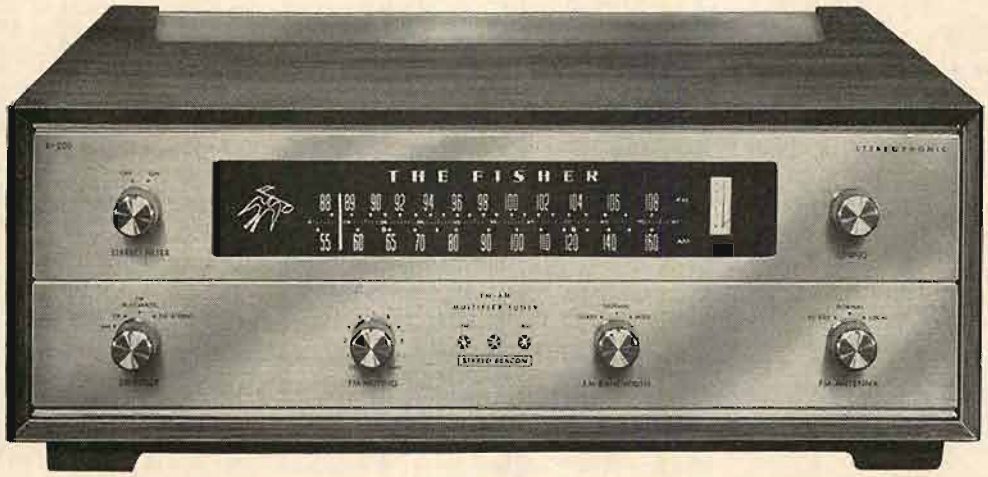

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be in the works for the other labels. For the present, the accent is heavy on artists such as Buddy Cole, George Greeley, Ferrante and Teicher, and the Pete King Chorale. Inclusion of the latter's "Moon River" will probably be enough to keep this reel on the active list for months to come.

Henry Mancini: Music from Hatari
RCA Victor LSP 2559

Not content with the acquisition of two "Oscars" in the 1962 Academy Awards (*Breakfast at Tiffany's* movie score and "Moon River" as the "best single song") Henry Mancini cuts loose in a totally new direction in his score for Howard Hawk's picture Hatari. Here Mancini is called upon to underscore the novel and comic aspects of game hunting in Africa. Instead of the usual shooting scenes, this movie provides its thrills in the live capture of wild animals for shipment to zoos. With the exception of the fierce drum rhythms in "Sounds of Hatari" that accompany the pursuit of an enraged rhinoceros, most of Mancini's music is devoted to smiling portraits of slightly more manageable beasts. "Baby Elephant Walk" and the description of the ostrich in "Your Father's Feathers" are inventions of singular charm and originality. A single ballad, "Night Side" takes care of the small amount of romantic interest contained in the film.

The first band of Side 2 of this disc illustrates a point about cutting procedure that has been under discussion since the introduction of the stereo disc. It's never been a secret that a stereo record can do a better job on percussion if you don't have to crowd the grooves. Band One (Sounds of Hatari) is only six minutes and forty-one seconds in duration. To my amazement, (and possibly that of RCA's accounting department—if they get wind of it) this band occupies more than half of the entire record's playing surface. With such lavish use of space, it's no wonder that the sound is far more convincing than usual in the handling of bass peaks. What caught my interest even more than the freedom in bass response was the exceptional sense of perspective in the spacing of the distant drums at the start of the piece. It was welcome to the ear because features such as these are aural delicacies seldom encountered in a mass-produced stereo groove.

My Geisha (Original Soundtrack Recording)
RCA Victor LSO 1070
Boccaccio '70 (Original Soundtrack Recording)
RCA Victor FSO 5

The latest batch of soundtrack stereo discs from RCA point up anew the contrast in recording methods used by domestic and foreign producers. Shirley MacLaine's film about Japanese Geishas typifies the American recording approach while the trilogy of short Italian stories in *Boccaccio '70* sums up most of the traits noticeable in recent RCA International soundtracks. If you think motion picture recording has been standardized in the past few years, you're in for a surprise when you hear the bass the Italians are currently favoring in their film tracks. Neither disc is exactly low in distortion when you consider the average recording made expressly for home use. Franz Waxman's score for *My Geisha* offers many of the familiar devices heard in travelogs dealing with Japan. A novel bonus for soundtrack fans is an opportunity to hear excerpts from Puccini's opera *Madama Butterfly* as sung by the Japanese soprano Michiko Sunahara and Barry Morell of the Metropolitan Opera Company. No matter how familiar you may be with the opera itself, it will take you a while to get used to the sound of "Un Bel Dì" as sung in Japanese.

The segment of *Boccaccio '70* starring Sophia Loren features the music of Armando Trovajoli who enjoys a unique position among his peers because he was the first composer to persuade Sophia Loren to sing in a film. He repeats his act of persuasion here to provide the outstanding vocal moments on the disc—unless you wish to count the unusual singing commercial in the segment called "The Temptation of Dr. Antonio." In this episode featuring the star and director of *La Dolce Vita* (Anita Ekberg and Federico Fellini) we are treated to the determined chanting of children's voices as they sell us the virtues of milk.

The Strings Sing Again
Riverside RLP 97527
Harry Robinson: Moody and Magnificent
Riverside RLP 97528

Two more entries from this label's British affiliate. Both items have been designed to appeal to the listener who doesn't go for the frantic arrangements that are all too common today. It's good to see (and hear) that not all labels are convinced that the listener is begging to be jolted out of his chair when he turns on his rig at the end *of that* heavy five-hour day. Riverside seems to be working on the old theory that most of us are still putting in a full seven- or eight-hour day because their new line of records offer relaxation and nothing more. The Knightsbridge Strings, aided by a choir of horns, borrow some of the songs made famous in recent years by Jo Stafford, Nat Cole, Perry Como, and Les Baxter and transform them into background instrumentals of solid grace. Of the hit songs from the theatre, only Kurt Weill's unsinkable "Mack the Knife" gets a jaunty treatment. "Hey There" from Adler and Ross' *Pajama Game* and movie favorites such as "Tammy" and "Song from Moulin Rouge" round out an album that is pleasantly low in syrup content.

Harry Robinson's orchestra works within a more varied instrumental framework in a collection that includes several unhackneyed songs. "While We're Young" by Alec Wilder and Ralph Burns' "Early Autumn" are outstanding among a list of tunes that have a long way to go before they reach saturation on records. This orchestra hasn't been given quite the high signal level of the Knightsbridge Strings but the stereo separation follows the same natural pattern found in conventional miking. For honest value in music making and a believable recording technique to put it over the home, you won't go for wrong in either of these albums.

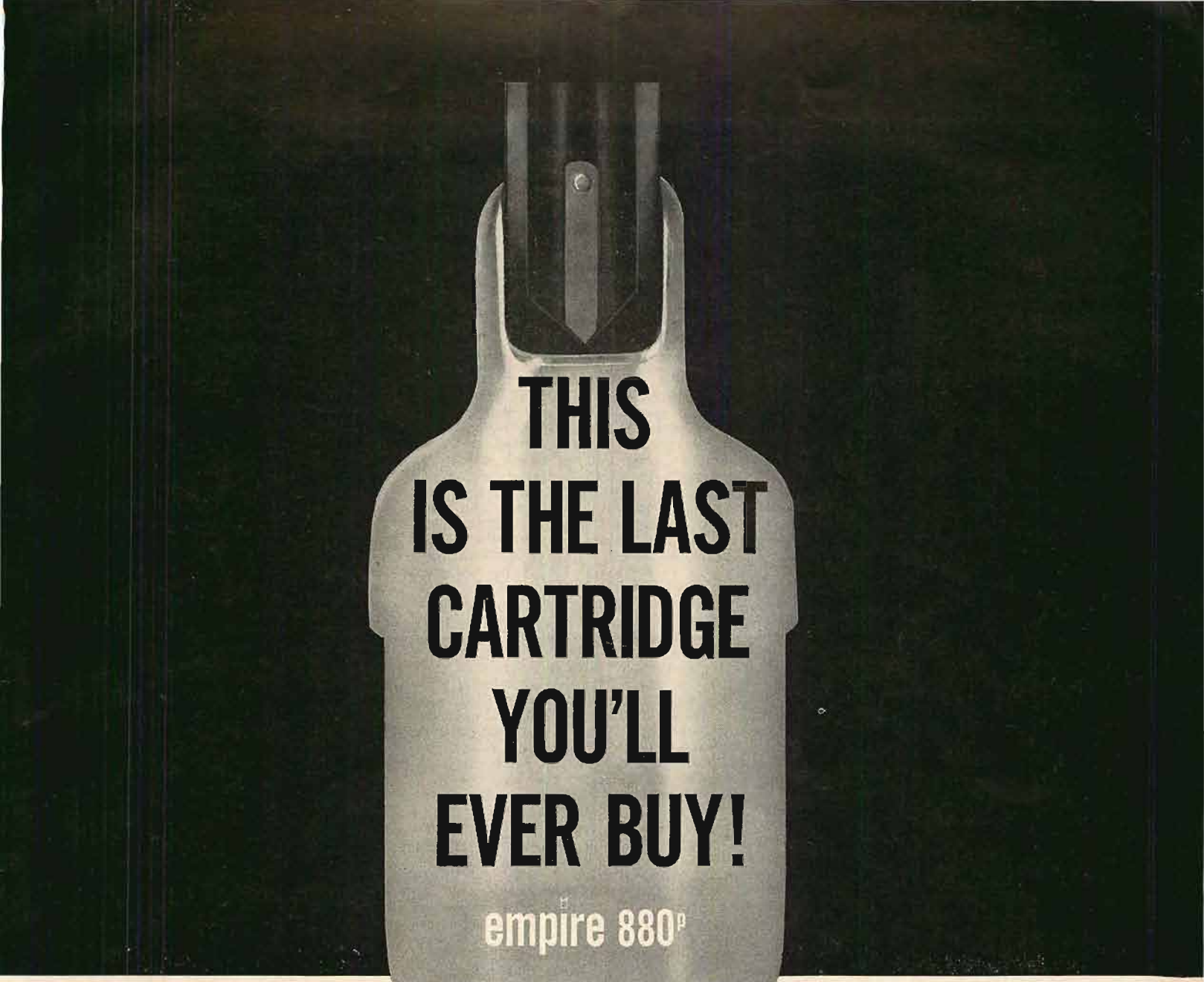
Billy May: The Sweetest Swingin' Sounds of "No Strings"
Capitol ST 1709

Few album titles these days sum up the contents of a release more rapidly than this one does. The highly commercial style of this band should take care of any demand for a swing treatment of the *No Strings* score. Billy May has made a minor concession in his choice of instrumentation for one of the past season's best shows. The brass section is handled with a bit more restraint than is usually found in this-hard-driving band. A soprano sax in a beguine setting establishes a lyrical mood in "The Sweetest Sounds"; the same mood carries over to the other top ballad in the show—"Nobody Told Me." Billy's fans will hardly be surprised to discover that the personal traits of his arranging style get their best chance to shine in the faster tunes of the stage production. "Maine", "La La La," and "Be My Host" have just enough satire in their makeup to activate the celebrated Billy May sense of humor.

John Keating: Temptation
London Tape LPL 74019

John Keating was born in Scotland but he seems determined to prove that he can be one of the more generous arrangers now working in the city of London. In this tape, no member of the orchestra or mixed chorus can complain of having too little to do as Keating, a former staff arranger for Ted Heath's big band, works over a sizable list of old favorites. As the listener faces the area between loudspeakers, there are at least five clearly defined points in that region bombarding him with bursts of vocal or instrumental sound. In Phase 4 as practiced here, the acoustic isolation of each channel is just about 100 percent effective. At full volume this reel almost succeeds in presenting an illusion of stereo acoustics. At lower volume the isolation of individual channels becomes downright amazing as each sound source recedes into its own bailiwick. The resulting illusion at lower volume is one

(*Continued on page 74*)



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From Somewhere in Europe . . .

DEAR AUDIO,

Once every so many years this column takes off for an "etc" vacation in Europe. Last time was 1956, and here I sit in almost the same spot upon which I sat six years ago to compose my *chef d'oeuvre* of that summer's long, leisurely trip. But then, if I remember rightly, it was freezing cold and foggy, the mist almost visible inside my small room. Now, "Yourp," as I like to call it with my American accent, is having a real old-fashioned hot spell, just like home, and I'm panting with my head hanging out the window *dans un chaleur extraordinaire*—an unprecedented heat that must be almost 80 degrees. Terrible. The local people are dropping like flies. But the flies aren't minding it a bit.

Outside my window, here in La Barboleuzaz, which is an offshoot of a small town called Arveyes in French Switzerland, a farm family is getting in the summer hay. Papa wields the fork. So does mama, who is boss, in her snazzy dirndl skirt and white blouse. The hay wagon is hooked onto a sleek little tractor with front wheel drive—the tractor has only two wheels, which operate as the front half of the wagon, and it steers by handlebars. Two sons, in blue jeans and "T" shirts, help with the family chore and two small children dressed in natty store clothes play around the wagon with toy hay rakes. In a few minutes that whole family will move up the hill a ways to a huge tube of shiny galvanized iron, one end a big hopper, the other leading into the hayloft of a small chalet that is probably 300 years old. A pop-pop one-cylinder engine somewhere inside the hopper neatly swishes the hay through the tube, and there's your harvest.

Straight up above me behind this progressive Swiss family is a lovely conical hill, all grass and a few dotted *sapins* here and there (local variety of spruce), and looking out from it, one above the other, are some fifty brown Swiss chalets, à la cuckoo clock, each with its overhanging roof and one or two balconies, all made of well varnished wood, cut heavily and put together to last for centuries—and to support three feet of snow. The older ones are dark, weathered black-brown, and date back anywhere up to three hundred years. The newer ones are shades lighter, ranging all the way to a pale, shiny maple tint. Those are the brand new ones; the lowest chalet, off to my right, is this year's crop, but they all look as though they'd been completed yesterday. On the very top of the mountain, straight ahead and a half mile above me at a steep angle, is a single chalet which caps the point, brashly standing out against the sky and lord of this particular mountain. A flagpole stands next to it, just to show its superior status, and I can just make out the large red Swiss flag with the white cross on it that decorates everything here-abouts, flagpoles included.

Up the mountainside, crisscrossing in neat zig-zags, runs the inconspicuous gravel road that services all these dwelling places, and as many more on the higher slopes above; a discrete whirring of helical gears goes on as small cars and medium sized ones—several Valiants have passed—dash lightly up and down. It takes about ten minutes to zig and zag all the way to the top and the climb would scare many a U.S. driver, especially when two cars pass, one of them hanging out over the green grass below. But life goes on efficiently at a 45-degree angle here, and even the cars seem acclimated. Heat or no heat, they all go up as fast as they come down and never a boil-over is to be seen.

Off to my right, just below, is the main drag of this up-and-coming community. Off a bit is a lovely grove of big spruces and behind it an old fashioned little hotel, an oversized chalet with gaily painted dark red shutters and a brace of colorful parasols on the gravelled terrace. But, alas, across the road, beyond a dismal stretched of bulldozed parking lot, is the New Switzerland, and the New Europe, too—an ugly, sprawling dine-and-dance joint called L'Escale. To be sure, the upper half is vaguely chalet style, though in glaring white plaster, and there are the inevitable window boxes of petunias and geraniums. The place is clean, like all Swiss places. But at night there is a huge mercury vapor light outside the lower story and inside the plate glass windows you see a bar, an enormous juke box, and a brace of pin ball machines. Raucous music comes out of the doors and around the machines are teenagers dropping in 20-centime pieces, dressed in tough looking blue jeans, boys and girls alike.

Funny—put up a pin ball machine, install a juke box, and the requisite teenagers, chewing gum or smoking, dressed tough, lounging around, just appear automatically. This garish spot, right in the midst of an idyllic mountain village, is no more than one finds everywhere hereabouts and elsewhere in Europe. Ah, America! They used to call us materialistic, crude, these Europeans; all we wanted was money and cars and refrigerators. Now, alas, all the average European wants is money and cars and refrigerators—and he's getting them fast.

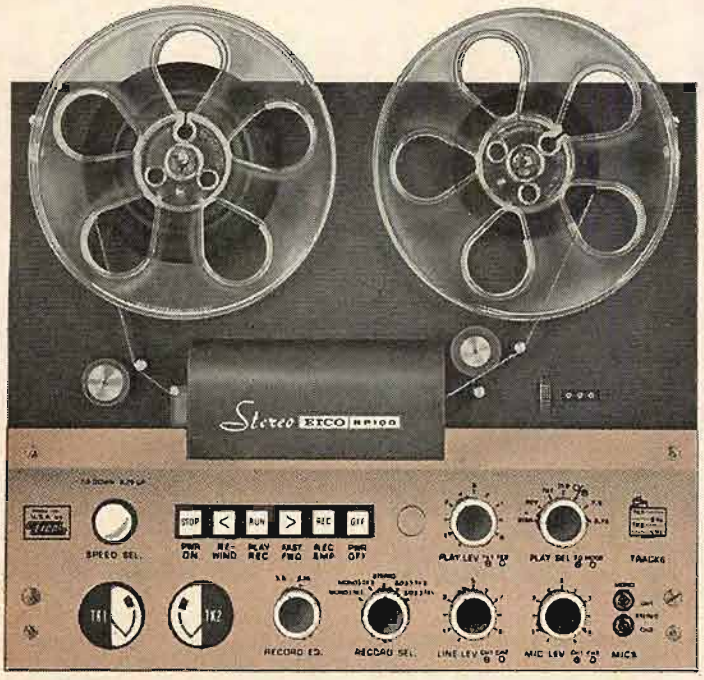
Especially cars. Six years ago, there were quite a lot of cars around and traffic was occasionally annoying, on the main through routes and in the big towns, like Paris. Today, there are millions of cars. Every road crawls (literally) with them. You can't park anywhere, even in those convenient spots marked with the big blue P that are set aside for the motor car in every town. On any main-ish road, this vacation time (*whose* vacation? Not ours; the Europeans') you travel in a long line of cars that simply never ends. All of them hell-bent for somewhere, too, and no dawdling on the way for sightseeing.

Not even on the main highway that runs through Chamonix, just below Europe's highest snow fields culminating in the great white dome of Mont Blanc. I left there yesterday. All of France is now on vacation, and two thirds is at Chamonix, not to mention every tiny town 'roundabouts, every clearing, every open space that has room for an orange tent. The town itself is one solid traffic jam, on its three or four narrow streets, with a half dozen frenzied gendarmes getting exactly nowhere untangling the mess. On the "open" road, cars whiz along in endless lines, all going just as fast as their little engines will take them and to heck with the views. They aren't going anywhere; they are already there. But that doesn't make a bit of difference. Only the French "deux chevaux," the tin-can Citroen with its two-cylinder engine as big as your head and its sardine can interior crammed with a whole family, —only these must labor slowly uphill, holding up miles of more potent buzz-bombs (as I like to call them), until a dangerous curve appears. Then with one accord, all the buzz-bombs zoom out to pass on the curve, trusting to the Frenchman's special fate, which seems to allow this sort of thing. Absolutely hair-raising to watch, but grandma, hanging out the rear window, and four or five kids and a dog never even notice.

Worst of all are the big *camions*, trucks. Trucks come with four-wheel trailers over here, and they are all diesel. But somebody long ago decided that the European motor transport should travel at 35 mph on the level, and approximately 7 mph at the slightest sign of a grade. To worm those big four-wheel trailers, loosely hitched and tending to waver from side to side, around Europe's still-sharp corners and through its still-tight little towns takes extreme caution and plenty of time. In any slightly hilly country, the average truck-trailer speed is maybe 15 miles per hour, and the trucks tend to travel in convoys, too. On the straightaway, in flat country, the 35-mph speed limit is not often passed. But most of the cars prefer travelling at 65 or so, if the road is wider than a dozen feet.

The result is that every truck-and-trailer is followed hour after hour by a long file of dozens and dozens of impatient motorists, whose blood pressure is soaring by the minute. A few stolid souls just mosey along, looking defeated, but every few seconds somebody in the rear of the file "explodes"—veers out of line and with motor screaming dashes past eight or ten cars, only to screetch back a second before hitting an oncoming car. As usual, the sight of an approaching curve or a hill seems to provoke this suicide impulse. Sometimes three or four little buzz-bombs suddenly zoom out at once, one behind the other, and careen over the top of a hill in the wrong lane, the road ahead completely invisible. Phew! Talk about Russian roulette.

The average-sized European auto is a feeble thing, at least in the hands of an American driver. All but a handful of cars are four- or even two-cylinder affairs, and few boast more than 60 horsepower. But what we forget is that these little monsters are highly maneuverable, sticking to the road, cornering superbly, with high-ratio steering. In the hands of a standard European driver they can do things that no American car could survive. Instant zigs and zags, in and out of traffic. Incredible accelerations into the sixties on twisty roads. One quickly learns to respect them, and to keep out of the way. It is odd that the European taste isn't bothered a bit by noisy motors and gears that squeal —in fact, this seems to add a certain *cachet*. Strangest of all are the French cars. They are mostly more potent than others on the continent, model for model, though gas costs almost twice as much as elsewhere, not far under $1 a gallon. French cars are generally the noisiest of all. They are made with non-silent first gears



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7. Playback preamps remain "on" during stop-standby mode to permit cueing.
8. Recording level adjustment during stop-standby.
9. Shock-absorbent helical spring tape lifters practically eliminate tape bounce at start of fast winding.

And All These Well-known RP-100 Features:

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

Wow and flutter: under 0.15% RMS at 7½ IPS; under 0.2% RMS at 3¾ IPS. **Timing Accuracy:** ± 0.15% (±3 seconds in 30 minutes). **Frequency Response:** ± 2db 30-15,000 cps at 7½ IPS, 55db signal-to-noise ratio; ± 2db 30-10,000 cps at 3¾ IPS, 50db signal-to-noise ratio. **Line Inputs Sensitivity:** 100mv. **Mike Inputs Sensitivity:** 0.5mv.

Semikit: Tape transport assembled and tested; electronics in kit form $299.95

Factory-assembled: Handwired throughout by skilled American craftsmen $399.95

An original, exclusive EICO product designed and manufactured in the U.S.A. (Patents Pending)

Carrying Case $29.95
Rack Mount $9.95

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FM-AM Stereo Tuner ST96
Kit $89.95 Wired $129.95
Includes Metal Cover and FET

70-Watt Integrated Stereo Amplifier
ST70 Kit $99.95* Wired $149.95*
40-Watt Integrated Stereo Amplifier
ST40 Kit $79.95* Wired $129.95*
* Includes Metal Cover

FM Multiplex Autodapter MX99 (Patent Pending)
Kit $39.95
Wired $64.95
Cover Optional $2.95

New Stereo FM MULTIPLEX TUNER ST97
Semi-Kit $99.95 Wired $149.95
Includes Metal Cover and FET

Another brilliant example of EICO's no-compromise engineering, the new EICO ST97 combines the features of station-monitor quality and fringe-area reception capabilities with exceptional ease of assembly for the kit-builder. No test or alignment instruments are needed. The two most critical sections, the front-end and the 4-IF stage circuit board, are entirely pre-wired and pre-aligned for best performance on weak signals (fringe area reception). The front-end is drift-free even with AFC defeated. The four IF stages and 1MC-wide ratio detector achieve perfect limiting, full-spectrum flat response, very low distortion, and outstanding capture ratio. The 10-stage stereo demodulator—EICO's famous zero-phase-shift filterless detection circuit (pat. pend.)—copes successfully with all the problems of high fidelity FM stereo demodulation and delivers utterly clean stereo outputs. Excellent sensitivity, selectivity, stability, separation and clean signal add up to superb fringe-area reception. The automatic stereo indicator and station tuning indicator travel in tandem on twin slide-rule dials. **Antenna Input:** 300 ohms balanced. **IHFM Usable Sensitivity:** 3μV (30 db quieting), 1.5μV for 20db quieting. **Sensitivity for phase-locking (synchronization) in stereo:** 2.5μV. **Full Limiting Sensitivity:** 10μV. **IF Bandwidth:** 280kc at 6 db points. **Ratio Detector Bandwidth:** 1mc p-p separation. **Audio Bandwidth at FM Detector:** Flat to 53kc discounting pre-emphasis. **IHFM Signal-to-Noise Ratio:** —55db. **IHFM Harmonic Distortion:** 0.6%. **Stereo Harmonic Distortion:** less than 1.5%*. **IHFM IM Distortion:** 0.1%. **Output Audio Frequency Response:** ±1db 20cps-15kc. **IHFM Capture Ratio:** 3db. **Channel Separation:** 30db. **Audio Output:** 0.8 volt. **Output Impedance:** low impedance cathode followers. **Controls:** Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat.

*Actual distortion meter reading of derived left or right channel output with a stereo FM signal fed to the antenna input terminals.

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and every French driver thinks he isn't driving if he doesn't start off with a screaming acceleration in this bottom speed until the gears practically strip. A few months of that sort of thing and your low gear sounds like a battery of high-powered rotary saws.

The Cadillac of France—or, I should say, the Oldsmobile—is the big Citroen DS-19 with its fancy hydraulic suspension. There are thousands of them and, coming up in your rearview mirror, they look like nothing so much as big frogs, low on the ground with front wheels wide apart and little rudimentary back wheels trailing behind, a big, froggish mouth grinning horribly at you. Nobody who has a Citroen will allow another mere car to drive in front of him. They always pass you, usually with a hideous blast of the exasperating French dualbeep horn. Obviously, to a Frenchman, a Citroen means POWER.

(Funny—in contrast, the swank German car is the big Mercedes six, square, effete, ever-so-snobby; its drivers tend to move deliberately, looking at scenery at leisure, ignoring the screaming maniacs waiting behind. Doesn't seem to matter what nationality of driver is involved. Just having a Mercedes makes you that way.)

The motorbike and the scooter still abound, especially *en ville*. They still, as always, act kings of the street, holding up auto traffic blithely, veering across in front of you with outstretched hand for a left turn, pulling slowly up a grade spang in the middle of the traffic lane, often two abreast, paying no attention at all to the cars they are holding back. But they are on the losing side. A few more years and they're going to have to get out of the way. Too many cars. The little Solex bikes—I've always been tempted to buy one—still roll along at twenty, the riders pedalling to help the mieroscopic and almost inaudible motor that sits on top of the front tire. Larger bikes are still ridden to work and back for lunch, and back to work, and back for dinner, by elderly secretaries and plump housewives, nicely dressed as always; teen-age kids zoom around corners at wild speeds, looking utterly bored; on long upgrades they sit akimbo, side-saddle, taking their ease, chewing gum. The blue jeans now look like blue jeans; six years ago they were still baggy imitations, *les jeans "cowboy."*

So much for traffic. It dominates the European world and, to the best of my knowledge, there isn't even a word for it in French. (There's a word for bottle, but none for can. Bottled beer is "en bouteille" —canned beer can be bought, but hasn't any name. The nearest they can come to it is the word for box—"boîte"—and so you ask for boxed beer, if you want it. Draft beer, illogically, is "sous pression"—under pressure. For goodness' sake, isn't canned beer too?) There isn't any name for rush-hour, or mad-scramble, either, in the slow-moving French language—and they sure need one. *"En temps d'affluence"* is the best that can be done—times of much-flowing. Flowing, my eye! Everything stands still these days.

The silliest thing for an American in France is the English. It is everywhere, and for the life of you, you can't figure how to say it. Once in a blue moon, an American term is pronounced as is—week end, for instance, which is standard new-French for week end. But when I flew into Paris awhile back, sallied out from my hotel for something to eat at a Self-Service, and tried ordering a Club Sandwich, only after a number of attempts could I get the idea over: *Cloob Sawnd Veech.* Very nice one, too. You can make a good stab at pronouncing such French terms as *Hot-dog* and *Hamburg* though the food you get isn't recognizable as such, even at the more popular *Self Serr Veeve* joints. The French sometimes borrow from the British instead of us—in my Geneva office there is a Self Service Lift (*Leefft*). Youngsters on school vacation get jobs as Lifters (*Leeff-teur*), a term no elevator boy *in the states* would stand for an instant. Nor, on week ends, would he wear a slip (*Sleep*). A slip is a brief bathing suit, male. Or was, until boxer trunks à l'Américaine, took over.

As for the amenities of life, the improvement is wonderful to behold. The Europeans, even the French, have at last discovered that electricity is to be used, not saved. Also water, in pipes, quite frequently hot. Amazing! Even as late as six years ago I reconciled myself to the single 15-watt bulb in most small hotel rooms, sometimes alternating with a reading lamp, same power—but never both at once. Now, the forty-watter is standard and the reading lamp works at the same time. There are outlets for shavers and everybody has them, like cars, though at varying voltages, (250 in Switzerland; around 101 in Paris.) Refrigerators, too, though little ones by our mammoth standards. Walk high up a mountain pass and at the top you'll find a small deepfreeze full of imported Italian ice cream sticks. One world. Apartment houses, modern and tall, go up everywhere now and offer all the conveniences—but the speed of construction is still no speed at all by our enlightened standards of hurry-up jerry-building. The Europeans still cling wistfully to the idea that one builds for the centuries, though the stuff they build won't last that long now, I assure you. Anyhow, they build deliberately and carefully, taking the longest way around. You should see the installation across from my window in Geneva where an old building was torn down and a new one is going up in the hole. Swarms of Italians (they do all the work in Switzerland) running around measuring, consulting, lifting and putting down. A big, three-story-high yellow tank for cement mixing, set up in the street, and a bright, shiny green crane on a tall green steel tower for general lifting—I saw them pour one floor of concrete the other day and was astonished at the ingenious slowness of it all. The yellow machine grinds, pulverizes and, in its lower levels, mixes concrete; it is loaded up by the darndest mechanized scoop I've yet seen, a sort of bucket affair that is pulled by a cable while a man runs along holding frantically to its handles to steer it into the mix—then pulls it back to the starting point under his own power. Took a whole day to pour what would have been a couple of loads of our cement-on-wheels, yet all was mechanized, most ingeniously.

It isn't that the Europeans aren't mechanized; it's simply that they are mechanized in a leisurely, take-your-time fashion. They have excellent minds for machinery, but—autos aside—not for hurry. To get back to the amenities, take the lunch hour. I've been working regular office hours in Geneva, for convenience, writing a book on an office typewriter. (Not *this*—this is being turned out on my baby Hermes, a Swiss product bought in New York.) In Geneva everybody starts work between 8 and 9 in the morning, having arrived usually by bike or tram. At noon the entire town leaves its desk and goes home. A frantic traffic jam. Except those lucky souls like me who, having no local home, go to restaurants for lunch. Mmmm! Two hours for lunch, sitting outdoors on a terrace, overlooking the beauti-

(*Continued on page 73*)

Superb Performance and Inexpensive New 10-inch 2-way Speaker PAX - 25B

The use of improved material and the simplicity of design are the two striking improvements noticeable about the PAX-25B. And through the streamlined manufacturing process arising from such a practical design, this 10-inch hi-fi speaker can be supplied at the lowest cost possible for a product of this caliber. Its performance, moreover, has been improved further through a better design.

PAX-25B is a 2-way speaker comprising a combination of a 10-inch woofer with a magnetic circuit and a completely independent cone tweeter. It is, therefore, practically devoid of intermodulation and interference distortions, and highly excellent in the transient characteristics.

Its frequency response from 35 to 20,000 cps, and it promises wonderful hi-fi reproduction with rich bass and particularly beautiful medium tones. The tweeter is extremely superior in directional characteristics and is best suited to stereo reproductions.

The woofer-tweeter combination is also highly excellent and exceptionally free of distortion near the crossover frequency. It will, as a matter of fact, deliver the best performance possible for any 2-way speaker.

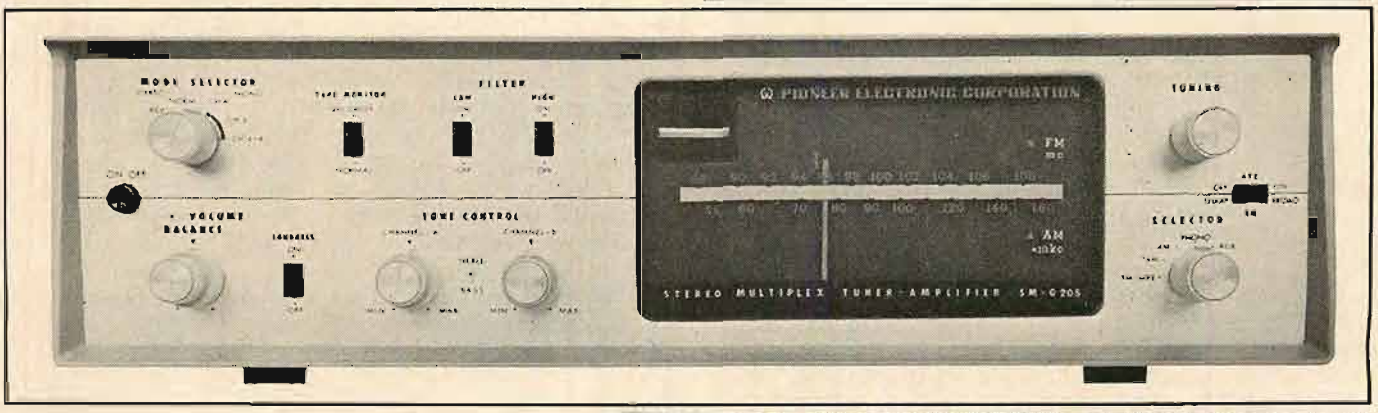
Specifications of PAX-25B

Voice Coil Impedance:		16 ohm
Resonant Frequency:		40 – 60 cps
Frequency Range:		35 – 20,000 cps
Maximum Power Input:		20 watts
Power Inqut:		15 watts
Sensitivity:		102dB/watt
Crossover Frequency:		3000 cqs
Q_0:		0.7
Magnet Weight:	Woofer;	12.8 oz
	Tweeter;	3.9 oz
Total Flux:	Woofer;	105,000 maxwell
	Tweeter;	17,000 maxwell
Flux Density:	Woofer;	10,000 gauss
	Tweeter;	11,000 gauss

Let's listen in to a wonderful FM stereo!

32 (16/16) watts AM/FM Multiplex Tuner Amplifier SM - G 205

The SM-G205 has both AM circuit and FM multiplex circuit for FM and FM stereo. The FM MPX tuner guarantee precise channel separation and perfect stereo reception, stabilized through the use of AFC. The phase inversion circuit, which balances the output impedance of phase-splitter tube, produces stable and distortion-free output as high as 32W. Loudness control and high and low filters provide stereophonic reproduction of natural tone quality. And, the SM-G205 is capable of reproducing a variety of program sources, including FM stereo, stereo discs, stereo tapes — all with the same dynamic and rich tonal quality. The smartly modern design and clear-cut dial lines are sure to satisfy the most discriminating taste.



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EDITOR'S REVIEW

SON ET LUMIERE

For several years, in Europe and Africa, there have been productions involving sound and light (son et lumière) in relation to a variety of historic sites and buildings. History-filled Palace de Chaillot and Versailles are brought to life with a tape-recorded dramatic presentation which interweaves voice, music, and light. This summer we had occasion to view a presentation of this kind at Independence Hall in Philadelphia. Appreciate, if you will, the potential of this setting combined with a script by Archibald MacLeish, music composed by David Amram, narration by Frederic March and a cast of recognized professionals, all of these elements placed in time and space by means of a 10-track tape machine—5 tracks for sound and 5 tracks to control lighting—with an unusually elaborate sound system inconspicuously located midst various historic objects. Well, we are still excited by that potential even though it was not fully realized at the performance we attended. We do not wish to dwell upon the unrealized potential except to speculate that perhaps the acoustics were the main stumbling block. We did not intend that comment facetiously—we are aware that the performance was outdoors—but rather to indicate that the combined efforts of wind, streetcars, and trucks were perhaps more than had been anticipated at that first showing.

Still the part that excited us most, and should be of interest to the audiofan is that here was an attempt to create a dramatic presentation by projecting reproduced sound and lighting effects in an appropriate setting. We would guess that a large number of audiofans have both the know-how and equipment to produce miniature pageants like this one in their own locality, tailoring the script to reflect the local historical site or events. On the other hand we can envisage all, or many, of the major historical places and events in this country being made alive by means of sound and light, most likely by professionals. What an exciting way to make history live—and at the same time encourage participation in creating dramatic performances. Wouldn't this be an excellent way for schools to help teach history, and English too?

We offer thanks and congratulations to the people at the Norelco High Fidelity Division for being one of the sponsors of this effort and installing the audio system.

While we are in a congratulating frame of mind, we would like to offer some to the Harman-Kardon people for encouraging Shakespeare-in-the-park, in Washington, D.C., by providing a control and amplification system to project the voice of the bard with low distortion. Although we were not in attendance at any of the performances, we are certain that the sound quality was infinitely superior to the high-distortion systems usually available in this type of arrangement. It seems rather grotesque to experience garbled words and distorted music at a live performance outdoors, especially when we know that exceptional reproduction is possible. Perhaps this experience with better-quality equipment will start a chain reaction and spread to all those places where outdoor performances are held. Perhaps.

FOR THE WOMEN

Recently, we have had occasion to note a trend towards concealing the controls on audio equipment, a trend that seems to be emerging slowly. In the newest Fisher control amplifier (Model X101C), and in the new Heath transistor amplifier kit, they have hidden all the sophisticated controls behind a swinging door, *a la* TV, so that the only controls that remain in view are the oft-used ones. We are sure that the reason for this expenditure, of engineering effort and parts, is to convince the distaff listener that one needn't be an engineer to operate a component high fidelity set. In our opinion, this effort has long been needed. In reality, most component manufacturers do recognize the importance of making high fidelity appealing to women—to the extent that the first day of the upcoming New York High Fidelity Show is dedicated to the ladies. However, recognizing the need and doing something about it are not necessarily related. Many control panels in component sets are a maze of knobs and mysterious switches that baffle even the audiofan at times. Confronted by this large number of controls, which may be labelled differently from set-to-set, it is not unlikely that the nontechnical person may revolt against the idea of buying such a component. We hasten to add that we think that all the controls are necessary for persons such as us, but that they could be displayed in a different manner. Taking our cue from the Fisher unit, we would vote for having all infrequently-used controls hidden behind some sort of door on the front panel. Thus, on a control center, the only controls that should be seen are the input selector, volume control, and the on-off switch; on a tuner only the tuning knob should show.

COMING EVENTS

Two important events are scheduled for October which we are sure many audiofans will want to attend. First, from October 2–6 is the seventh annual New York High Fidelity Show. It will be held at the same location as last year, the New York Trade Show Building. We need not introduce this show to most audiofans in this area, but for those of you who have never attended, we extend an invitation to stop in at our room on the fourth floor if you are confused, perplexed, or just plain tired. We will be there often to say hello and just talk.

The other important event is the Fall Convention of the Audio Engineering Society, which will be held October 15–19 at the Barbizon-Plaza Hotel in New York City. Naturally this meeting will be of interest mainly to the technical people involved in the high fidelity, recording, and broadcast industries. The meeting is devoted mainly to the presentation of technical papers and in our October issue we will present the full list of the papers to be presented—you may find enough of them sufficiently interesting to attend. If so, we will likely cross paths.

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

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

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

*More commercial background music systems use STANTON Stereo Fluxvalves than any other magnetic pickup.

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

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Model 481AA STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with ultra-light-weight tone arms capable of tracking within the range from 1/4 to 3 grams. Supplied with the D4005AA V-GUARD diamond stylus assembly.
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Model 481A STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with manual tone arms, recommended tracking force is from 2 to 5 grams. Supplied with the D4007A V-GUARD diamond stylus assembly.
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NEWS FROM
BELL LABORATORIES

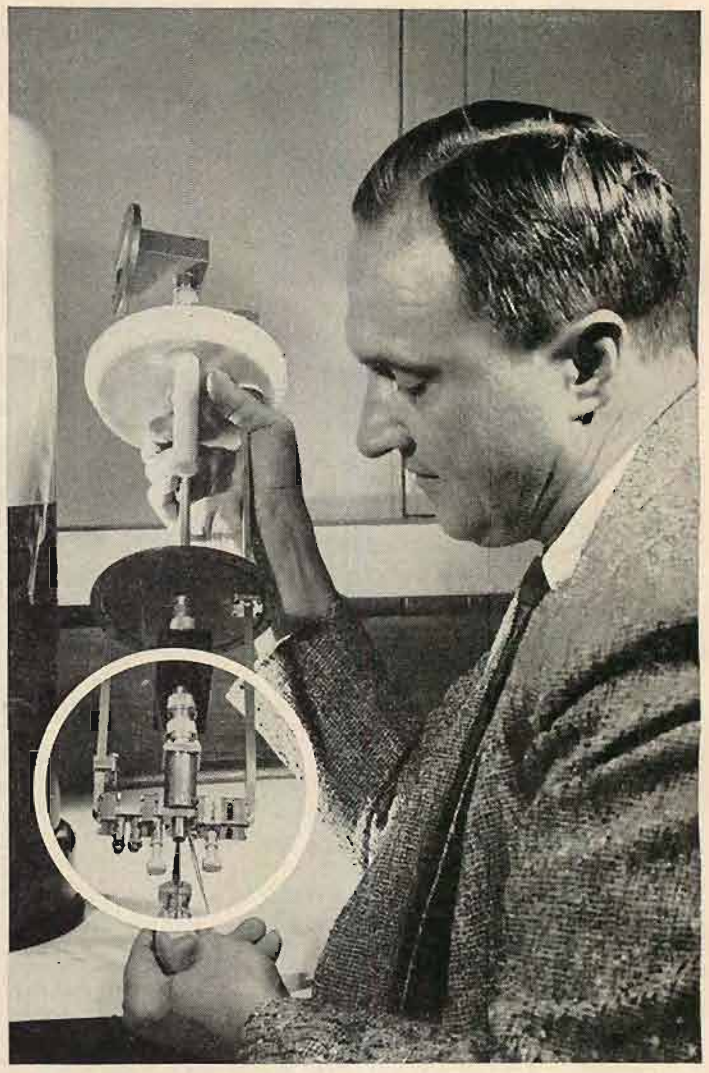
A simple, highly sensitive microwave amplifier

Bell Laboratories engineers have developed an extremely sensitive parametric amplifier which approaches the maser in sensitivity. Both will be used in experiments with Telstar, the Bell System's experimental communications satellite.

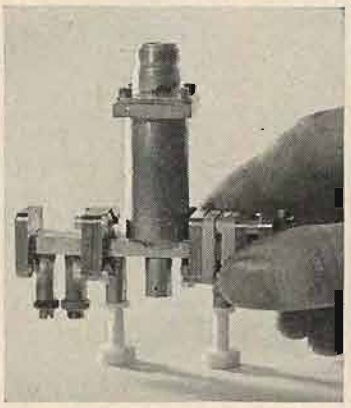
Heart of the parametric amplifier is a newly developed semiconductor diode with very low intrinsic noise. Previously, the sensitivity of such amplifiers at microwave frequencies was severely limited by the unwanted noise generated in their diodes. The new diode, no bigger than the eye-end of a needle, solved this problem.

Our engineers also devised new circuitry to stabilize precisely the output of the klystron (microwave generator) supplying power for the amplifier. To reduce further the intrinsic noise of the amplifier, they immersed the diode and its circuits in liquid nitrogen, utilizing a new cooling arrangement which economically maintains a low temperature for many days without attention.

The new amplifier fills a need in the communications field for a simple microwave amplifier of high sensitivity in applications for which the higher sensitivity of the maser does not justify its additional complication.



Bell Laboratories' Michael Chruney adjusts waveguide assembly (in circle) housing the diode. After adjustment the entire parametric amplifier will be immersed in liquid nitrogen in dewar at left. The new amplifier operates at 4170 megacycles (center of band) and provides an almost flat gain of 38 db over a 50-megacycle band with a noise figure of approximately 0.6 db.



Close-up of the waveguide assembly, in which Bell Telephone Laboratories' newly developed diode is located.

Heart of amplifier—a hermetically sealed gallium arsenide diode—is compared with eye of average-sized sewing needle.

BELL TELEPHONE LABORATORIES

World center of communications research and development

A New Turntable-Arm Design

EDGAR VILLCHUR*

Incidental to a description of a new product in the realm of record-playing equipment is this thorough analysis of the physical principles and the geometry involved in the design of an arm and turntable.

IN TWO PARTS—PART 1

THE INTERDEPENDENCE OF TURNTABLE AND TONEARM in a record player is analogous to that between a speaker and its enclosure. The correct mounting of the tonearm depends on its relationship to the turntable in exact positioning (both vertical and horizontal) and in the necessity for common mechanical isolation from the motor, from external stimuli, and from acoustic feedback.

Deficiencies in record player performance result from unwanted *relative* motion between the arm and platen. The design approach described here therefore considers the arm-turntable as a single mechanism.

Requirements of a Good Record Player

A record player that is excellent in performance will not noticeably intrude its characteristics into the signal at all. Record player design is advanced enough for this goal to be a realistic one.

The following qualitative criteria of performance were considered most significant when we undertook the design of the AR turntable:

1. Rumble to be inaudible on program material
2. Wow and flutter[1] (including vertical warp wow) to be inaudible on program material
3. Speed to be accurate, and stable with time, with changes of line voltage or of mechanical load
4. Arm to be capable of tracing warped and/or off-center records
5. Tracking-error distortion to be low
6. Isolation from mechanical shock and from acoustic feedback to be adequate for even severe conditions
7. Convenience in handling, ruggedness, and safety to be provided

Quantitative Standards on rumble, flutter, and speed accuracy were established in 1953 by the NAB, then called NARTB, for broadcast equipment. These Standards call for rumble at least 35 db below 1.4 cm/sec peak at 100 cps (equivalent to 6.3 cm/sec at 1000 cps on the RIAA curve), flutter and wow no greater than 0.2 per cent peak in reproducing turntables and no greater than 0.1 per cent peak in recording turntables, and a speed accuracy of ± 0.3 per cent (21 dots/min. drift on a standard 216-dot 33⅓-rpm stroboscope card).

Unfortunately these Standards do not provide adequate guideposts for describing a completely self-effacing record player, in that they do not take into account the frequency destribution of the rumble or the predominant rates of the flutter. While an over-all rumble level of 35 db below the NAB reference is a very low figure when measured as specified by the NAB, it is an incomplete specification. Rumble at the higher bass frequencies needs to be considerably lower in level than the NAB Standard to be inaudible, because of increased hearing sensitivity in this range, while subsonic rumble much higher in level than the Standard will offend neither the ear nor the amplifier.[2] The NAB document specifically points out that its rumble measurement reflects only an electrical effect, not aural annoyance value.

Flutter whose rate is in the 3-cps region is of the order of three times as noticeable as flutter at 30 cps, and twice as noticeable as flutter at 0.5 cps.[3] An ASA Standard of 1954[4] established a unit called "flutter index" which takes into account the subjective influence of flutter rate, but no scale of values is suggested.

On the basis of this incomplete state of Standards relative to record players, it was decided to design a unit which would meet NAB specifications, and would in addition stand up to more stringent measurement criteria that were weighted for subjective sensitivity to rumble frequency and to flutter rate. Such weighted measurement data were available through the use of a flutter and rumble meter, referred to later on.

The NAB Standards call for a rumble-level meter with the same ballistic characteristics as a VU meter; this speed of needle response has been found to correspond well to aural effects. Both rumble and flutter measurements can be "improved" by employing a more highly damped meter movement. Another method of showing a dramatically lower rumble figure is to make the measurements with the pickup working into a flat preamplifier rather than one with the normal RIAA equalization. With a flat preamplifier, the rumble measurement relative to a 7-cm/sec 1000-cps test signal will be approximately 19 db lower than the corresponding NAB figure. Such a measurement does not represent the actual level of the rumble under operating conditions, but it appears to be in use by one testing organization.

Solutions to the problems of turntables and arms appear to the writer to be a matter of correct design rather than of expensive processes and materials. Since the record-player art is well advanced, the AR design borrows liberally from good engineering practice existing at present, combined with some new approaches.

Mounting

Aberrations in record player performance must result from any relative

* *Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass.*

[1] In the *American Standard Acoustical Terminology* "flutter" refers to any deviation in frequency; "wow" is a colloquial term used to describe those deviations which are relatively slow in rate and recognizable as pitch fluctuations.

[2] While rumble that is subsonic in frequency is inaudible, it cannot be ignored because it can load the amplifier. The order of amplitude involved in rumble which is anywhere near the NAB standard, however, is so low as to rule out any possibility of loading the amplifier significantly. Rumble which is no more than 20 db below reference, for example, will only drive the amplifier to deliver an additional 1 per cent of power.

[3] F. A. Comerci, "Perceptibility of flutter in speech and Music," *JSMPTE*, June, 1955.

[4] *"American Standard Method for Determing Flutter Content of Sound Recorders and Reproducers,"* Z57.1-1954.

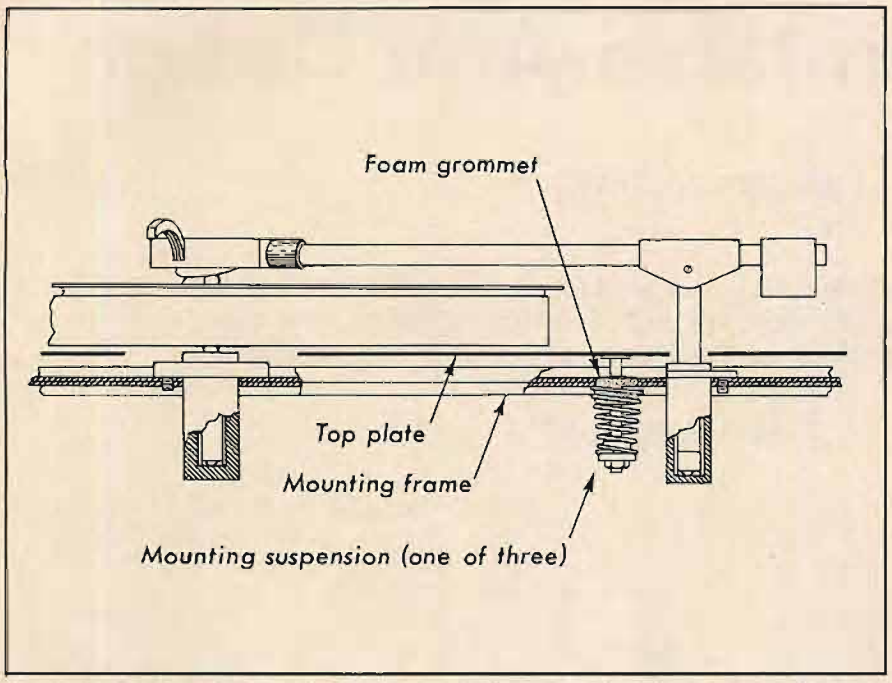


Fig. 1. Suspension system of the arm-turntable assembly. The tonearm pivot and platen bearing are connected by a steel I-beam, which is suspended from the top plate by three springs. Note that neither the tonearm nor the platen touches the top plate at any point.

motion between the arm and platen. A player can tolerate all sorts of violent motion so long as the arm and platen do not move relative to each other. Therefore the main platen bearing and the tonearm pivot are ideally mounted as rigidly as possible with respect to each other. The AR design uses a steel I-beam as a basic frame on which these two parts are mounted, with a crossbar to form a T-shaped mounting structure. The rigidity achieved could be equalled by a very heavy steel plate, but at much greater expense and inconvenience. As it is, the entire frame can be suspended with springs from a top plate that is both light and inexpensive.

This system decouples the arm and platen from the motors, and also shock-mounts the arm-platen assembly as a unit against external mechanical shock and acoustic feedback. It is possible to deal a moderate hammer blow directly to the top plate or to stamp on the floor violently without making the needle jump grooves.

Balance is an important element in shock mounting. With an unbalanced assembly there would be a greater tendency for the entire unit to rock, that is, to move rotationally. The inertia at the different points of support would not be equal, and one suspended point of the assembly would move farther than another in response to the same external force. Therefore the points of spring suspension are located so that they are equidistant from the center of gravity of the complete assembly, and are spaced on equal arcs.

The lower the resonant frequency of the shock-mounted assembly the better the isolation from external forces. As the frequency of a stimuating force is lowered below resonance, the mounting suspensions act increasingly as though they were rigid. The practical figure chosen for mounting resonance was 3.5 cps. In this range the resonant frequency of a mounted turntable assembly can be determined simply by giving the spindle a push and counting the rate of free oscillation. Unfortunately many record players are mounted with a much higher resonant frequency, often so high that the frequency cannot be determined visually. Performance of such record players can be improved considerably by a more compliant mounting. Stability in the presence of floor shocks is increased greatly, and perhaps more important, acoustic feedback is reduced or eliminated.

The importance of the latter is often not recognized. Acoustic feedback is sometimes responsible for a seemingly inexplicable "hoomy" quality of reproduction or for an apparent increase of rumble, created by incipient low-frequency oscillation. The floor and room structure provide a path of positive feedback from the speaker back to the pickup; proper shock-mounting of the player assembly opens the feedback loop.

A qualitative method of testing for acoustic feedback from speakers to the record is to place the needle on a record at rest, and then to observe how far the volume and bass-boost controls can be advanced without creating feedback. While the information gained by such a test is entirely relative, the adequacy of a particular installation can be evaluated roughly by turning the volume and bass controls to the maximum position in which they would be used in that installation, placing the needle on the still record, and stamping lightly on the floor near the turntable or tapping the table surface on which the turntable rests. Any tendency to feedback will be evident in a train of low-frequency oscillations following the mechanical excitation.

The positions to which volume and bass controls can be advanced is a function of pickup output, preamplifier sensitivity at low frequencies, and room conditions. In a typical installation the AR turntable does not show feedback instability with the volume control at maximum and the bass controls fairly well advanced.

A simple method of choosing mounting springs is to use the formula $F = (10/D)^{1/2}$, where F is desired resonant frequency and D is the static deflection of the spring in inches when loaded with its mass. If one wanted to shock-mount an assembly weighing x pounds with three springs, for example each spring would be tested with an $x/3$-lb. load. For a resonant frequency of 3.5 cps the static deflection would have to be 13/16 in., which is to say that the length of the loaded spring at rest would be changed from its unloaded length (either stretched or compressed) by this amount.

Figure 1 illustrates the T-frame suspension system of the AR turntable. Foam washers that help center the spring also provide a light amount of damping, which is desirable. Note that the platen bearing, T-frame, and tone-

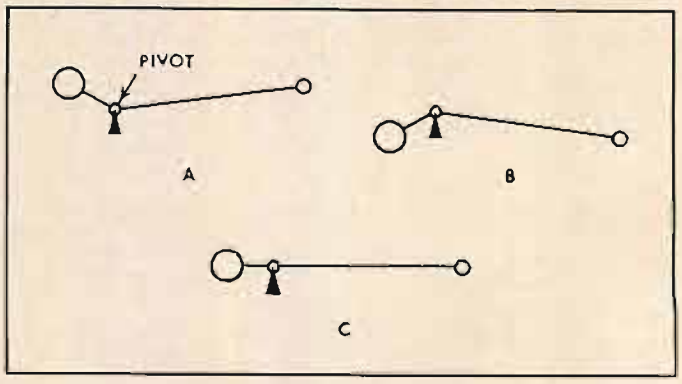


Fig. 2. Three types of static balance: (A) unstable, (B) stable, and (C) neutral.

arm pivot will move as a unit if excited through their mounting springs. Shock-mounting either the tonearm or the platen independently would tend to increase rather than decrease relative motion between the two.

The H. H. Scott turntable and the more recent Stromberg-Carlson unit used a similar design approach in suspending a rigid arm-platen assembly from the top plate.

Tonearm Balance

There are three kinds of static balance—unstable, stable, and neutral. There is also dynamic balance, which has no significance for tonearms and which will be discussed a little later.

Unstable balance exists when the line connecting the centers of gravity of two sides of a balanced system passes above the pivot, as in *A* of *Fig.* 2. If either side is tipped it will continue to move. This is undesirable for tonearms, because the stylus force will not be the same in all arm positions, and will vary with warped records. It is easier for the needle to skip when it hits a bump.

Stable balance, useful in scales, exists when the line between centers of gravity passes below the pivot, as in *B* of *Fig.* 2. In this case there is a tendency for the system to return to the horizontal if it is tipped. The stylus force of a tonearm in stable balance is again different for different arm positions. As in the case of the unstable arm, a warped record will create instantaneous changes in stylus force, although in the opposite direction. When an arm in stable balance is lifted by an uneven record surface, stylus force will increase, creating a tendency for the needle to dig into the record.

Neutral balance, most desirable for tonearms, is illustrated in *C* of *Fig.* 2. Here the line between centers of gravity passes *through* the pivot. The system will be in equilibrium at any angle, and stylus force does not vary with vertical motion of the arm.

Neutral balance for the horizontal plane can be provided in various ways, but the principle is the same; the line between centers of gravity of the forward and rear sections of the arm must pass through the pivot for horizontal motion.[5] Five different methods of keeping the horizontal pivot on this line are currently employed (see *Fig.* 3):

(A) The counterweight and cartridge shell are connected by a straight arm, which must then enter the offset cartridge shell obliquely (Gray, GE, Stromberg-Carlson).

(B) The counterweight and cartridge shell are in line as in (a), but in order to allow the arm to enter the shell at a right angle the arm is given a double curve (ESL, Weathers, Ortofon, AR).

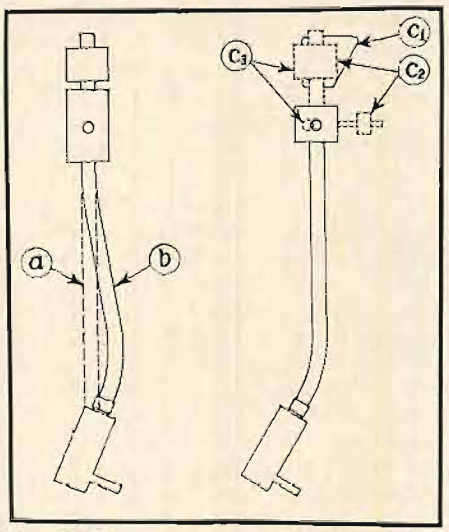


Fig. 3. Five ways of achieving neutral horizontal balance: (a) straight arm entering cartridge shell off-center, (b) arm with reverse curve, (c_1) offset counterweight, (c_2) additional "outrigger" weight, and (c_3) offset horizontal pivot.

(C) A single-curve arm enters the cartridge shell at a right angle, and the center of gravity of the counterweight is shifted in the opposite direction either through the shape of the counterweight (C_1, Dynaco), by an additional adjustable side weight (C_2, Grado, Rek-o-Kut), or by moving the horizontal pivot inward from the vertical pivot (C_3, Empire).

Stable balance in the vertical plane does not need to be perfect. The quantitative effect of different degrees of unstable balance is the given by the following examples. If the pivot is ½ in. below the line connecting the arm centers of gravity, the net force of gravity on the pickup, with typical arm parameters, would vary roughly 1½ grams for every inch the pickup was lifted above the record surface. In a record with a 3/16-in. warp (about as much as can exist in a playable record), the instantaneous stylus force would vary by ⅜ gram. If the pivot were only ⅛ in. from the height needed for neutral balance the variation in stylus force would be cut in four, to 3/32 gram.

It was decided to position the AR pivot exactly in line between centers of gravity because there was an additional advantage involved. The AR arm is so designated that if it is dropped from a point several inches above the record its rate of fall is slowed up by a damping mechanism (released when the arm touches the record). An unvarying downward force on the pickup to a distance of three or four inches above the record was therefore desirable, to keep the rate of fall constant.

It is no more expensive to design an arm with neutral balance than one which does not have it. There is an allied problem, however, which affects the the form of this design—vertical warp wow.

Vertical Warp Wow

All records must be considered as having normal warp which creates vertical arm motion. Even a record that fulfills NAB Standards of Good Engineering Practice is allowed a 1/16-in. vertical warp, and obviously all records do not, particularly after use, meet this standard.

When the cartridge moves up and down along an arc the needle must move back and forth along the groove, as illustrated in *Fig.* 4. The instantaneous relative speed between needle and groove will therefore be changed. It makes no difference, of course, whether the platen has actually changed speed or the needle moved along the groove; the audible and measured wow is the same.

It can be seen from *Fig.* 4 that there will be minimum longitudinal needle motion when the pivot controlling vertical motion is as far back as possible, and when the height of this pivot brings it as close to the plane of the record surface as possible (more precisely, to the average plane of the warped sur-

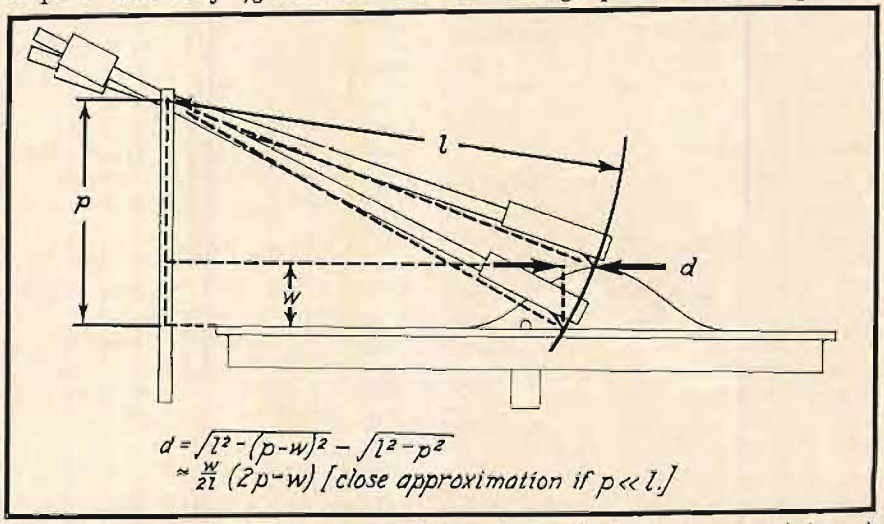


Fig. 4. Geometry of vertical warp wow. When the needle is swung up and down by vertical warp, it must also move horizontally (distance d) along the groove. p = pivot height, w = warp height, l = arm length.

[5] I am indebted to John McConnell of ESL for first calling my attention to the significance of balance in the horizontal plane.

face). Warp wow as high as 1 per cent has been reported; a little geometry applied to *Fig.* 4 will show that such a high percentage can be achieved by using a very high pivot and a very short arm for vertical motion.

The vertical pivot-to-needle length of the AR arm is 9 in. With an arm of this length, and a hypothetical pivot set ½ in. above the record surface, longitudinal displacement of the needle along the groove (*d* in *Fig.* 4) for a normal 1/16-in. warp would be .0032 in. Assuming that it takes 0.15 seconds for the needle to travel this distance—representing a not atypical bump in the record covering about 60 degrees of arc—the wow introduced would be an undesirable 0.1 per cent. This is to say that the instantaneous needle-groove velocity (19.2 in/sec at a 5-in. radius) would be changed by 0.1 per cent, just as if the turntable had been slowed or speeded up by that amount. This much wow from a single cause is significant in relation to the NAB limits for wow stemming from *all* causes of 0.1 per cent for recording and 0.2 per cent for reproducing turntables. On the other hand, the pivot could not be lowered from this height without creating unstable balance.

The way out of this dilemma was to lower both pivot and counterweight. The line between centers of gravity of the forward and rear sections of the arm, using a typical lightweight cartridge, then passes through a pivot ¼ in. above the record surface. This is the pivot height actually used in the AR turntable. Warp wow under the conditions described above is approximately 0.05 per cent.

The rear section of the arm slopes at an angle of 1.5 deg. to the horizontal, the slope of the line between centers of gravity. This is so that neutral balance will not be disturbed at any adjustment of the counterweight.

A warped record tends to exhibit more vertical motion when it is supported at its center than when it rests on its outer surface. The outer section of the AR turntable mat is therefore raised slightly.

Dynamic Balance

The term "dynamic balance" has been described by writers in the field as referring to: a) the use of a counterweight, b) the use of a statically balanced arm with stylus force supplied by a spring, or c) static neutral balance in both horizontal and vertical planes. Dynamic balance as a standard term in physics has a more specific meaning.

Dynamic balance is a condition of balance in which forces created by rotation of the arm about the pivot do not upset the balance conditions that exist *at rest*. Static balance has to do with the forces of gravity, while dynamic balance has to do with inertial forces. An example of combined static balance and dynamic imbalance given by the *International Dictionary of Physics and Electronics* (D. Van Nostrand Co., 1956) is shown in *Fig.* 5, and this system illustrates the type of dynamic unbalance that can occur in a tonearm.

The system of *Fig.* 5 is in neutral balance statically, and will remain in equilibrium and at rest when left in any position. When the system is rotated, however, the centrifugal force of each weight creates a force perpendicular to its own arm. Two opposite forces are thus exerted on the horizontal pivot shaft at two different points, creating a "couple" that tries to turn the shaft about an axis perpendicular to the plane of the weights.

Applying this concept to tonearms it will be seen that dynamic balance requires that the line between centers of gravity on each side of the arm not only passes through the pivot but is perpendicular to the axes of rotation. Offsetting the counterweight horizontally as is done

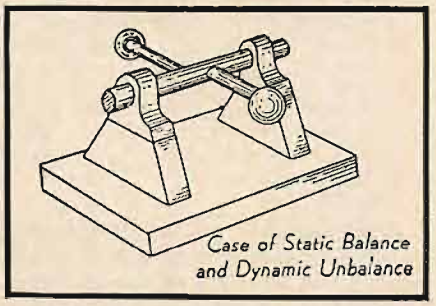


Fig. 5. Example of combined static balance and dynamic unbalance given by the International Dictionary of Physics and Electronics, 1956. Courtesy D. Van Nostrand Co.

in some current designs, or vertically as is done in the AR arm, or using side weights, loses dynamic balance.

Dynamic balance was deliberately ignored in the AR arm, as it is in most current arms, in order to lower the counterweight and make it possible to use a lower pivot for vertical motion without losing neutral static balance. This means that when the arm is moved horizontally by an off-center record, tiny vertical forces will be created because of the application of centrifugal forces at two different points on the axis of the pivot.

The magnitude of this vertical force, assuming the worst possible conditions of record eccentricity and dynamic unbalance, is measured in thousandths of a gram and has no significance for record players, even with stylus forces of a gram or less.

Tonearm Mass

When the tonearm is set into motion vertically by record warp, or horizontally by record eccentricity, inertia becomes a controlling element. The greater the inertia at the end of the arm the more the stylus will alternately dig into the groove and try to leave it.[6]

This inertia must not be confused with stylus force, even when the stylus force is provided by unbalancing the counterweight. In order to set the arm into motion the inertia of *both* front and rear sections must be overcome. The momentum of both cartridge and counterweight is in opposition to the required reversal of arm motion when record warp changes slope, or when an eccentric center hole swings the arm back and forth.

Thus the effect of the inertial mass of the counterweight must be added to, not substracted from, the total inertial mass in both horizontal and vertical planes. Clearly the arm should be as light as possible for maximum stability. It might seem contrary to common sense that a heavy arm will not keep the needle in the groove as well as a light one in the face of record warp and eccentricity, but it is true. No matter what the stylus force, once a heavy arm is set into motion either sideways or upwards, the chances of the needle leaving the groove are greater than in the case of a light arm.

In previous years too light an arm involved the danger of allowing too high a resonant frequency of the needle-suspension/arm-mass system, with an attendant bass-response peak in the audible range. Modern cartridges have such highly compliant needle suspensions, however, that it is possible to work for minimum arm mass and still keep the resonant frequency in the subsonic range. Further, in the case of the AR turntable the drive motor has a fundamental frequency of 6⅔ cps (400, rpm), and the arm resonance, which is in the 10-cps region with typical stereo cartridges, should not fall too close in frequency.

The first prototype of the AR turntable employed an arm with an aluminum cartridge shell, which turned out to be heavier than desired. By changing to an acrylic plastic the weight was reduced by more than half, to 7 grams. This is a double saving, since the required mass of the counterweight is also reduced.

The tracing capabilities of an arm (ability to maintain proper needle-groove contact) may be tested by subjecting the arm to severe adverse conditions such as those provided by a badly warped record. Some years ago C. G. McProud suggested a tracing test that consisted of playing a 45-rpm record placed eccentrically on the turntable, that is, with the spindle against

[6] R. E. Carlson, "Resonance, tracking, and distortion," *JAES*, V. 2, No. 3, July, 1954. Mr. Carlson uses the concept of "equivalent mass" referred to the stylus tip in discussing inertial effects.

one edge of the large inner hole. The arm is swung back and forth—creating, of course, severe wow due to the changes in path length—but the needle is expected to maintain contact with the groove.

The McProud test was conceived in terms of the needle forces then current, which were generally in the six- to eight-gram range. As the stylus force is reduced the tendency for the needle to be thrown from the groove in the McProud test is correspondingly increased. The inertial force tending to throw the arm sideways and the horizontal-pivot bearing friction remain the same for a given arm, while the downward force holding the needle in the groove is reduced.

The McProud test at six grams vertical force would not be a stringent one for modern arms, but it becomes increasingly difficult as the stylus force is reduced. The AR arm begins to fail the McProud test in the range between ½ and ¾ gram. The exact value depends on the mass of the cartridge, which contributes to the total inertia of the arm.

Counterbalance: Spring vs. Weight

There are three methods currently used for providing vertical stylus force: a), the use of a spring to cancel out all but the desired mass of the cartridge and arm, with no counterweight, as in the Bogen; b), the use of balanced masses, with a spring applying the desired force, as in the ESL, Grado, Shure (universal), Empire, Dynaco, and so on; and c), the use of an underbalanced counterweight to provide stylus force, as in the Pickering, Weathers, SME, H. H. Scott, Shure (integrated), Pritchard ADC, and AR.

There is a rationale to each of these methods. The counterweightless, all-spring system provides the lowest inertia, but the greatest sensitivity to external mechanical shock and to tilt of the turntable because of the extreme unbalance of masses. The balanced-mass, spring-loaded system provides the greatest stability under conditions of imperfect leveling and exposure to external mechanical stimuli, other things being equal.

Once neutral balance was established in the AR arm, stylus force had to be provided, either by adding a spring or by unbalancing the counterweight. The latter method was chosen, mainly for simplicity and reliability. (It must be understood that the advantage of neutral balance, in keeping stylus force constant at different arm positions, remains.) It was felt that the problems solved by the balanced-mass, spring-loaded system did not exist in the AR turntable, although this system could certainly provide advantages in other applications. The AR turntable is already isolated to an unusual degree from external mechanical shock by a balanced system. So far as tilt is concerned this suspension system provides a degree of self-leveling sufficient for the normal slopes of floors and furniture.

On the other hand simple mass counterbalancing presented the positive advantage of reliability of setting. There is no reason for the stylus force, once set for a particular cartridge, to change.

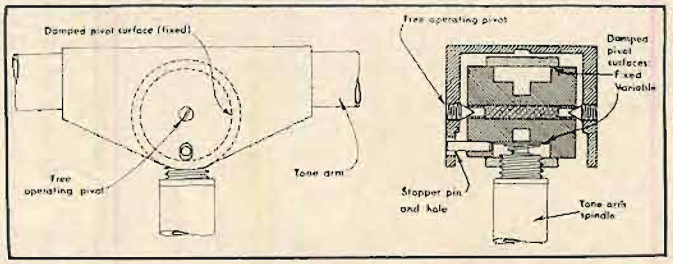


Fig. 6. (a) Tonearm damping release mechanism. The arm is damped if dropped, but has ⅜" free vertical play while playing a record. (b) Side view of damping release mechanism.

Tonearm Pivot

The first prototype of the AR arm employed damped pivots in both vertical and horizontal planes. The advantages sought included suppression to tonearm resonance and convenience in handling.

While the damped pivot[7] did provide these advantages when it was designed, its use with modern high-compliance stereo cartridges presented new problems. If enough damping were used to brake the prototype AR arm adequately when dropped, the impedance of the arm pivot while playing records was increased to an undersirably high value. The needle suspension, rather than the total arm, tend to yield to record warp and eccentricity, and the arm tended to "hang up" on warped records.

The advantage of a damped arm drop appeared very attractive, however. There are few people who have not at some time fumbled a tonearm and allowed it to slip from their fingers onto the record.

A design was worked out (for which patent application has been made) in which the arm *drop* is damped to the desired degree—the arm takes several seconds to reach the record when dropped. As soon as the needle reaches its destination, however, the damped bearing surfaces are disengaged from the arm by a simple device, illustrated in *Fig.* 6.

When the arm is dropped the front edge of the stopper hole presses against the stopper pin, which is smaller in diameter than the hole. This stopper pin is rigidly mounted on a porous bronze shaft impregnated with silicone fluid. The shaft is forced to rotate inside a Delrin sleeve, and the silicone provides the necessary drag.

When the needle comes to rest at the lowest point on the record there is no longer any force between the stopper hole and the pin. Then, when a warped section of the record lifts the arm, the stopper hole and pin are free of each other and no force is exerted on the damped bronze shaft. The arm lifts on its operational pivot, consisting of polished steel conical set screws turning in Delrin bearings.

The arm is allowed this freedom over a vertical distance of ⅜ in. at the stylus. When the arm is lifted by hand the back edge of the stopper hole engages the pin and forces the bronze shaft to turn again, resetting the damping mechanism. Horizontal arm motion remains undamped at all times.

The release of the damping mechanism during record play makes it possible to use the necessary degree of damping for the arm drop, without having to consider the effect on tracing records. In order to keep the same velocity of drop at different adjustments of the counterweight (for different cartridges) the absolute amount of viscous friction must be adjustable. This is accomplished by changing the pressure on a spring-loaded washer resting against part of the silicone-soaked bronze shaft. The pressure is varied by turning the tonearm spindle relative to the arm itself.

Tracking Error

The equations for minimum tracking error distortion are well known.[8, 9] Tracking-error index is a function of tracking error divided by record-groove radius, since the same value of tracking error creates increasing distortion at the inner grooves. Offset angle and overhang are calculated on the basis of the maximum and minimum groove radii the arm is designed to play. It must be noted in passing that an arm designed

(*Continued on page 69*)

[7] W. S. Bachman, The application of damping to phonograph reproducer arms. *Proc. I.R.E., 40,* 2, Feb., 1952, 133–137.

[8] B. B. Bauer, "Tracking angle in phonograph pickups," *Electronics,* March, 1945, p. 110.

[9] J. D. Seagrave, "Minimizing pickup tracking error," *Audiocraft,* December 1956.

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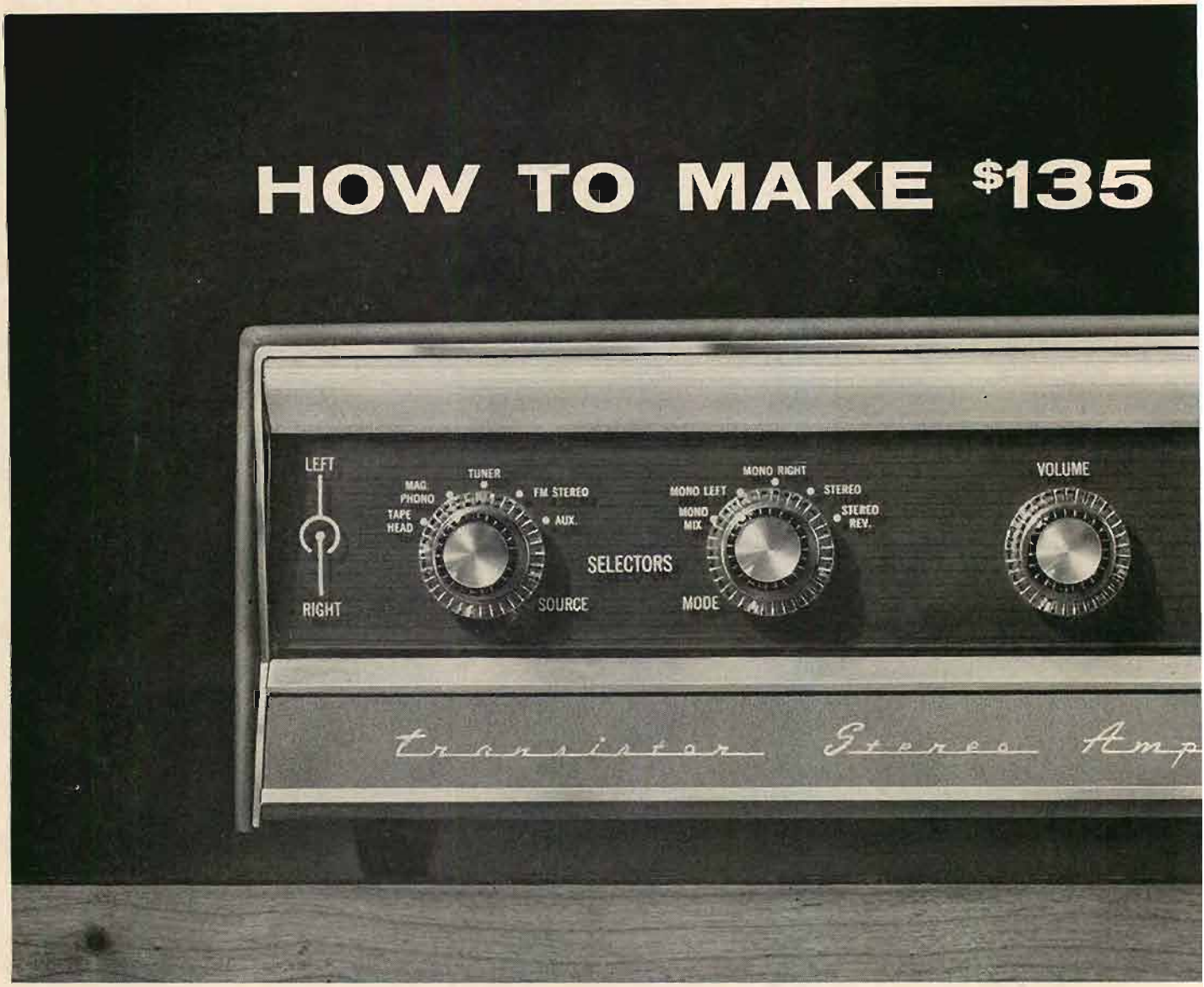

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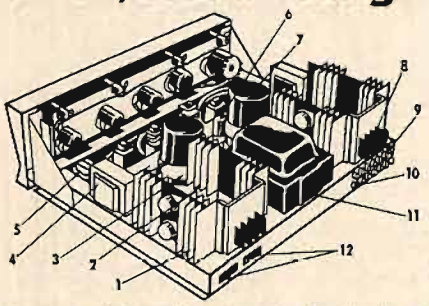

1. Eight germanium power output transistors mounted on four finned heat sinks. **2.** Output circuit breakers. **3.** Two power amplifier circuit boards containing four transistors and six diodes. **4.** Two driver transformers. **5.** Two preamplifier circuit boards containing six epoxy-sealed component modules and ten transistors. **6.** Two germanium driver transistors plus four electronic filter transistors. **7.** Two 3,000 mfd filter condensers and four power supply diodes. **8.** Two output terminal boards. **9.** Stereo input jacks. **10.** Tape recorder output jacks. **11.** Power transformer. **12.** AC power outlets. All primary and secondary controls accessible at front panel area!

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TRW

6325 Huntley Road Columbus 24, Ohio

Use of D.C. Relays in Home Audio Systems

FRANCIS F. CHEN*

D.c. relays can have several advantages in audio systems because they do not produce hum nor do they chatter. They are especially valuable in control applications such as the automatic turntable shutoff, remote control, and clock-timer described in this article.

IT IS WELL KNOWN that sensitive d.c. relays which operate on only a few milliamps of current have several advantages over the usual a.c. relays which are energized by either the 117-volt line or the 6 volts of a.c. in the filament circuit. One of these advantages is particularly important to audio systems: d.c. does not produce hum. A second advantage is that d.c. relays do not chatter upon closing, since the exciting voltage does not go to zero and reverse, as it does in a.c.

In this article three illustrations are given in which the audiofan can make use of these properties of d.c. relays in the power switching of his home audio system. In the first example, a simple circuit is described which will automatically turn off a turntable at the end of a record without any interaction with the tonearm during the play of the record. The second example is a versatile relay circuit with which remote, automatic switching of the power to the entire audio system can be performed. In the third example, it is shown how an accurate timer can be made, which can switch on a tape recorder or an entire stereo system within a fraction of a minute of a predetermined time. These are of course, only illustrations of ways in which relays can be used; but from these examples the audio hobbyist should be able to design circuits suitable for his own particular needs.

* *P. O. Box 81, Kingston, N. J.*

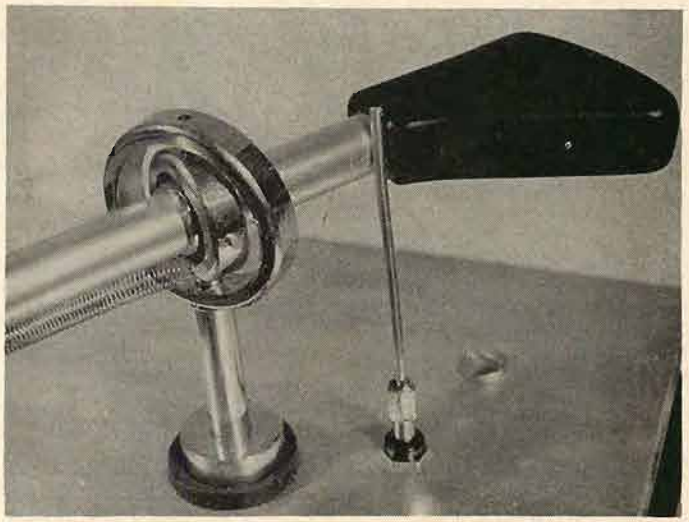
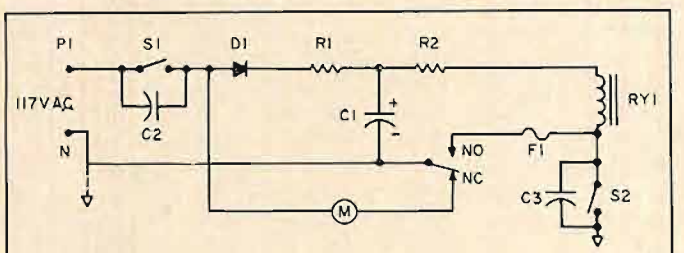


Fig. 2. Close-up view of contact for shutting off turntable automatically at end of record. CAUTION: Do not use bare wire as shown here; wire should be either of the enamelled variety or covered with spaghetti and bared only in the contact area.

I. AUTOMATIC TURNTABLE SHUT-OFF

Much of the inconvenience of a turntable, as contrasted to a changer, can be avoided merely by making a device to turn the player off at the end of a record, thus eliminating the annoying click-clack of the runout groove and allowing the listener to change the record at his leisure. At least two such devices are available commercially, but one of them is quite costly, and the other is a purely mechanical device which lifts off the tonearm but does not provide any electrical signal for switching off other components. The relay circuit shown in *Fig.* 1 is simple, reliable, inexpensive, and can be used with any metallic tonearm.

The two most important requirements of a switch-off device are that it should not interfere in any way with the delicate balance of the tonearm and that it should not introduce any hum. One way to detect that the record has ended is to make use of the absence of audio signal or the approximately 1-cps clicking signal from the runout groove. This method would have no interaction, either electrical or mechanical, with the tonearm at all. However, a little thought shows that such a device would be very difficult to perfect and adjust. One could also use



P1 POLARIZED A.C. PLUG
S1 SPST MAIN TURNTABLE ON-OFF SWITCH
D1 IN538 OR EQUIV. SILICON DIODE
C1 12 µf 250V ELECTROLYTIC
R1 30K, 1W
R2 10K, 1W
C2,C3 .01µf DISC
F1 FUSE, 1/100 AMP
RY1 SENSITIVE D.C. RELAY, 10K, 2.5 mA COIL, SPDT POTTER & BRUMFIELD RS5D OR EQUIV.
S2 CONTACT TO GROUNDED TONE-ARM

Fig. 1. Schematic of automatic turntable shutoff.

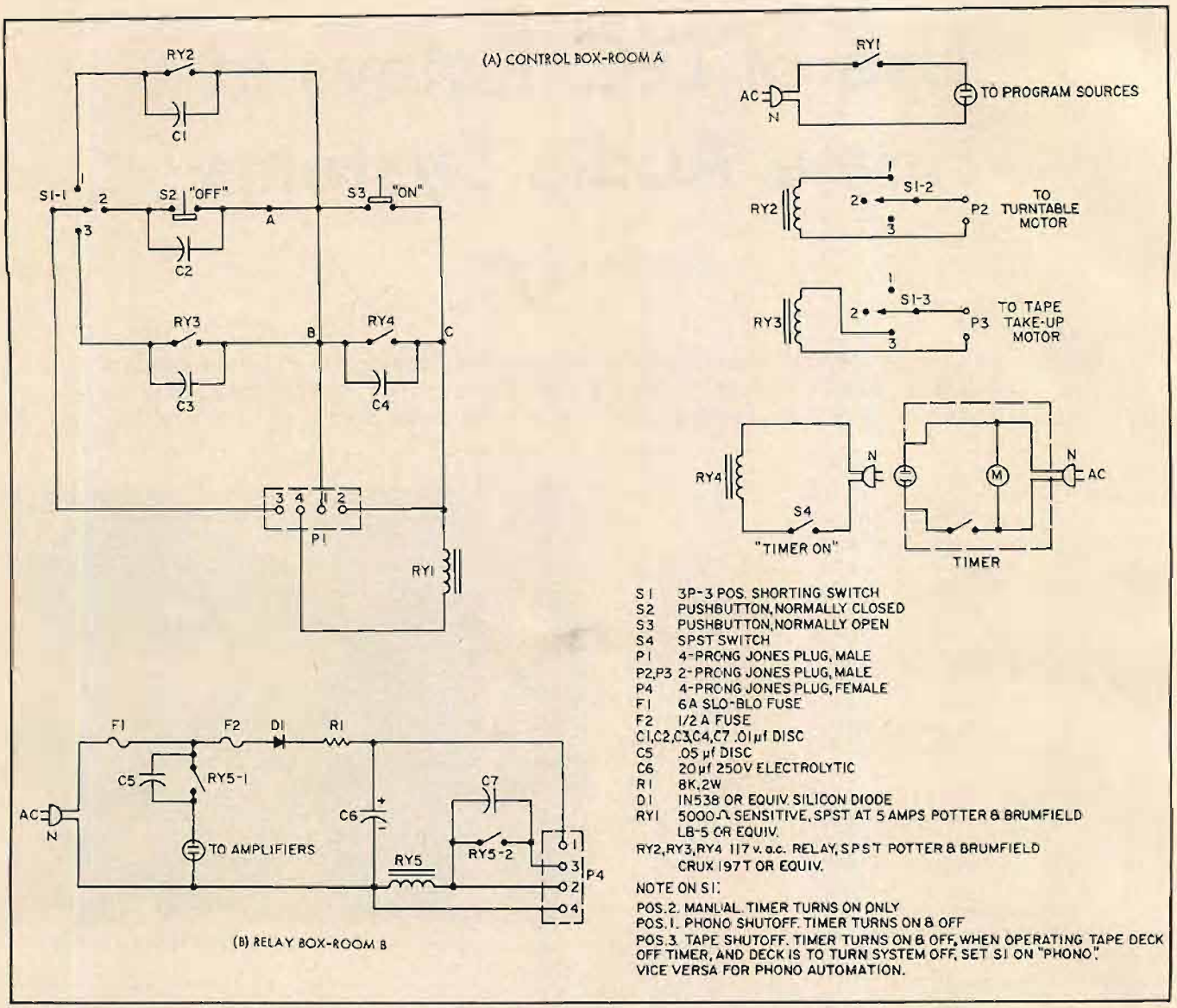


Fig. 3. Schematics of control and relay boxes.

a photocell to rig up an "electric eye" device to tell from its shadow when the tonearm has reached the inner radius of the record. This method also has no direct interaction with the tonearm, and the circuit could be fairly simple. This was tried, but it turned out that it was hard to adjust the sensitivity so that it would work under all conditions of ambient light, unless a complicated, collimated light source was built. Thus we decided to use a direct electrical contact on our metallic tonearm.

As shown in *Fig.* 2, this involves only a small, inconspicuous addition to the turntable. A small hole is drilled in the baseboard in the region of the tonearm overhang, and a feed-thru insulator is mounted in the hole. A fairly stiff bare[1] wire (about #14 AWG) is soldered to the feed-thru and bent so that it makes contact with the rear part of the tonearm when the latter enters the runout groove. This adjustment is quite easy to make. To ensure that an electrical contact is made with the arm, it is probably necessary to rub off the finish-protecting coating on the tonearm with fine sandpaper or emery cloth. Since the tonearm itself is used as a conductor, it is not necessary to add wires to it, and its operation is not interfered with in any way until after the record is over. This contact, S_2 in *Fig.* 1, is then used to trip a relay.

To prevent a large spark when the contact is made and to avoid a hum-inducing a.c. voltage on the contact wire, a sensitive d.c. relay RY_1 (*Fig.* 1) is used. This should have a coil resistance of 5000 to 10,000 ohms and require 2 to 4 ma of coil current. A standard relay is listed, but a suitable relay can often be obtained at less cost from the large radio supply houses. (For example, Lafayette Radio in New York sells an imported d.c. relay for $1.95.) The relay is powered by d.c. from a half-wave rectifier supply consisting of diode D_1 (also available cheaply from the large supply houses) and the filter R_1 plus C_1. The switch S_1 is the on-off switch for the turntable. Note that a polarized plug must be used so that the neutral side of the a.c. line is connected to the relay contacts. The turntable motor is connected to the hot side of the line returned to ground through the normally closed relay contact. The switch S_2 is the contact to the tonearm (*Fig.* 2). If the tonearm is grounded to the chassis of the preamplifier, and this is eventually returned to a good ground (such as a water pipe), the circuit through the relay coil will be completed when the tonearm touches the contact wire. When the relay is energized, power is removed from the motor, and the relay circuit is completed through the normally open contact. The relay then holds itself on and the turntable off regardless of whether or not S_2 stays closed. The relay is de-energized by momentarily opening S_1. While the turntable is on, there is normally about 100v of d.c. on the contact wire. The resistor R_2 and the relay coil itself

[1] In order to reduce the danger of shock, we recommend that this wire be insulated by means of spaghetti or that it be enamelled wire and that it be bared *only* in the contact area. *Ed.*

WHETHER YOUR PARTICULAR REQUIREMENTS IN A TAPE RECORDER ARE SIMPLE OR COMPLEX ...WHETHER THEY REFLECT THE DEMANDS OF YOUR HOBBY OR YOUR PROFESSION... WHETHER THEY STRESS LISTENING OVER RECORDING OR VICE VERSA, OR PROFESSIONAL QUALITY OVER PORTABILITY OR VICE VERSA, CHOOSING THE ONE RIGHT TAPE RECORDER FOR YOU HAS NOW BECOME AS SIMPLE AS A-B-C! FOR THERE ARE NOW FOUR NORELCO CONTINENTALS. ONE FOR EVERY PURSE. ONE FOR EVERY PURPOSE. ALL GUILD-CRAFTED BY PHILIPS OF THE NETHERLANDS. EACH DESIGNED TO PROVIDE ITS OWNER WITH THOSE FEATURES BEST SUITED TO HIS SPECIAL REQUIREMENTS—WHETHER ON VACATION, ON LOCATION, IN THE HOME, STUDIO, OFFICE, CHURCH OR SCHOOL.

CONTINENTAL '100' (EL 3585) shown on top: transistorized, 7 lb., battery portable • records 2 hours on 4" reel, from any source • plays back thru self-contained speaker as well as radio, TV or record player • response: 100-6000 cps • tapes interchangeable with other 2-track 1⅞ ips machines • constant-speed operation • complete with dynamic microphone.

CONTINENTAL '200' (EL 3541) shown bottom right: 4-track stereo head output direct to external stereo preamp for portable high fidelity tape-deck applications • completely self-contained for 4-track mono record and playback • mixing facilities • lightweight, compact, rugged • dynamic microphone.

CONTINENTAL '300' (EL 3542) second from top: 4-track stereo playback (tape head output) • self-contained 4-track mono record-playback • 3 speeds • dynamic microphone • ideal for schools, churches, recreation centers, etc. • choice of audiophiles seeking top quality at a sensible price.

CONTINENTAL '400' (EL 3536) bottom left: 4-track stereo and mono recording and playback • 3 speeds • completely self-contained, including dual recording and playback preamplifiers, dual power amplifiers, two loudspeakers and stereo dynamic microphone • frequency response: 50 to 18,000 cps at 7½ ips • wow and flutter: less than .15% at 7½ ips • signal-to-noise ratio: —48 db or better • cross-talk: —55 db.

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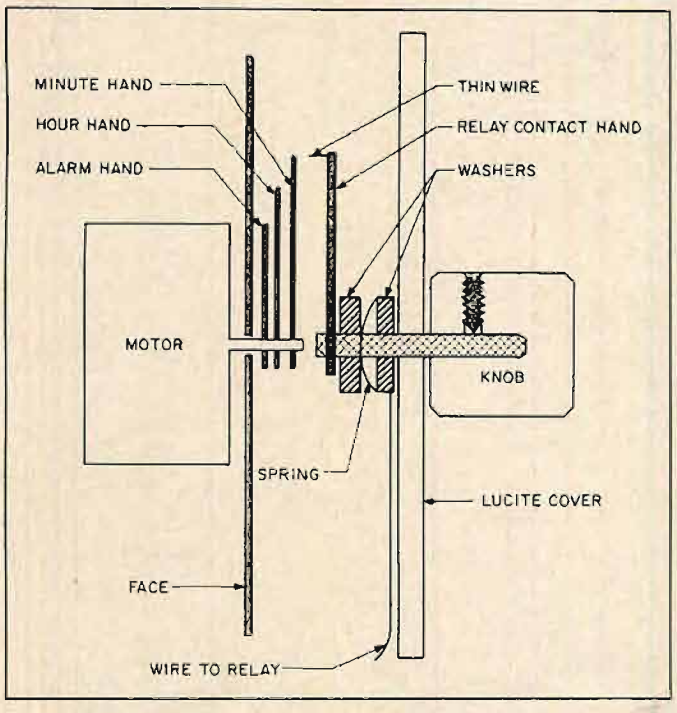


Fig. 4. Selection of clock front area showing placement of relay contact hand wire to relay.

limit the current to about 5 ma in case the wire is touched accidentally; this cannot be felt. In the unlikely circumstance that P_1 is accidentally reversed (if a polarized plug is not used), *and* the relay closes, *and* the contact wire is touched, one could conceivably get a shock from the power line (see note 1). The fuse F_1 protects the user against this contingency. The capacitors C_2 and C_3 are the usual switch bypasses to eliminate "pops."

This circuit has worked admirably without failure for several months on a Weathers turntable with a Dynaco B & O arm. Since no power transformer is used, there is no noticeable hum due to this circuit, and no clicks or pops when the turntable goes off. Current has to flow through the tonearm only for a few milliseconds while the relay closes; after this the holding-contract arrangement supplies current to the relay. Note that the contact to the tonearm need not be very good—the high impedance of the relay power supply makes it a constant-current source which will trip the relay even though the contact has thousands of ohms of resistance. There is only one word of warning: with turntables with idler wheels, be sure to release the idler within a reasonable time to prevent flat spots from developing.

II. AUTOMATIC POWER CONTROLS

The circuits shown in (A) and (B) of *Fig.* 3 are designed to allow remote control of the power amplifiers (in Room B) from the equipment cabinet (in Room A). The location of the power amplifiers outside the living room is really the sensible thing to do, since these amplifiers are generally unsightly and space-consuming, and moreover generate heat and hum. They can, of course, be turned on and off from the preamp if a power cord is strung between the two rooms. However, the Fire Underwriters' Code requires that such a wire, going through a wall, must be AWG #14 or larger; and this gives rise to some problems in installation and decor. On the other hand, the small amount of power required to trip a control relay can be handled by a small, inconspicuous wire. If this were the only reason, the use of relays would hardly be justified; but as we shall see, the use of a holding relay allows us to incorporate a number of automatic features.

The d.c. relays in this case are RY_5 in Room B, (B) of *Fig.* 3, which supplies power to the amplifiers, and RY_1 in Room A, (A) of *Fig.* 3, which controls the program sources. The reason d.c. relays should be used here is that they will not chatter upon closing. When a.c. relays were tried, they occasionally caused the fuse to blow on the amplifiers because of large current surges induced when the contacts bounced upon closing. The power to activate these relays comes from a half-wave rectifier consisting of diode D_1, capacitor C_6, and the current-limiting resistor R_1. One contact of RY_5 is used to switch the amplifiers. The other contact is hooked up in a holding arrangement so that once the relay is tripped (by shorting pins 1 and 2 on Plug P_4), it is held in the energized condition by current which comes from pin 3 of P_3 through the second pole of RY_5. Power is turned off when the d.c. on pin 3 is removed momentarily. These operations are performed in the control box, which is connected to P_4 by a small four-conductor cable.

To turn the system on, the normally open pushbutton, S_3, is pushed, momentarily shorting pins 1 and 2 of P_1 (or P_4). This trips RY_5, as previously described; and both relays, RY_1 and RY_5, are then held closed by current which flows from pin 1 of P_1 through the normally closed "off" button S_2 and selector switch S_{1-1} (shown in the "manual" position) and through pin 3 and the contact RY_{5-2} to the relay coils. This circuit is broken momentarily by pushing the "off" button, and this is sufficient to de-energize RY_5 and RY_1, turning off the power to the entire system.

With this arrangement, it is now easy to add the automatic features. To turn the system off automatically at the end of a record, the "off" button is replaced by the contact of RY_2 by turning the switch S_1 to the No. 1, or "phono," position. At the same time, RY_2 is energized by the second pole of S_1. The coil of RY_2 is connected in parallel with the motor of an automatic turntable or charger, which is already on. When this is turned off, for instance by the circuit of *Fig.* 1, RY_2 is de-energized, and power is removed from pin 3 of P_1, turning off the entire system. The same function can be performed by a tape recorder by RY_3 and the No. 3, or "tape," position of S_1. The coil of RY_3 is connected to the take-up motor of the recorder, and

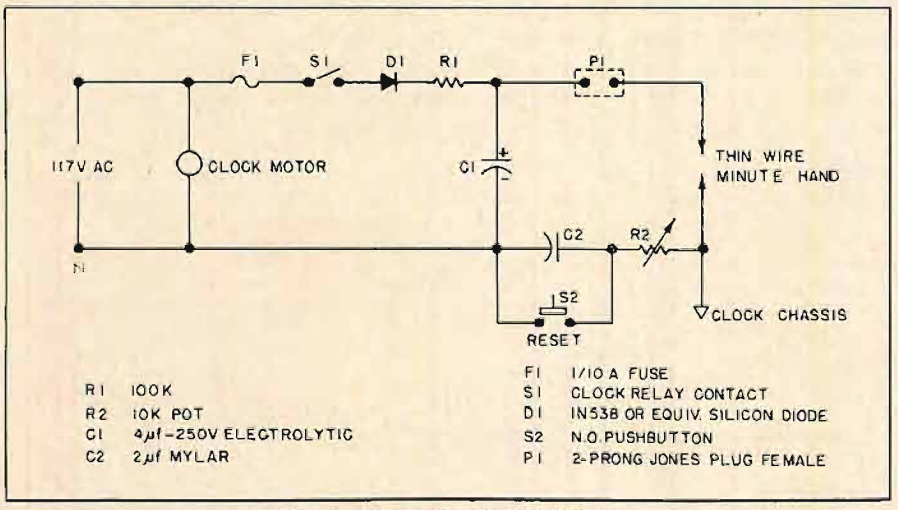
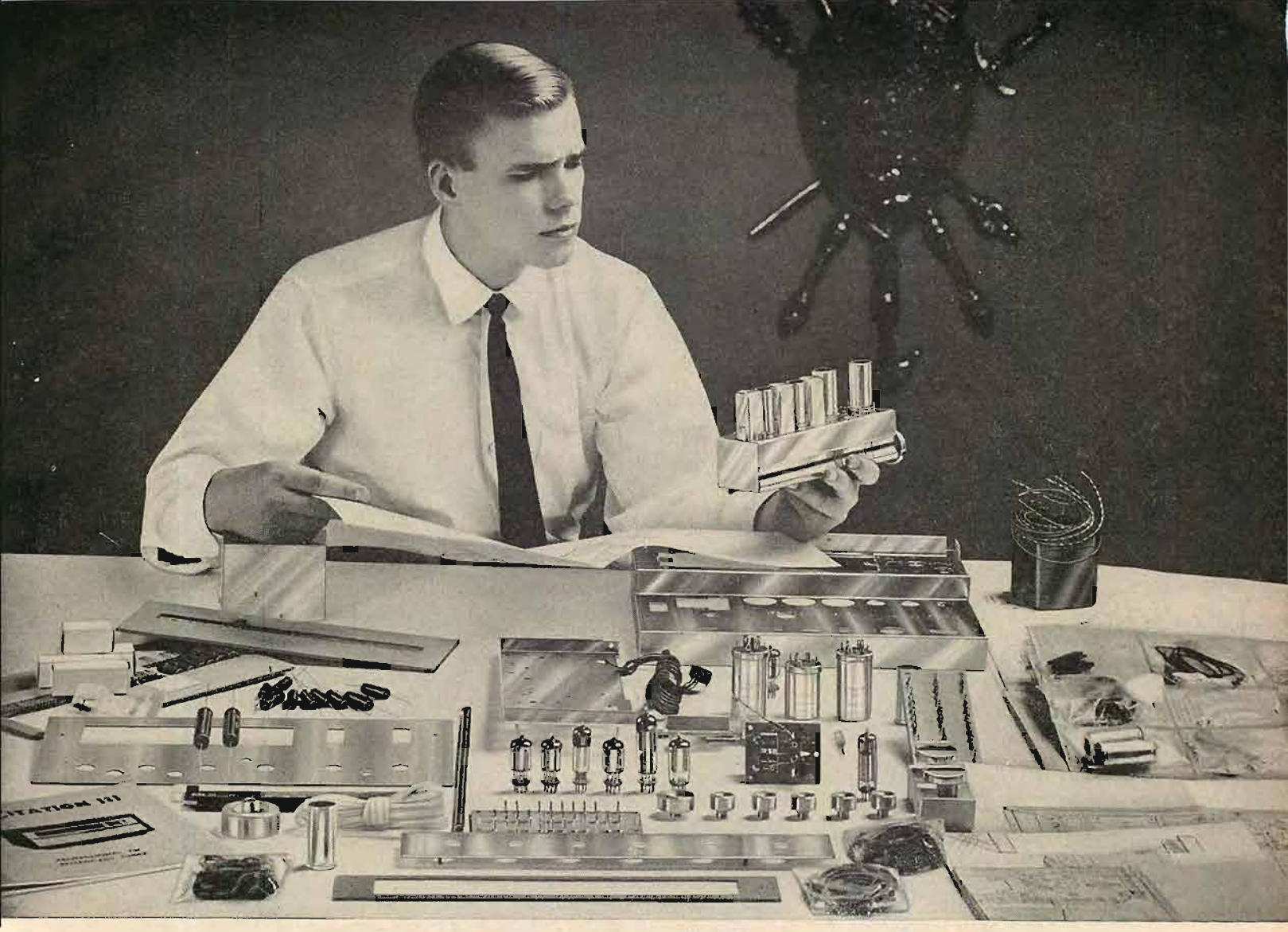


Fig. 5. Schematic of clock-timer.



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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-9, 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, $79.95. The Citation III X integrated multiplex tuner — kit, $219.95, factory wired, $299.95. All prices slightly higher in the West.

The Citation III

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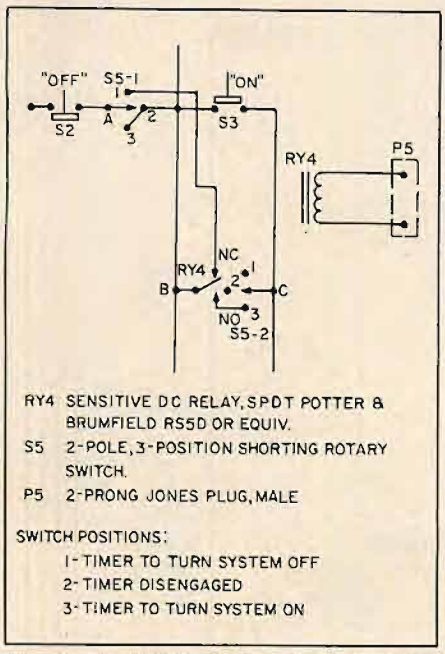


Fig. 6. Modification of control box for clock-timer.

when this is turned off automatically at the end of a tape, the entire system is turned off.

For automatic turning on of the system at a preset time, the contact of relay RY_4 is used in parallel with the manual "on" button. The coil of RY_4 is plugged into an ordinary appliance timer, which energizes it at a preset time only if the timer switch S_4 is closed. This will allow a radio program to be recorded automatically in one's absence, or will turn on a record or tape automatically, say, during a party at which the host is busy with other chores. If S_1 is in the "manual" position, the system will stay on. If it is in the "tape" or "phono" position when the corresponding device is used, the system will turn off when the tape or record ends or when the timer turns RY_4 off, whichever occurs later. If the switch S_1 is in the "tape" position when a turntable or tuner is used, or in the "phono" position when a recorder or tuner is used, the timer alone will determine the turn-off time. This is useful, for instance, when one wants to retire at a given time. Almost any type of relay can be used for RY_2, RY_3, and RY_4, and for simplicity we have chosen relays that operate off the line voltage so that no special power supply has to be built. There is a danger that hum from the relay coils will be picked up in the preamp; however, this has not been noticeable.

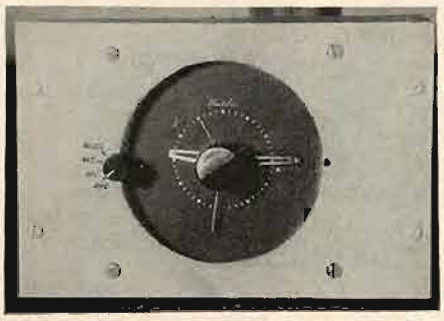


Fig. 7. Front view of clock-timer. Note extra hand.

This switching system has been operating without failure for a year and a half. Its main contribution has been to free the listener from being tied down by FM schedules. With automatic tape recording, one can listen to FM concerts at his leisure regardless of when the broadcast actually occurred.

III. AN ACCURATE CLOCK-TIMER

Anyone who has tried to tape a program while he was away has probably come across this problem: ordinary appliance timers cannot be set very accurately, and coming within five minutes of the desired time would be considered above par. This means that you either miss the first few minutes of a symphony, or you have 200 feet of wasted tape at the beginning of a reel—and perhaps not enough at the other end to finish the recording.

This problem can be licked by adding essentially the relay circuit of *Fig.* 1 to an ordinary appliance timer. Such a timer can be obtained for about $3 from the large electronics supply houses (for instance, Radio Shack in Boston) and is simply an unmounted electric clock movement with an alarm hand which can be set to turn on a SPST switch. The clock is mounted on a piece of lucite (plexiglas), which in turn is screwed onto an aluminum utility box which houses both the clock and the electronics.

A fourth hand (in addition to the clock's hour, minute, and alarm hands) is now attached to the lucite face, as shown in *Fig.* 4. This consists of a knob, a piece of ¼-in. potentiometer shaft, a stiff piece of wire to form the hand, and a small piece of fine flexible wire soldered to the hand. The fine wire is placed at such a radius that it makes electrical contact with the minute hand but not with the hour hand. This fourth hand is wired electrically by means of a fine wire soldered to a washer which makes contact with the shaft as the hand is rotated.

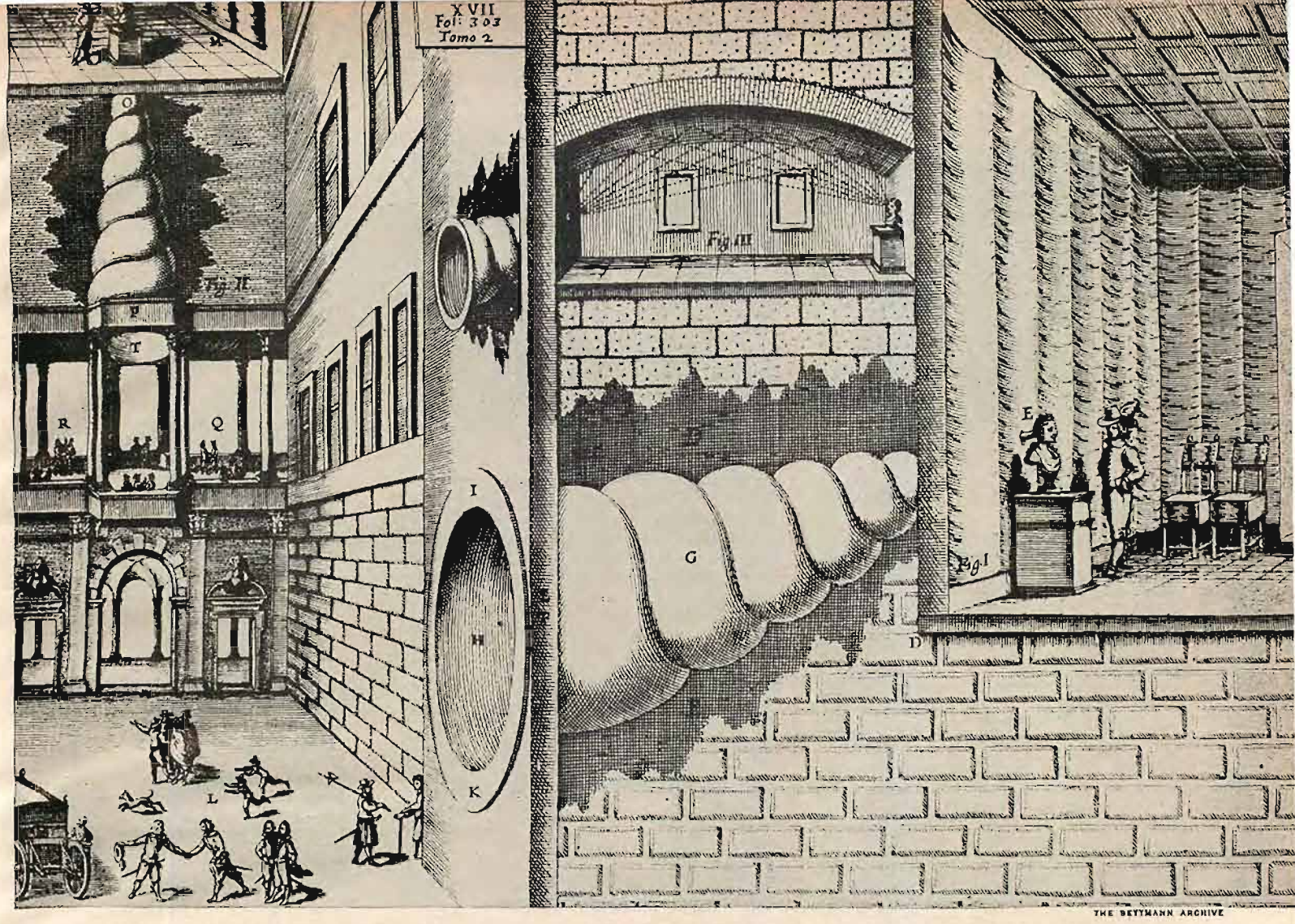
Here is how it works. In *Fig.* 5, D_1, R_1, and C_1 will be recognized as the d.c. power supply for a sensitive relay, whose coil is connected across plug P_1. The alarm hand is set about 15 minutes before the desired time, so that nothing happens until the proper hour arrives. When the built-in alarm of the clock goes off, the switch S_1 closes, and our d.c. power supply is energized. A d.c. voltage appears on the fine wire of the fourth hand, but no current can flow until this hand makes contact with the minute hand, which is grounded to the chassis. Imagine, for the moment, that the capacitor C_2 is replaced by a short. Then when the thin wire makes contact, the circuit is completed, and the d.c. relay is energized to turn on the power to the audio system. Since it is possible to set the fine wire to a given position quite accurately, the relay can be made to trip within a fraction of a minute of the desired time.

Note that the line plug should be polarized as shown so that no voltage appears on the clock mechanism. For added safety, the clock mechanism should be insulated from the metal case; this is easy to do since the clock is mounted on an insulating lucite panel. Note also that the fine wire of the fourth hand should be flexible enough to allow the minute hand to brush by an indefinite number of times.

The trouble with this circuit is that most clock mechanisms turn switch S_1 on but not off; S_1 must be reopened manually. This means that the relay will trip once every hour until you return to reset S_1 manually. This defect is overcome by adding the capacitor C_2 and the reset button S_2. Now current can flow through the relay coil only for a few milliseconds until C_2 is charged up. The potentiometer R_2 is adjusted so that a current pulse just large enough to trip the relay is passed when the thin wire contact is made. When the contact is broken, as the minute hand moves past, C_2 will be left charged. An hour later, when the contact is again made, no current can flow since C_2 (and the minute hand) are still charged. For this purpose, it is obvious that the clock *must* be well insulated. The capacitor C_2 must also hold its charge for an hour. It was found that mylar capacitors are good enough for this purpose. The voltage drop after an hour is so small that on successive contacts with the minute hand too small a current flows through the relay to trip it. At the same time, each contact charges C_2 back to full voltage for the next hour. This cycle then repeats until you return to reopen S_1 manually. The reset button S_2 should be pushed when setting the timer to make sure that C_2 is discharged.

This timer is incorporated into the relay circuit (A) of *Fig.* 3 by adding the circuit of *Fig.* 6 at the points labeled A, B, and C. The relay RY_4 in (A) of *Fig.* 3 is now replaced by a sensitive d.c. relay with SPDT contact. The plug P_5 is connected to P_1 (*Fig.* 5) by a twin lead. The switch S_5 enables one to disable the timer, or make it turn the system on or off (but not both) at a given time. This timer can, of course, be used without the entire circuit (A) of *Fig.* 3. In this case RY_4 should have DPDT contacts, and one pole should be hooked up as a holding contact, while the other is used to switch power to the system.

The face of the clock-timer is shown in *Fig.* 7. This circuit has worked well for several months and has proved to be a great boon to tape recording. AE



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The Classic Mark II.

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The Tape Guide

HERMAN BURSTEIN*

Q. My tape recorder has separate high-level and microphone inputs for each stereo channel but no provision for the mixing of two or more microphones for each channel. I would like to construct a mixer to handle three microphones per channel, and would like to know if something like the enclosed diagram (Fig. 1) would be satisfactory. Specifically, I would like to know:

1. *What values should be used for R, the three volume controls?*
2. *What, if anything, should the third terminal, A, of each volume control be connected to?*
3. *Is it necessary to provide any amplification in a mixer, or would a design such as the above be satisfactory? If amplification is needed, where could I find suitable plans for a high quality amplifier?*

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

A. Your diagram would result in tremendous interaction among the gain settings of each microphone. *Figure 2* is a suggested mixing arrangement that would produce much less interaction, at most about 6 db. The minimum insertion loss of this arrangement for any one microphone is about 4 db, and the maximum is about 10 db, the latter occuring when the other two microphones are at minimum volume. The diagram includes optional switches for each microphone. This means that if you are using only one microphone you can avoid any insertion loss at all, or at least minimize such loss, by opening up the switches to the other two microphones. These switches should be of the make-before-break type in order to avoid popping.

The diagram assumes that you are going to use magnetic rather than piezoelectric microphones. For good bass response, the latter typically require a load impedance of about 2 or 3 megohms instead of the 500K impedance shown in the diagram.

There is a reasonable chance that you will not need any subsequent amplification, taking into account the typical sensitivity of microphones for home use and the gain of the typical tape recorder. But if you require amplification, the diagram shows an amplifier stage which is followed by a gain control whose purpose is to avoid the possibility of overloading your tape recorder's first stage. You want to operate the *individual* microphone controls at as high a setting as possible in order to obtain maximum signal-to-noise ratio, the noise being principally that of the following amplifier stage. If you want to completely eliminate interaction among the microphone settings, each microphone would have to be followed by a separate amplifier stage, with the outputs of the three amplifier stages then being combined.

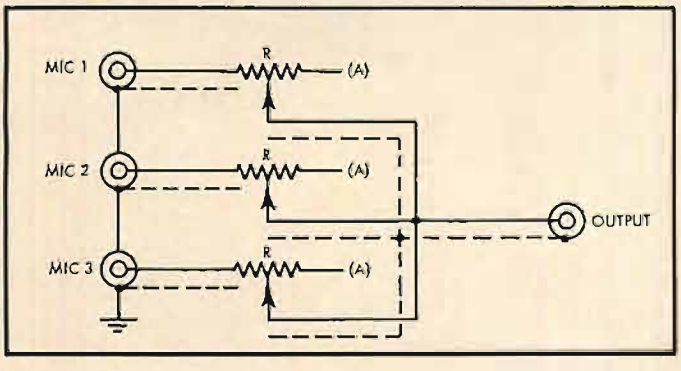


Fig. 1.

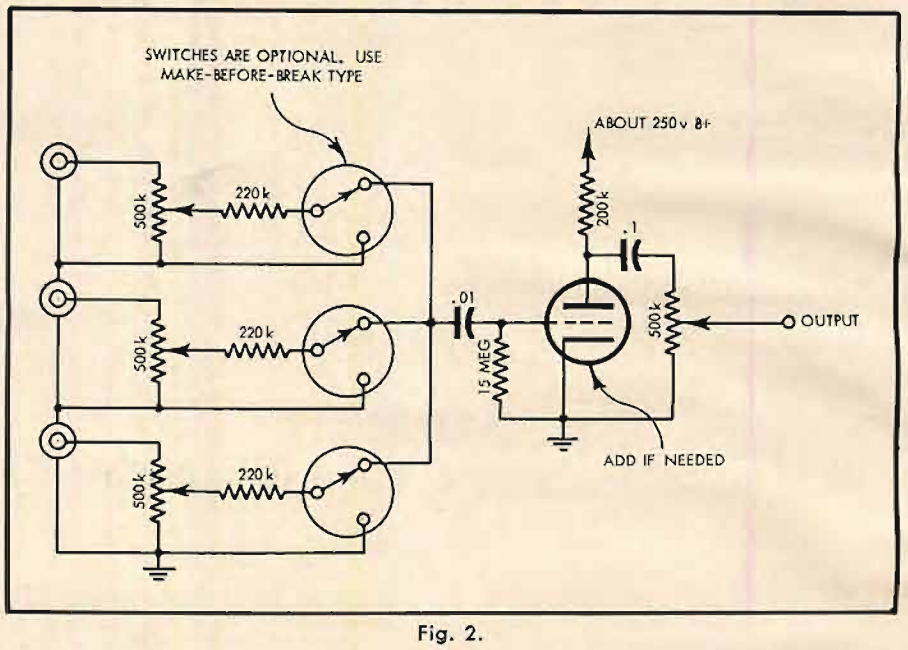


Fig. 2.

Q. I have been planning on purchasing a high-quality tape recorder, and with it I plan to tape FM-multiplex, copy other tapes, and tape live organ and other music. I have been considering the purchase of a four-track machine, but recently have been given reason to doubt the advisability of four-track stereo recording with home tape machines. A (tape) friend of mine, who is also an electrical engineer, has had very adverse experiences with four-track stereo recording. He experienced a very restricted dynamic range and found the recording level to be highly critical with distortion and tape hiss prevalent in many instances. It is true I would like the savings of four-track stereo, but not at the risk of any loss of high fidelity, or in difficulty of taping. I would appreciate your personal opinion, as there is a lot of beautiful music waiting to be recorded.

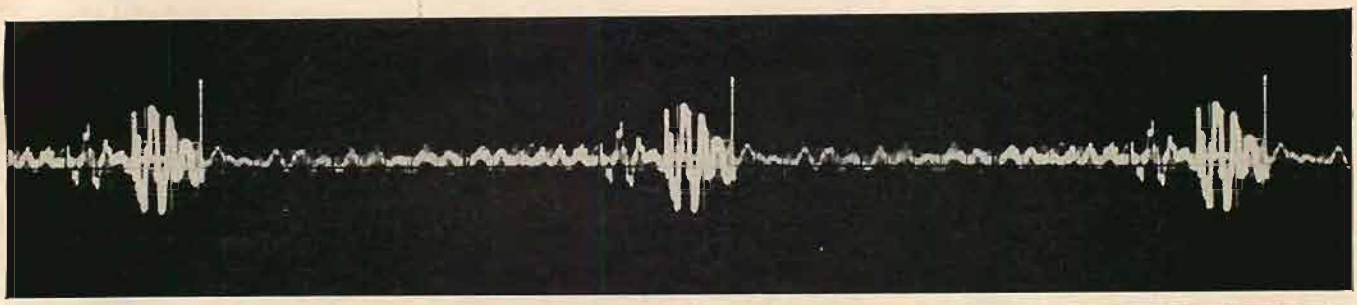
A. I am inclined to vote for a quarter-track (four-track, as you call it) tape machine, provided that you get something in the top quality class. Quarter-track machines have become virtuallp the standard for home use, and almost all commercial prerecorded stereo tapes are now of this variety. Top-quality home machines are able to achieve signal-to-noise ratios of about 55 db at 7.5 ips, quarter-track, based on a recording level producing 3 per cent harmonic distortion at 400 cps. This meets high fidelity requirements. By going to a half-track machine you wouldn't be doing much better.

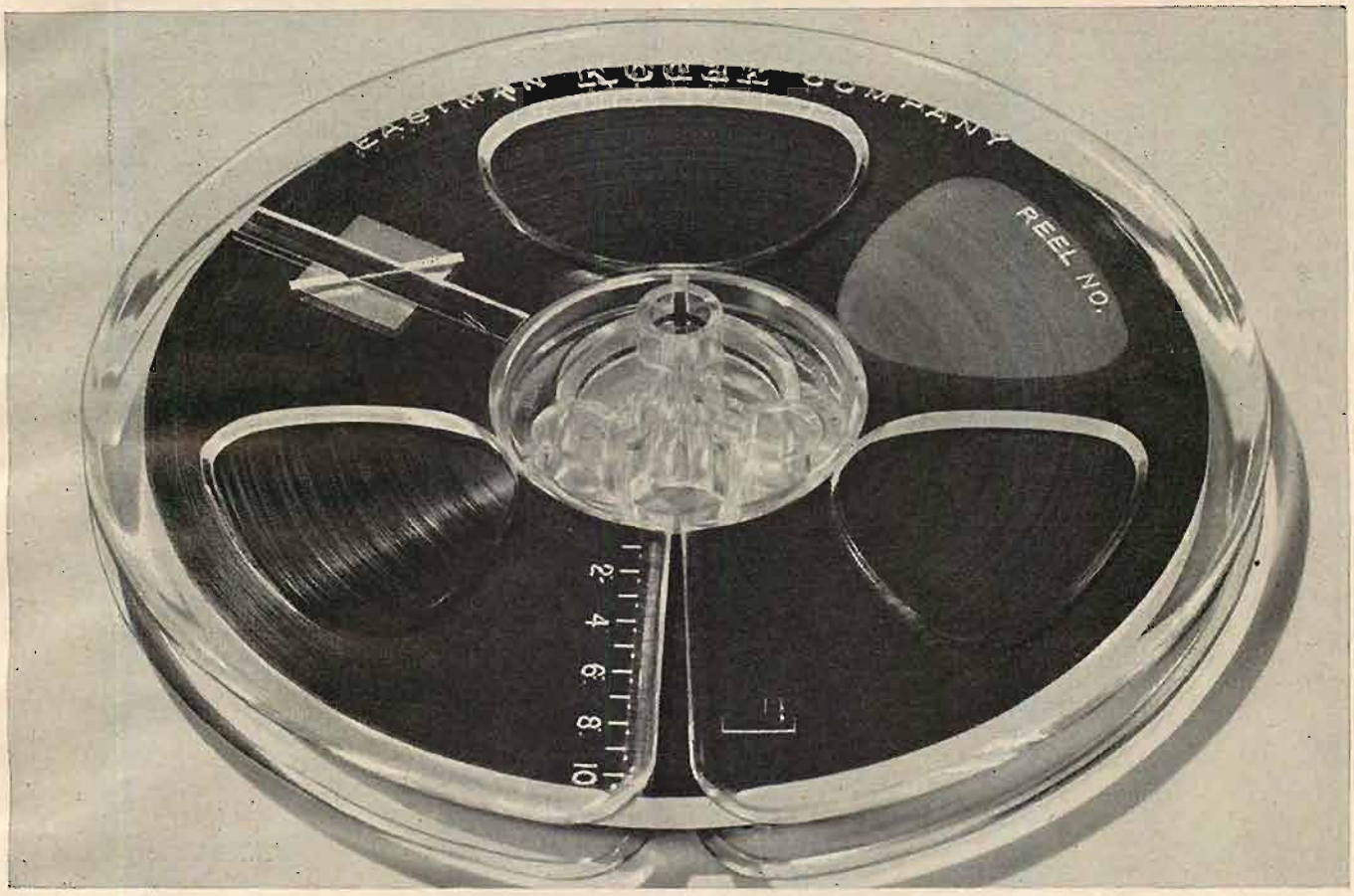
True, some home machines fall appreciably below 55 db signal-to-noise ratio, and therefore cannot be classified as high fidelity instruments. Quite a number of home tape recorders attain signal-to-noise ratios of only 45 to 50 db at 7.5 ips, quarter-track. The 5-db difference between 50-db and 55-db signal-to-noise ratio is very precious.

Half-track machines are less subject to dropouts (sudden, brief reductions in volume) because of inconsistencies in the tape oxide. The wider the track, the more chance there is for variations in oxide to average out, resulting in greater constancy of volume. But the continual improvements in tape have made dropouts much less of a problem than they were years ago; so much so that, if you use tape of the best quality, you are unlikely to find that the problem exists even when operating quarter-track.

(Continued on page 59)

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





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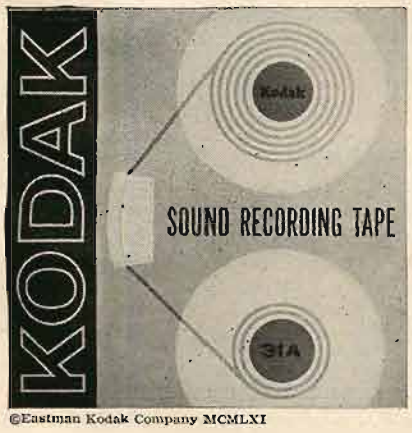

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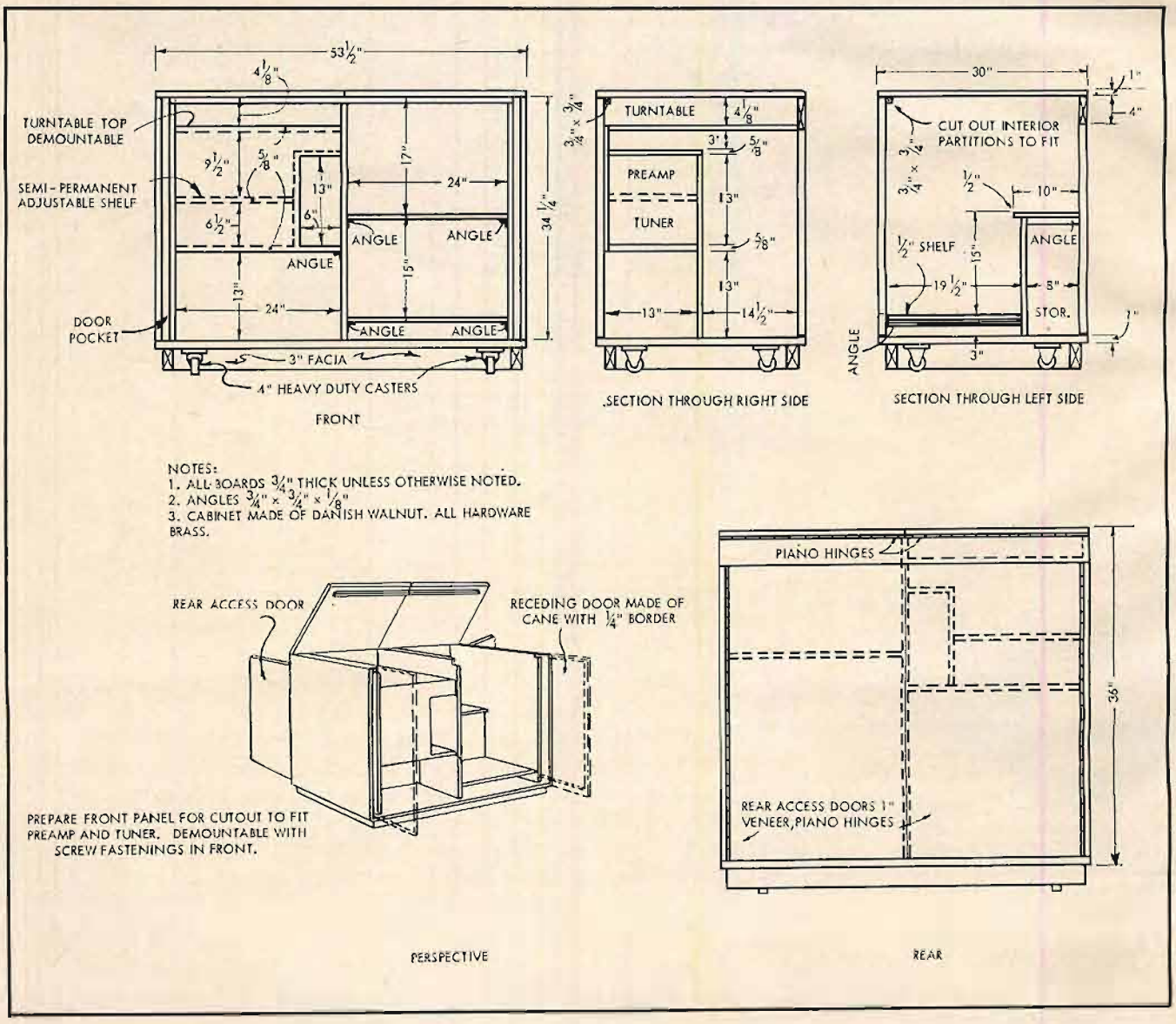
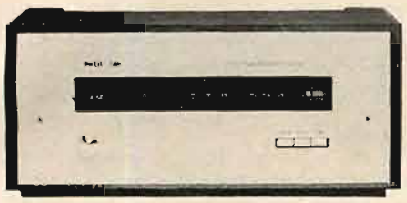
This is literally a professional recording studio as well as a home entertain-

(*Continued on page 74*)





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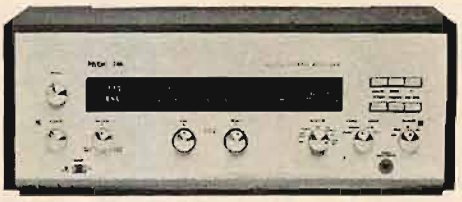

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A Light-Actuated Gain Control

WILLIAM G. DILLEY*

Photo-conductive cells, in high-impedance circuits may eliminate the need for expensive matching transformers and attenuators.

WHEREVER A REQUIREMENT EXISTS for a multiplicity of controls within a relatively small area for ease of operation, it is usually necessary to provide remote controls. The remote feature is dictated primarily because of insufficient space for the associated electronics after the control functions have been arranged and compressed into a usable area. Such a condition is encountered in the audio field quite frequently, and providing for complete remote control is the accepted approach in the design of recording or broadcast consoles. Because of noise and bandwidth considerations, the modern console design accomplishes the remoting of gain (attenuation) controls through impedance-transforming action. The output impedance is lowered to reduce hum pickup and high-frequency loss for the run to the console where a pad is employed for gain control. Upon return to the electronics package, the impendance is raised and amplification follows. This cycle is then usually repeated for one or more functions, depending upon the complexity of the individual console.

While such a console is obviously desirable, as evidence by widespread acceptance and use, it does have one marked disadvantage that is well known to most small firms that desire, but do not possess such a unit. This disadvantage is, of course, cost. Excluding all luxuries, frills, and colored lights usually associated with a console, the primary increase in cost results from the impedance transformation and pads used in this type of design. High-quality results with respect to bandwidth and distortion when employing transformers can be obtained only through considerable expenditure, i.e., the employment of high-quality transformers. The same philosophy obviously applies to noise when considering pads for use as gain or mixer controls.

* *677 East Avery St., San Bernardino, Calif.*

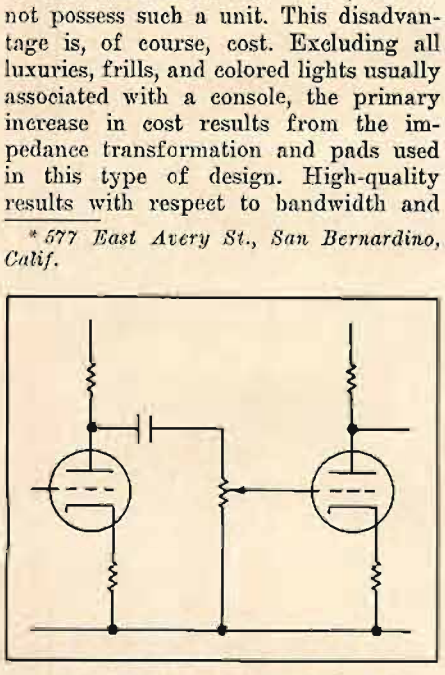

Fig. 1. Basic gain or mixer circuit.

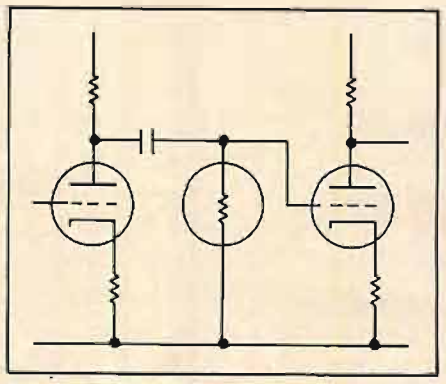

Fig. 2. Basic circuit with a cadmium-sulphide cell substituted for the potentiometer.

Since both transformers and pads are manufactured items, it is not even possible for the small-firm engineer to effect a saving on this portion via the "do-it-yourself" route.

A design that would allow straight-through, high-impedance electronics to output, while still allowing remote control operation, would eliminate the requirement for all intermediate transformers and eliminate costs associated with this portion. Similarly, the elimination of noise and impedance considerations associated with pad action would eliminate the requirement for expensive attenuators.

With the thought that the consolidated savings might bring console operation within the realm of small radio stations or recording studios, an investigation was conducted utilizing a cadmium-sulphide cell as the primary means of accomplishing the stated requirements.

Circuit Investigation

The basic gain or mixer circuit is shown in *Fig.* 1 and the circuit to be investigated is shown in *Fig.* 2, where a cadmium-sulphide cell has been substituted for the potentiometer of the basic circuit. Prior to circuit employment, certain characteristics had to be ascertained through test. Utilizing an inexpensive cell (Polaris MAJ-1) and a standard 6-volt pilot lamp (GE 47) a sample test was run to determine the resistive range available and the shape of the *E versus R* curve of the combination (see *Fig.* 3). The resulting resistive range was more than adequate but the shape of the curve was not particularly encouraging for use with standard potentiometers. In order to gain a more realistic presentation of the combined action, another test was conducted employing the circuitry of *Fig* 4. In this case, a plot was run on cell resistance *versus* degrees of rotation of the control potentiometer. The resultant curve (see *Fig.* 5) while not ideal, approximates a log curve and is usable in the intended application.

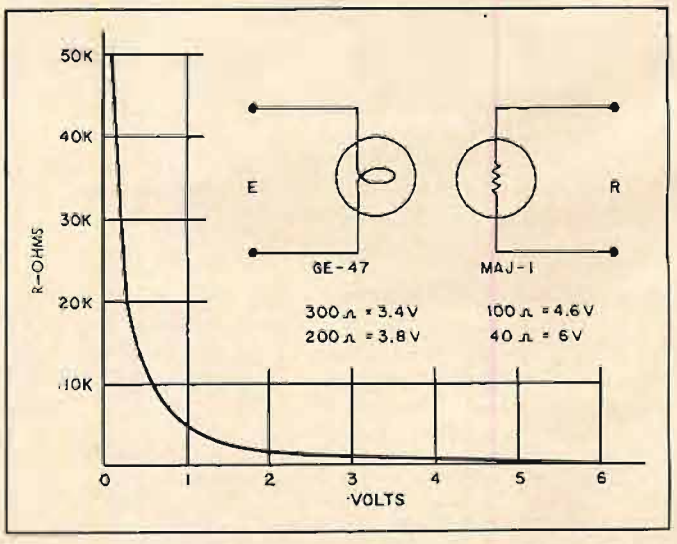

Fig. 3. Curve resulting from circuit of Fig. 2 utilizing Polaris MAJ-1 cell and GE-47 pilot lamp.

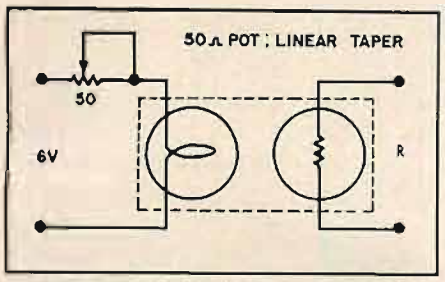

Fig. 4. Revised circuit for more realistic presentation.

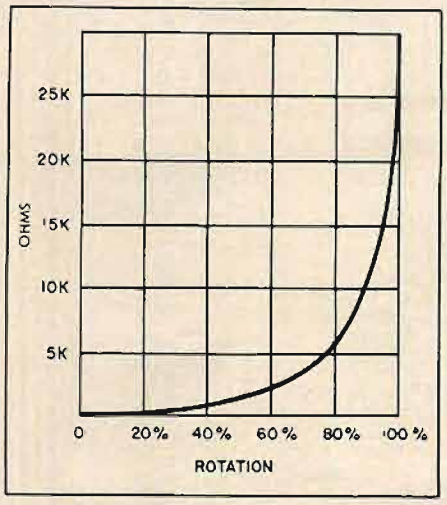

Fig. 5. Curve resulting from circuit of Fig. 4.

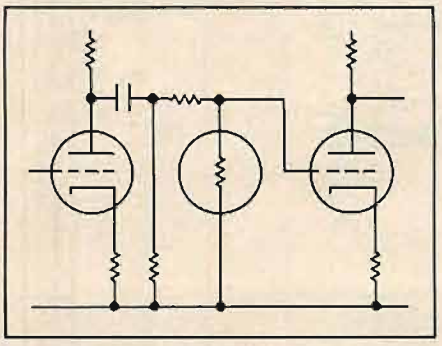

Fig. 6. Addition of pads to correct inability to attain complete grid cut-off and a variation of input impedance with signal level.

Further measurements of noise in the cell, in the static and dynamic condition, (while not absolute because of equipment and difficulty involved in low-level investigation) indicated complete compatibility for this use. The response of the cell was specified as 200k ohms per second. No attempt was made to measure the response time of either the cell or the lamp individually but the combined action was measured, and further tested audibly with signal application, with the results approximating that of the cell alone. The action was slower than a direct signal control, but was, in the opinion of the author, satisfactory for the application.

Use of the cell in the grid circuit now appeared feasible with correction of two undesirable features: complete grid cut-off was not possible, and input impedance varied from a very low figure to a high figure with change in signal level. The most simple and inexpensive solution seemed to indicate a pad to accomplish both functions, and the completed circuit is shown in *Fig.* 6.

Design Example

For purposes of illustration, let us assume we wish to design a remote light-controlled circuit with an input impedance of at least 50,000 ohms. Arbitrarily selecting a range of 100 ohms to 100k ohms for the cell (more about this later) it is only necessary to decide the degree of attenuation desired to design the pad to meet both requirements. For mixer circuits an attenuation of 60 db should be adequate so using this as a criteria, a voltage divider providing a ratio of 1000: 1 is required in the grid circuit for the fully attenuated position. A 100k-ohm resistor in series with the 100-ohm resistance of the cell satisfies this requirement. This portion of the circuit now varies from 100,100 ohms to 200,000 ohms and, when paralleled with 100,000 ohms, offers an input impedance that varies from approximately 50k ohms to 68k ohms with an insertion loss of 6 db (see *Fig.* 7).

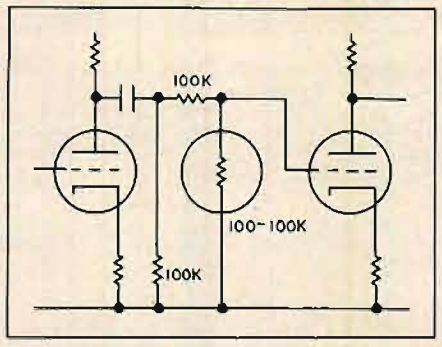

Fig. 7. Practical circuit.

Had 60 db of attenuation been desired with an input impedance of 100k, the cell could have been operated from 200 ohms-200k ohms and two 200k resistors completing the pad would have netted the same results.

Construction Details

For those who might like to construct the basic light cell combination, a descriptive of the prototype unit used by the author might prove helpful. Some means of isolating the cell from outside light is required, and in order to facilitate chassis mounting at the same time, an i.f. can was selected as to serve as a housing. The coil adjusting hole in the top of the can was enlarged to accept a standard Dialco pilot lamp holder, and the cell, loosely wrapped in electrical tape to allow a wedge fit, was inserted from the open end. A small hole was drilled in the chassis to accept the leads from the cell and the i.f. can was then attached to the chassis with a rubber gasket separating the two. (See *Fig.* 8.)

Circuit Variations

The requirements of almost any resistance-coupled circuit can be met by control of the cell's resistance range and the associated padding. Resistance at the low end (attenuated) of the cell occurs with maximum illumination of the lamp and this condition, therefore, will dictate the distance required between the two when located in the selected container. Resistance at the high end (max gain) will depend upon the degree of cell isolation from any external light,

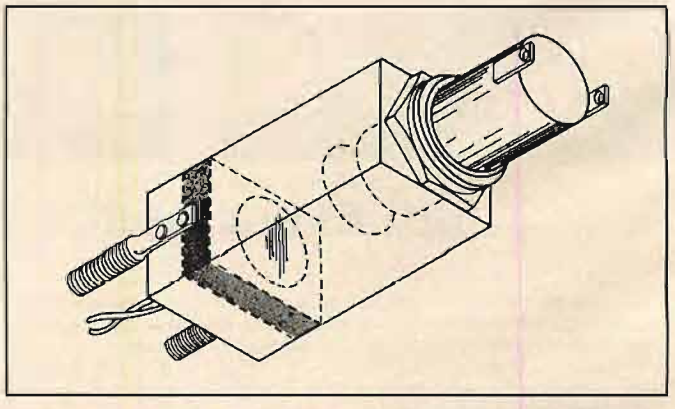

Fig. 8. Mounting of cell and lamp in i.f. can.

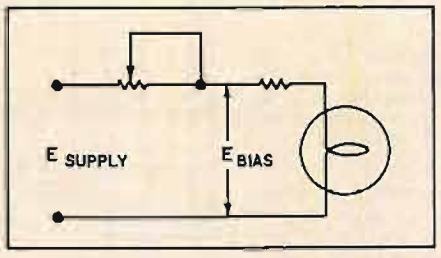

Fig. 9. Arrangement for achieving a minimum bias voltage.

and where it is necessary to limit the resistance to a value less than that obtained with no voltage to the lamp, a minimum bias voltage may be employed. (See *Fig.* 9.)

Where identical maximum gains are desired in multiple mixer circuits, an additional potentiometer may be employed ahead of the control potentiometer and allow setting of all mixer attenuators by injection of the usual

(*Continued on page 67*)

Measuring and Matching Tape Playback and Microphone Preamplifiers

MANNIE HOROWITZ*

Optimum performance from a tape playback head and a microphone are ensured by measuring their response through the amplifier. Suitable equalizer circuits can then be introduced.

1. TAPE PLAYBACK CHARACTERISTICS

THE FREQUENCY RESPONSE characteristics of the tape playback head are similar to those of the constant-velocity phonograph cartridge. Thus, if a tape were magnetized equally at all frequencies and played on a tape machine, the output from the playback head would rise linearly with frequency at the rate of 6 db per octave. This rise would continue to the frequency limits of the head if several factors didn't intervene to upset this convenient state of affairs.

In the recording process, the degree of tape magnetization theoretically is proportional to the current passing through the recording head. At high frequencies this characteristic is altered because of the close proximity of the tiny magnets which make up the recorded tape. The opposite poles adjacent to each other "cancel" some of the magnets.

Another loss is due to insufficient depth in the recording layer. The frequencies at the treble end of the spectrum are recorded at the surface of the magnetic material while the lower frequencies penetrate the recording layer to a greater degree.

It can also be demonstrated that the recording bias current has a definite relationship to the recorded signal appearing on the tape. Excessive current tends to decrease the high frequencies more than it does the low end of the band. On the other hand insufficient bias will cause excessive distortion. A compromise between the two extremes must be chosen to make a good recording.

Deviation from a standard relationship (for the particular head) between recorded flux and audio signal power fed to the record head, can be related to power losses in the head. This is particularly true at high frequencies. The standard ratio assumes that equal magnetic fields are set up for equal head currents, at all frequencies. This is not the case. There is more power dissipated in the head at high frequencies than at low frequencies. As a result, less high-frequency power remains to magnetize the tape.

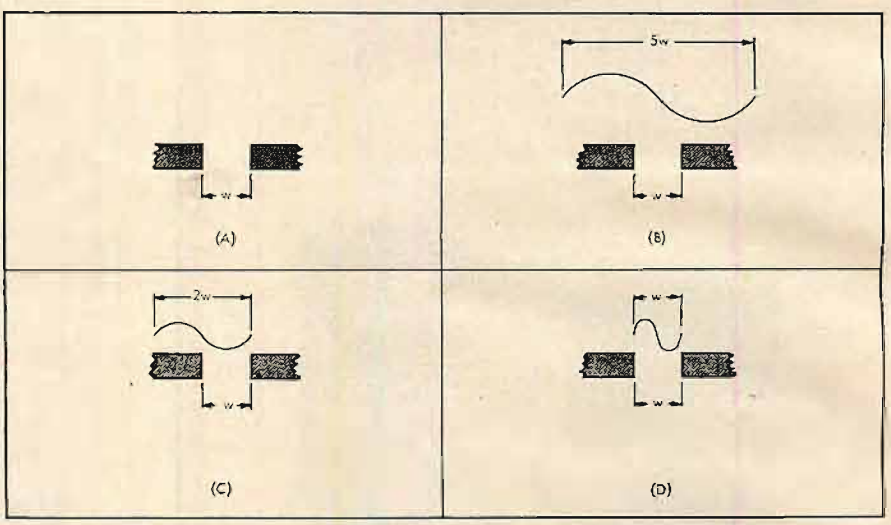

Fig. 1. Effect of gap width on current through playback head: (A) Head gap is w; (B) a portion of the cycle is sampled; (C) when wavelength is twice gap width, half the cycle is sampled at any one moment; (D) when wavelength is equal to gap width, output is zero.

Although high-frequency losses are of primary significance in the recording process, losses at both extremes of the audio band are important in playback.

If the opposing magnetic poles, which result when a recording is made on tape, lie near the head gap, the output will be high. At very low frequencies, because of the large wavelengths, the poles may be far from the head gap and the output will tend to decrease.

The width of the gap in the playback head is significant for high-frequency response. This can be explained with the help of *Fig.* 1.

Assume that tape passes over a gap of width w. If the recorded wavelength is greater than w, let us say $5w$, the gap sees only a portion of the recorded waveshape at any one instant of time as the tape passes over the head. Each portion sets up a different current through the head coil until the entire sine wave is traced. As the wavelength is decreased, a greater portion of the cycle appears across the gap at any one instant. When the wavelength recorded on the tape is twice the gap width, the current through the head represents the average[1] current of a half cycle or $2I_{peak}/\pi$. When the gap width is equal to a complete cycle, the average output current in the playhead is zero. The output increases again, with frequency, after the null. At the null frequency, the gap width equals the recorded wavelength.

* *Project Engineer, EICO, 33-00 Northern Blvd., LIC, N. Y.*

[1] The average current of a curve is equal to the area under the curve divided by the length along the X (or w) axis. Thus, for the sine wave function $i = I_p \sin \theta$, the area under the curve for a half cycle is $\int_0^\pi I_p \sin \theta \, d\theta$, and the distance along the x axis is $\pi - 0$. The equation for the average area under half a sine wave is

$$\frac{1}{\pi} I_p \int_0^\pi \sin \theta \, d\theta = \left[\frac{I_p}{\pi} (-\cos \theta) \right]_0^\pi = \frac{I_p}{\pi} (1+1) = \frac{2I_p}{\pi}$$

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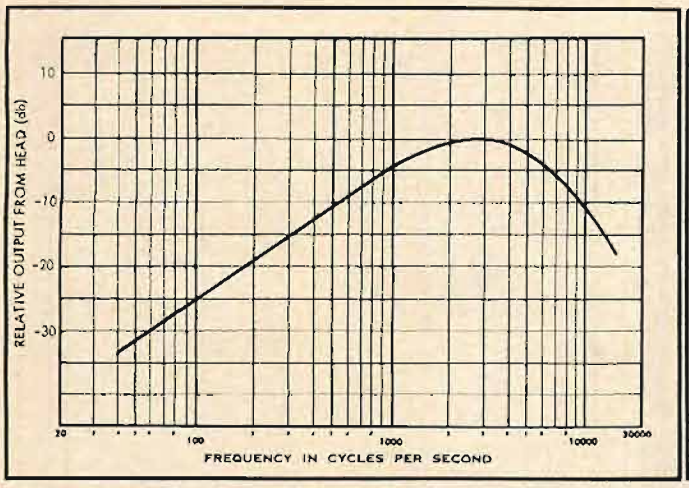


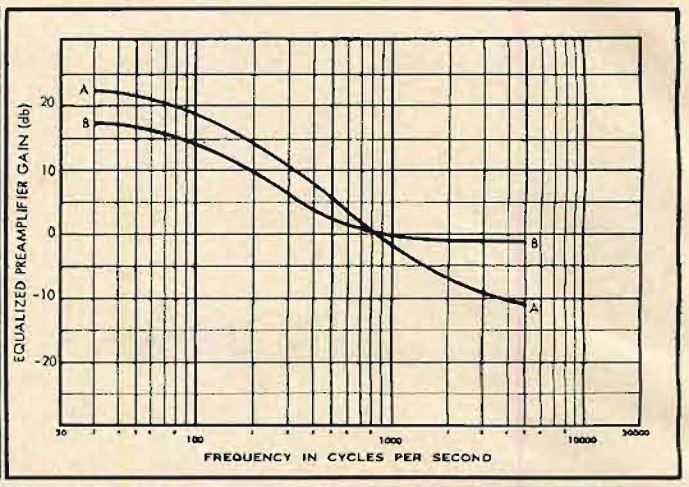


Fig. 2. (left) Output from playback head reproducing a constant-current recording at 7½ ips. Gap width is 0.0002-in. although effective gap is greater. Fig. 3. (right) Standard preamplifier equalization curves: A-A is the curve for 7½ ips; B-B is the curve for 3¾ ips.

This leads to two commonly assumed factors. First, the usable wavelength is double the gap width of the playback head, for only then is there sufficient compensateable output from the head. Second, for the same gap width, the usable upper frequency is less at slow speeds than at high speeds, because the recorded wavelength, w, is reached at a lower frequency when recording at slow speeds than at high speeds.

Finally, the usable bandwidth can be calculated from the gap width. The null in output is at the frequency when the recorded wavelength is equal to the gap width. The recorded wavelength can be derived from the equation

$$\lambda = vt = \frac{v}{f} \qquad Eq.\ (1)$$

where λ is the wavelength, v is the velocity of the tape, t is the period or the time duration of one cycle, and f is the frequency in cycles per second.

The null frequency is then:

$$f = \frac{v}{\lambda} \qquad Eq.\ (2)$$

As an example, use a velocity of 3.75 ips and a wavelength of 0.0001 inches per cycle. The wavelength is numerically equal to the gap width. Substituting these into *Eq.* (2) yields:

$$f = \frac{3.75 \text{ ips}}{0.0001 \text{ ips}} = 37{,}500 \text{ cps.}$$

The usuable upper limit of the reproducible band is 37,500/2 or about 18,000 cps. This limit is seldom realized for the effective gap is usually greater than the mechanical gap. The imperfections at the edge of the gap across which the tape rides is a major factor in producing this discrepancy. A typical playback curve resulting from a constant-current recording is shown in *Fig.* 2. The roll-off frequency is a function of the gap width, tape speed, and tape resolution characteristics.

To produce a flat playback response from a constant-current recording, the playback preamplifiers are equalized in accordance with the curves shown in *Fig.* 3, accepted as a standard by the industry. In order to determine the resultant frequency response due to the preamplifier and the playback head combination, the curve in *Fig.* 2 (head characteristics) must be added to one of the equalization curves in *Fig.* 3. An example of this procedure at the 7½-ips speed is shown in *Fig.* 4.

Figure 4 indicates that there is insufficient boost at the high and low frequencies of the audible band. This should be compensated for in the recording process and thus is of no interest here.

The preamplifier must provide the characteristic shown in *Fig.* 3. The test setup shown in *Fig.* 5 can be used in the testing procedure. For a discussion of the test circuit and the correct test procedure, read "Measuring and Matching the Phono Equalization Curve" in August AUDIO.

2. MICROPHONE CHARACTERISTICS AND REPRODUCTION

Piezoelectric microphones used in high fidelity applications, usually fall into two groups. The first group utilizes crystal or ceramic elements which operate on the piezoelectric principle. They are designed so that the resonant frequency is above the audible range. The output voltage will then be substantially constant, for a uniformly applied signal at all frequencies. Equalizing networks, similar to the type used with constant-amplitude phonograph cartridges, can be used to flatten the response as required over the audio spectrum.

The equivalent circuit of the crystal and ceramic microphone is a voltage source in series with a capacitor which should work into an essentially resistive load at the microphone preamplifier. All this is shown in *Fig.* 6.

The equation for the circuit in *Fig.* 6 is:

$$\frac{e_{out}}{e_{in}} = \frac{R}{R + \frac{1}{j\omega C}} = \frac{jR\omega C}{jR\omega C + 1} \qquad Eq.\ (3)$$

The numerator in the equation indicates that the output for a zero frequency (d.c.) input is zero. The 3-db rolloff point is determined by the denominator when

$$jR\omega C = j \text{ or } f_1 = \frac{1}{2\pi RC} \qquad Eq.\ (4)$$

The curve described by this equation is shown in *Fig.* 7.

(*Continued on page 70*)

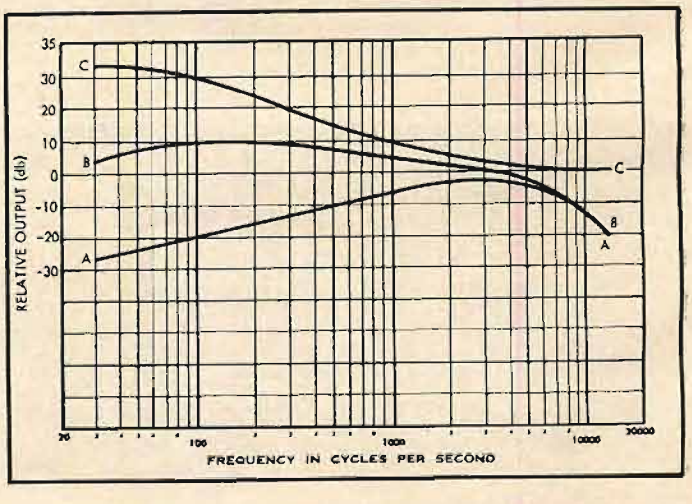


Fig. 4. Playback curves at 7½ ips; A-A from constant-current recording; B-B is result when A-A is added to C-C; C-C equalization for 7½ ips.

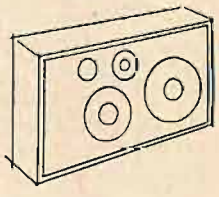
Superbly Engineered...Slim and Stylish

Jensen's new TR-9 speaker system is all-new modern design inside and out. Slim proportioning . . . combined with the new subtle appeal of our exclusively woven two-toned grille fabric and smart cabinet styling . . . allows graceful adaptation to almost any decor. The wood is genuine walnut veneer in oil finish. Place the TR-9 on any surface, or hang it on the wall. Full bodied, big speaker sound comes from a special FLEXAIR* woofer, large midrange speaker and SONO-DOME* ultra-tweeter . . . smoothly blended for complete coverage of the full frequency range. Cabinet measures 13½" H., 23¾" W., and only 5⅝" D.

Compare styling, sound, value. There's nothing like the TR-9!

*T. M.

TR-9 3-speaker, 3-way system. Impedance, 8 ohms. Power rating, 25 watts. In Oiled Walnut.....**$89.50.**



Jensen MANUFACTURING COMPANY
Division of THE MUTER CO.

Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill. / Canada: Radio Speakers of Canada, Ltd., Toronto

The new Weathers "66" weighs 96 ounces

...and every ounce is pure performance!

The Weathers "66" is the finest achievement in uncompromising design and performance. The low mass of the Weathers "66" makes it the proper turntable for today's high compliance stereo cartridges and tonearms. In appearance alone, the "66" is radically different. It is 16" long, 14" deep, but only 2" high, including the integrated base. It is the closest approach to rotating a record on air. It achieves this ideal through unique engineering design and precision manufacturing.

The Weathers "66" uses two precision hysteresis synchronous motors mounted on opposite sides of the deck. Virtually vibration-free, they directly drive two soft rubber lathe-turned wheels which in turn drive against the inside rim of the platter. This is the quietest, most accurate and dependable drive system yet designed. Its -60 db. rumble is the lowest of all turntables.

Eliminates Feedback Problem—Because the new high compliance cartridges and tonearms track at extremely light pressures, they can pick up floor vibrations which are transmitted into the music as audible distortion. The "battleship" type of turntable more easily picks up room vibrations and transmits them with greater amplitude. When a high compliance pickup system is used with the heavier turntable, acoustic feedback is apt to occur. And there is no practical, effective way to acoustically isolate these heavier units.

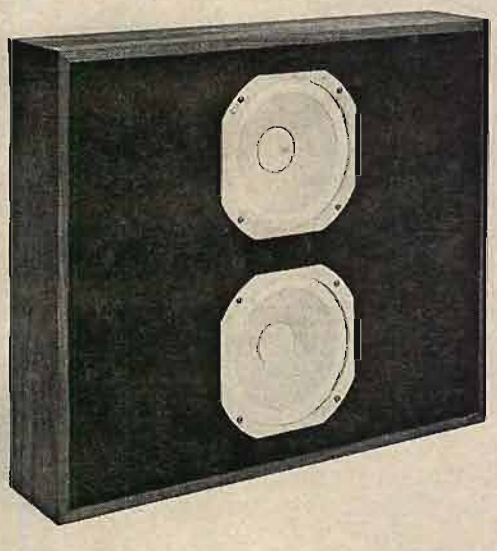
The Weathers "66" is suspended on 5 neoprene mounts which produce an isolation from floor vibrations of more than 500 to 1. Paul Weathers calls this system a "seismic platform" (implying that only a violent earthquake could cause any vibrations or feedback).

On Pitch—The speed constancy of the Weathers "66" is so accurate that a special test record had to be made to measure its 0.04% wow and flutter content. It reaches 33⅓ rpm immediately, and will be accurate within one revolution in 60 minutes. Most heavy turntables will usually deviate 4 or more revolutions in 60 minutes—a painfully obvious inaccuracy to anyone with perfect pitch. You hear only the music—no rumble, no wow, no flutter, no feedback, no noise of any kind.

The "66" is a strikingly beautiful turntable that you can use anywhere, without installation. And you need not buy a base—it's an integral part of the turntable! ■ Turntable—$75.00 net. With viscous-damped arm—$99.50 net. Turntable and Arm with new Weathers LDM Pick-up—$129.50 net. At your high fidelity dealer, or write: Dept. A

WEATHERS
Division of TelePrompTer Corp.
50 W. 44th St., N.Y. 36, N.Y.

T-9



THE TRIMLINE **54**....

NEW PASSIVE LOW FREQUENCY RADIATOR GIVES FULL, TRUE BASS IN LESS THAN A CUBIC FOOT OF SPACE!

Decor-conscious listeners want small speaker systems for their stereo installations. Thay have shown great enthusiasm for the thin-silhouette enclosure. They also demand full bass, bass without compromise. Yet, up to this point, they have not been able to get it from a reflex, folded horn, or "infinite baffle" system this small. Now JBL has found the right way to meet the need. The Trimline 54 is a precision loudspeaker system only 5¼" deep, 23¾" wide, 20" high. It contains two radiators, one dynamic, one passive. The dynamic unit is the 8" Linear-Efficiency model LE8T, a loudspeaker that reproduces the complete audio spectrum with a linearity unprecedented in a transducer of this size. The new passive 8" low frequency radiator is almost identical to the LE8T. It has the same treated cone, same frame and Lans-a-loy suspension; but it does not have a voice coil or magnet assembly. The passive radiator reacts to the dynamic driver at low frequencies exactly the way air mass and port react in a full-size reflex system. The passive cone doubles the effective piston area for fundamental bass tone reproduction. By providing optimum loading it also prevents distortion and increases power handling capacity. The Trimline 54 is solidly built, is given the rich JBL oiled walnut finish on all four sides. Back is recessed and provided with hangers so the unit may be suspended tight against a wall. A set of decorator-designed brass legs is optional. Again JBL solves a critical acoustical problem by coming up with the right idea at the right time.

PRODUCTS OF JAMES B. LANSING SOUND, INC., ARE MARKETED BY JBL INTERNATIONAL, LOS ANGELES 38, CALIF.

Phono Curve Data For Indolent Engineers

BRUNO STAFFEN AND JOHAN VAN LEER*

Originally designed for use with the General Radio Graphic Level Recorder, the new CBS glide-tone test record can be used with any good quality audio graphic level recorder by transposing the resultant curves.

IF YOU ARE INVOLVED with development, design, or testing of phonograph equipment, the new Columbia STR100 record will relieve you of much tedium in recording response data. Of course, this assumes your place of work has an automatic or semi-automatic recording curve tracer of some sort.

It really doesn't matter what kind of curve recording equipment you have, provided it can do the following:

1. Record level variations in decibels on your coordinate paper.
2. Move with a constant and repeatable speed.
3. Provide some kind of monitor so you can start the machine when the 1000-cps reference tone stops.

Your apparatus will need a positive start control plus enough dynamic range to record the corresponding channel crosstalk. You'll want to record the crosstalk curve as directly related to the given channel trace. To obtain a frequency lineup, you will have to arrange some means of monitoring the 1000-cps calibrating signal at the beginning of the glide tone. When you hear this signal stop, start the curve tracer going.

When the 1000-cps reference tone stops, the glide tone starts at 40 cps. At 20,000 cps the gliding signal stops thus indicating the termination of the test. It is important that you be able to locate the start and end points definitely on the trace made by your apparatus. It is the key to the method of transposition to standard audio frequency response paper. Once you have the mechanics of curve tracing worked out and can identify the start and stop points of the glide tone on your trace, the rest is easy.

The glide tone recording is made using a logarithmic rate of sweep. So you'll need an accurately printed or drawn logarithmic frequency reference chart of some sort. Clearprint Paper Co. No. T1 frequency paper is one. It has semilog printing and shows calibrations from 20 to 20,000 cps.

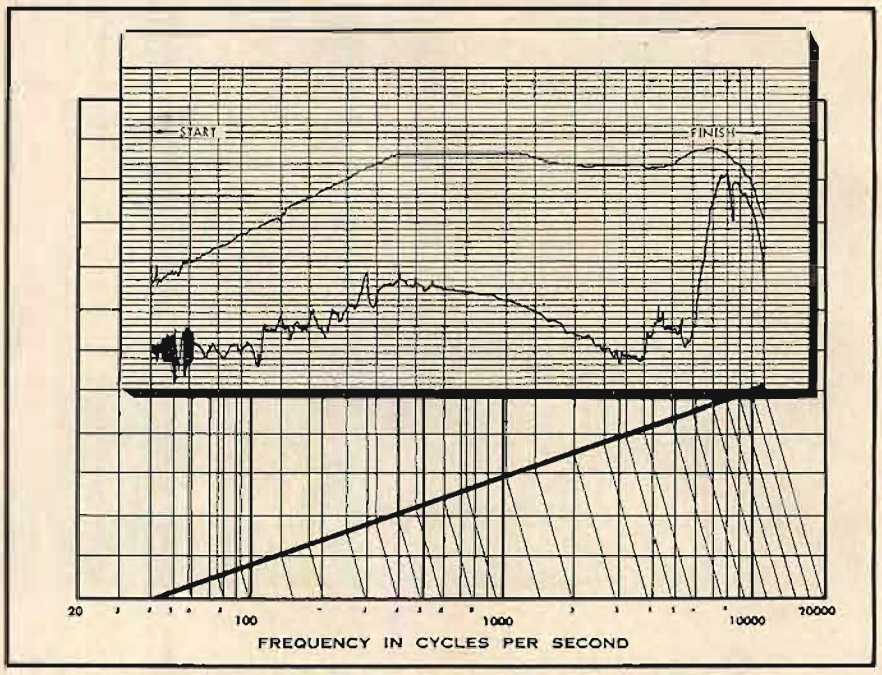


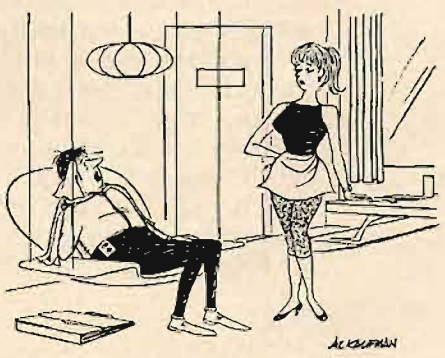
Fig. 1. An example of transposing a curve to standard form.

The procedure is as follows:

1. Draw diagonal from finish line on curve (20,000 cps) to 40-cps point on standard paper.
2. Draw diagonal from finish line (intersection of line drawn in step 1.) to 20,000 cps point on standard paper.
3. Extend lines from curve tracer paper to line drawn in step 1.
4. Now extend these same lines from point where they intersect step 1. diagonal to frequency coordinate line at the same angle as the line drawn in step 2.

Explain your needs to your friendly draftsman and show him *Fig.* 1. He or you can prepare a custom transparency or something to locate accurately any frequency on your own trace.

As a result of this revelation, we now look forward to a whole rash of vastly improved phono instruments? Æ

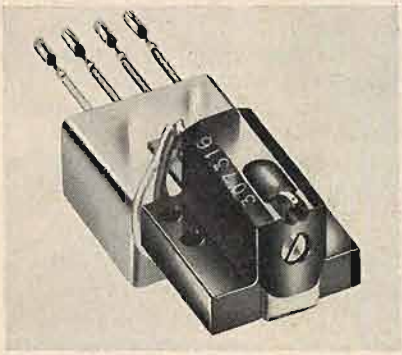


"Boy, what a day! The electronic brain broke down and we all had to think!"

* *1423 North Hudson Street, Chicago 10, Ill.*

Getting only half the sound?

Hear it all with Ortofon Stereo Cartridges



All the stereo sound . . . the ultimate in sound from your records . . . is yours when you switch to the incomparable Ortofon stereo cartridge.

Only Ortofon gives you clear, clean channel separation throughout the *entire* audible frequency range . . . not merely, as with ordinary cartridges, only at a specified single frequency!

Ortofon has long been recognized as a supplier of the finest recording and playback equipment to professional recording studios throughout the world. Today, ELPA, for the first time, brings Ortofon equipment to the high fidelity market here . . . tailored to *your* needs, but featuring the same Ortofon engineering perfection, the same superlative design, the same meticulous attention to every detail.

Of course, you'll want to assure the perfect tracking of your Ortofon cartridge by installing it in a low-inertia, high-precision Ortofon arm — though the new Ortofon SPU/T cartridge will fit any standard stereo arm. You'll find an Ortofon arm that's exactly right for your needs and budget. See and hear the Ortofon at your franchised dealer's today. Or write for information. . . including comparative cartridge tests made under identical conditions. **Guaranteed for One Full Year. $49.95 Net**

Only Ortofon Brings You the Marvel of "Sepra Spectrum" Sound!

Ortofon RMG 212 arm—$54.95 net . . . most thoroughly professional 12" stereo arm on the market. Ortofon arms cover the price range from $19.95 to $59.95 net to fit every requirement.

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ELPA

Taillight Transistor Protector

An ordinary 6-volt automotive taillight lamp prevents thermal runaway in the common-emitter ouput stage because its positive temperature coefficient provides d.c. degeneration with minimum power sacrifice.

NORMAN KRAMER*

PERHAPS ONE OF THE MAIN design considerations in high power transistor circuits is the limitations imposed by temperature. The temperature problems of transistors are inherent due to the electrical considerations of their construction. At high temperature, control of the transistor current is necessary to avoid development of a runaway condition which can lead to destruction of the device. The power transistor has a maximum collector-junction temperature rating which has been assigned by the manufacturer and observance of this limit can extend the useful life of the unit indefinitely. Exceeding this limit can lead to permanent loss of gain or enrly failure of the transistor. Adequate heat sinking of the transistor and stabilization of the d.c. operating point of the device will control the transistor current so as to prevent a rapid rise in junction dissipation as temperature rises.

In the common-emitter circuit, stabilization can be obtained by d.c. degeneration or by thermistor control of the bias circuit. The first method can easily be obtained by inserting resistance into the emitter lead of each transistor, as in the case of R_1 and R_2 of Fig. 1. The larger the value of R_1 and R_2 the greater the degeneration and the greater the temperature control and stability. On the other hand maximum power capabilities are seriously curtailed.

* *Project Engineer, Allied Radio Corp., 100 N. Western Ave., Chicago, Ill.*

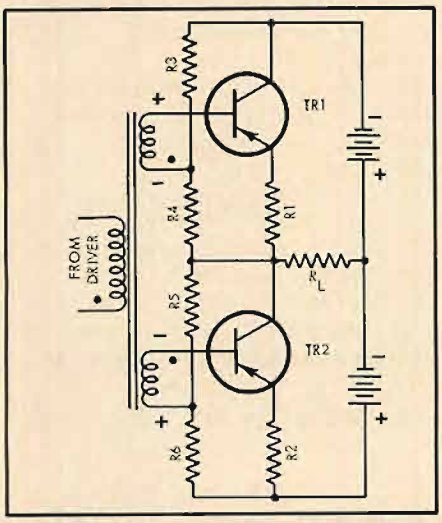

Fig. 1. Common emitter power output stage. R_1 and R_2 provide temperature control as they get larger in value.

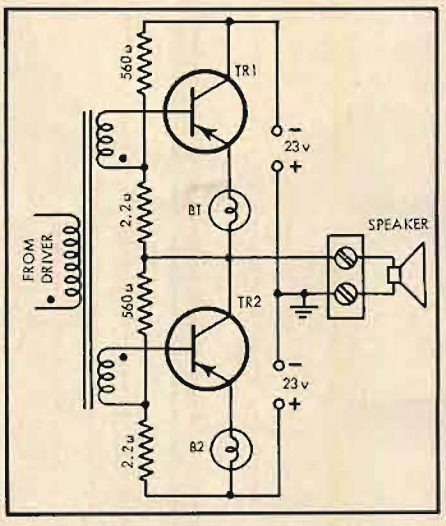

Fig. 2. Power output stage with 6-volt lamps instead of R_1 and R_2. This design is used in the Knight-Kit KX-60 50-watt stereo amplifier.

However, if a resistor of positive temperature coefficient is used for R_1 and R_2 the ultimate in stabilization can be obtained without great sacrifice of total power. It was found that the resistance characteristics of a tungsten filament bulb were ideally suited for this application. The bulb chosen in the amplifier (Knight-kit KX60) is similar to the kind used in a 6-volt automotive taillight. This not only provided the necessary d.c. stabilization but it also provided the speaker the protection of an extremely quick-blow fuse. The tungsten lamp is extremely sensitive to applied voltage since the life varies inversely as the 12th power of applied voltage. In this way the normal 200-hour life at 6 volts would be reduced to $\frac{200}{(23/6)^{12}}$ hours in the circuit, if a wiring error or component failure placed the full 23 volts on the lamp. This corresponds to approximately 70 milliseconds and provides adequate protection for both speaker and transistor. By the same formula, since the lamp is normally only exposed to a few tenths of a volt, its life is extended thousands of hours beyond its normal 200 hour life at 6 volts. In addition to the stabilization and protection afforded by the emitter lamps there is a measure of self balancing afforded to the output circuit since they are sensitive to the current through them and seek an equilibrium with the transistors in which they are in series balancing the bridge and keeping any d.c. from flowing through the speaker.

Several 6-volt automotive lamps were investigated for their characteristics before this lamp was chosen. The life-*versus* over-voltage characteristic is virtually the same for all the lamps examined, therefore, they would all provide the desired speaker protection. However, a lamp with a design current rating in the range of the maximum load current in the 4-ohm load condition would cut the 4-ohm power capability approximately in half. On the other hand, a lamp with maximum design current far greater than the load current encountered at rated power in the 4-ohm load condition would provide only marginal d.c. stabilization on 4-ohm loads and virtually no protection for 8- and 16-ohm load connections where far less load current normally flows.

Hence, having selected the proper bulb and having provided stabilization on 4-, 8-, and 16-ohm loads the amplifier tends to approach a constant-power device rather than the more typical constant-voltage device since the 4-ohm load current will be limited more than the 16-ohm load current. This is evident by the fact that the maximum continuous sine wave power is 36 watts for 4-ohm loads and more than 30 watts for 16-ohm loads. *Figure* 2 shows the output circuit modified for use with the emitter bulbs. AE

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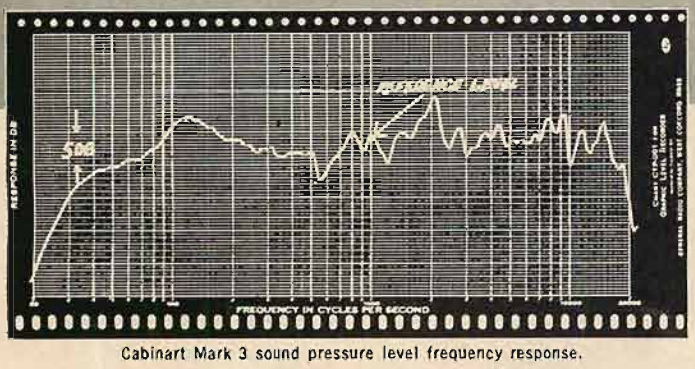
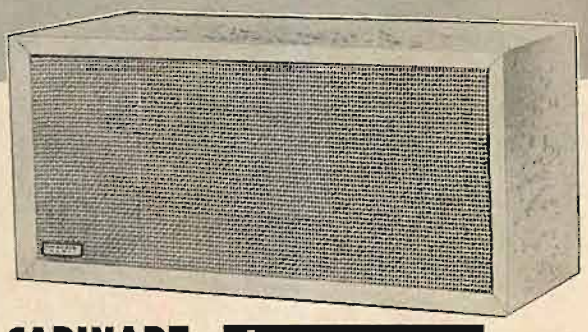
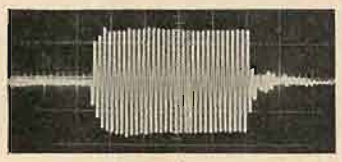
To achieve the magnificent full range tonal response, CABINART Research now presents the FIRST bookshelf Reflex-Horn enclosure around a precision engineered loudspeaker. The MARK 3, priced at $18.00, establishes a new zone of value and quality with the publication of complete Electro-Acoustic data.



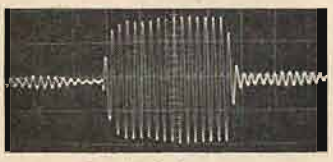
Cabinart Mark 3 sound pressure level frequency response.



CABINART MARK 3 **$18.00 Unfinished** Oiled Walnut, $30.00



1500 Cycles



100 Cycles

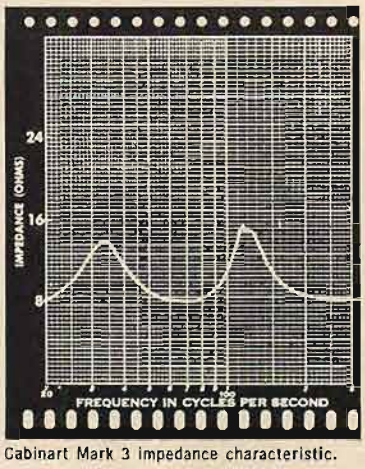
Tone Burst Test

SPECIFICATIONS: 23" long, 11" high, 9½" deep Loudspeaker: 8", with rolled annulus • 8 ohm impedance, 10,000 Gauss • 6.8 Dual Diameter Alnico 5 magnet • 3" whizzer cone for HF dispersion • Free air resonance: 65 cycles **FREQUENCY RESPONSE:** SPL, 50 to 19,000 cycles **SENSITIVITY:** ¼ watt input for 85 DB 10 feet on axis **POWER HANDLING CAPACITY:** 10 Watts

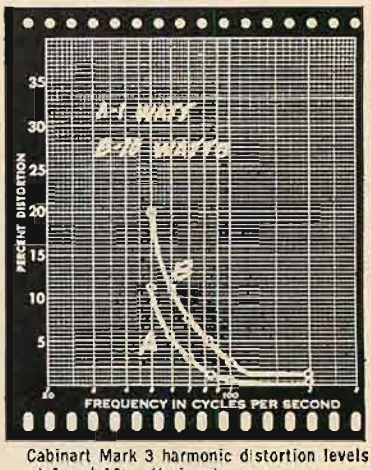
TEST EQUIPMENT COMPLEMENT USED IN CABINART DETERMINATIONS

Bruel & Kjaer Condenser Microphone Model 4134
Bruel & Kjaer Cathode Follower Model 2614
Bruel & Kjaer Microphone Amplifier Model 2604
General Radio Beat Frequency Oscillator Model 1304B
General Radio Graphic Level Recorder Model 1521
Hewlett-Packard Signal Generator Model 200CD
Hewlett-Packard Distortion Analyzer Model 330B
Ballantine Vacuum Tube Voltmeter Model 310A
Tektronix Oscilloscope Model 503
Delco Radio Div. Tone Burst Test Generator Model XP-13295

Data derived from ten production units.



Cabinart Mark 3 impedance characteristic.



Cabinart Mark 3 harmonic distortion levels at 1 and 10 watts input

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You must be satisfied for 10 full days or your money back.

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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 3 Unfinished $18.00 each

.....Mark 3 Oiled Walnut $30.00 each

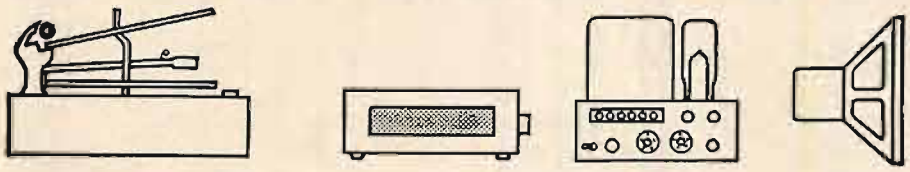
(Please make check or money order payable to Cabinart Acoustical.)

Name_____

Address_____

City_____ State_____

EQUIPMENT PROFILE



THORENS 4-SPEED TURNTABLE AND ARM, MODEL TD-135

Thorens is an old and respected name in the high-fidelity field. Perhaps their best-known product is the TD-124 turntable which has been highly regarded for a good many years. The point of these recollections is that the TD-135 is a happy marriage of the essentials of the TD-124 and the relatively new BTD-12S tonearm. For those who are unfamiliar with this arm, it was introduced earlier this year as Thorens first venture into the tonearm field. As originally presented, this arm was tailored for the TD-124 (or TD-121) inasmuch as it came complete with appropriate mounting board. Although we have not reviewed the arm separately (that is, as the BTD-12S) we are certain that it is exactly the same mechanism as presented here, differing mainly in mounting method.

The TD-135 is a 4-speed turntable with tonearm combination, with the convenience of the on-off switch on the tonearm (the arm is rotated out, away from the spindle, to start the motor) so that the motor is turned on by the arm at the beginning of play and automatically turned off, by the arm, at the end of the record. An automanual switch permits play and the motor to be stopped at any point on the record. A mechanical switch is provided which permits gently lowering the arm to the record, or conversely, raising it away from the record.

The method of mounting the turntable to the mounting board is rather unusual and extremely effective. Four rubber ball-shaped grommets are used to isolate the turntable mechanically from its mounting rather than the usual springs. We found this method unusually satisfactory in preventing external mechanical vibrations from being fed back to pickup.

In view of the automatic features, it is important to note that performance has not been sacrificed to attain them: the TD-135 is truly a marriage of a fine turntable and tonearm with the ceremony performed at the factory instead of our own workshop.

One area wherein the TD-135 differs from the TD-124 is in the absence of the built-in stroboscope. Instead an aluminum disc with the appropriate markings is provided which mounts over the spindle (see *Fig.* 1). In order to adjust the turntable speed it is necessary to view the disc under a light source which reveals the line-frequency; light sources such as neon or fluorescent bulbs. When viewed under such light, the circle of lines for the speed at which the turntable is rotating (excepting 16 rpm for which there is no pattern) should stand still. A fine-adjustment control is provided to compensate for small variations in speed.

Fig. 1. Thorens 4-speed turntable and arm, Model TD-135.

The Turntable Mechanism

The turntable is 12-in. in diameter, weighs 8-lb., and is made of zinc. The turntable shaft is ⅜-in. in diameter and it rotates in a hard bronze bushing. The shaft has a precision ball bearing, mounted on the end opposite the platter, which rides on a nylon bearing surface. The turntable is driven by a heavy-duty induction motor which is isolated from the chassis by means of three rubber shock mounts. The motion of the motor is transmitted to a motor pulley which in turn drives a four-stepped pulley by means of a ground rubber belt. The use of this belt, in conjunction with the shock mounts for the motor, prevent the transmission of unwanted vibrational motions from the motor, which means lower rumble.

The four-stepped pulley now transmits the appropriate speed to the platter by means of a large rubber idler. Speed selection is effected by raising or lowering the rubber idler to contact the proper surface on the four-stepped pulley. The idler rides on the accurately machined inner surface of a flange which extends down from, and is an integral part of, the cast platter. The inner surface of the flange forms a circle about 9½-in. in diameter.

Although the drive mechanism of the TD-135 seems rather complicated when compared with those systems which drive the turntable directly from the motor pulley by means of a belt, the reason becomes rather obvious—and logical—when the four-speed option is considered: The Thorens turntables are the only four-speed belt-driven turntables available commercially. Of course the price paid for this extra flexibility is the extra complexity. In practice, however, the price has proved to be exceedingly small; we have never heard of any serious problems arising from this arrangement.

We mentioned previously that fine-speed adjustment was possible by rotating the center portion of the speed-selector knob. The method whereby speed is adjusted is both unique and extremely intelligent. When the fine-speed knob is rotated, a metal bar inside the four-stepped pulley is rotated closer to, or further from, a permanent magnet located just outside the pulley. The magnet is shaped to conform to the outer diameter of the pulley and the metal bar is shaped to conform to the inner diameter. The bar and magnet act together as an eddy brake to vary speed up to 3 per cent. By applying the braking force to the four-stepped pulley, which is belt-driven, there is no extra load applied to the motor. Of course the most valuable aspect of this method of speed control is that there are no friction-producing parts involved.

The Arm

The tonearm, as we mentioned before, is essentially the BTD-12S, factory designed to integrate with the turntable. The main difference here is that a lever arm has been affixed underneath the turntable which contacts the ON switch when the arm is rotated away from the turntable, and contacts the OFF switch when it is rotated

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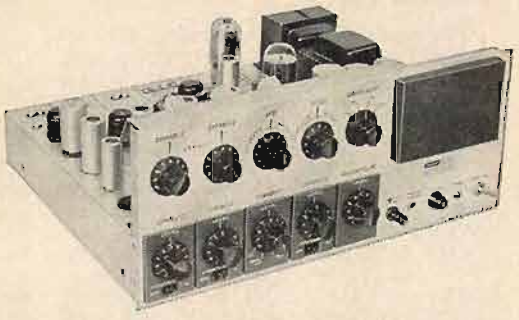

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HK-75

toward the spindle a set distance (presumably enough to play any record).

The arm is provided with a plug-in head which accommodates all standard cartridges. Provision is incorporated in the shell to adjust the overhang by means of a simple cartridge-sliding arrangement. Four leads are provided for the cartridge and a fifth lead, a chassis ground, joins the four at the connector block. Standard shielded connecting cables with phono-plug terminations are already installed. An additional chassis ground lead is incorporated in the lead to each channel.

The arm is suspended by means of precision ball bearings for both the horizontal and vertical planes of motion and the vertical pivots canted so that their axis is tangent to the turntable. The arm is made of a fairly thick-walled tube of duraluminum while the pickup shell is extremely thin aluminum. The counterweight is isolated from the rest of the arm by a soft-rubber damper. Naturally the purpose for this arrangement is to prevent the dog being wagged by the tail.

The method whereby the arm is raised from the record remotely (the control is just forward of the pickup) is simply to press a spring-loaded finger against flange which is attached to the arm (by means of a collar). Because the finger is loaded with a relatively soft spring, the action is extremely gentle. Controlling this action from the front of the turntable is merely a matter of providing the usual arrangement. Naturally, lowering the arm is the reverse of raising it; the finger pressure is removed.

The appropriate stylus-force adjustment is accomplished rather simply by means of a flat blued-steel spring which bears on a flat portion of the vertical-pivot shaft. As pressure is applied to the flat spring it causes the pivot shaft to rotate in that direction which applies a downward force to the stylus. Inherently, the limitation on accuracy of this method is the linear accuracy of the spring tension as pressure on it is increased. Although we found the scale to be relatively accurate, we would recommend the use of a precision stylus-force gauge for the initial setting.

Listening tests, with several cartridges (including a new Ortofon unit which we will evaluate fully at some future date) confirms the reputation Thorens has earned: The TD-135 is an excellent platform for a record and, with the appropriate cartridge installed in the arm, performs its function of providing the amplifier with all of the signal pressed into the recording "without interpretations." The audiofan with a "medium" budget should be interested. K-20

AUDIO DYNAMICS "PRITCHARD" PICKUP SYSTEM, MODEL ADC-85

The Pritchard Pickup System consists of the ADC-1 cartridge plus the ADC-40 tonearm. The ADC-1 cartridge preceded the tonearm by at least a year and in reality the arm is designed to complement the well-known excellence of the cartridge: We reported our liking for the ADC-1 in May, 1961. At the time we tested the cartridge, there were no tonearms available which would permit tracking with sufficiently low force to take full advantage of the unusually high compliance of this cartridge. As we understand it, the ADC-40 was specifically designed to permit tracking at ¾ of a gram—and it does. Just as a matter of curiosity, we wonder if the ADC-1 would perform equally well (or better) if the arm permitted tracking with a force of ¼ of a gram . . . or 1/10 of a gram?

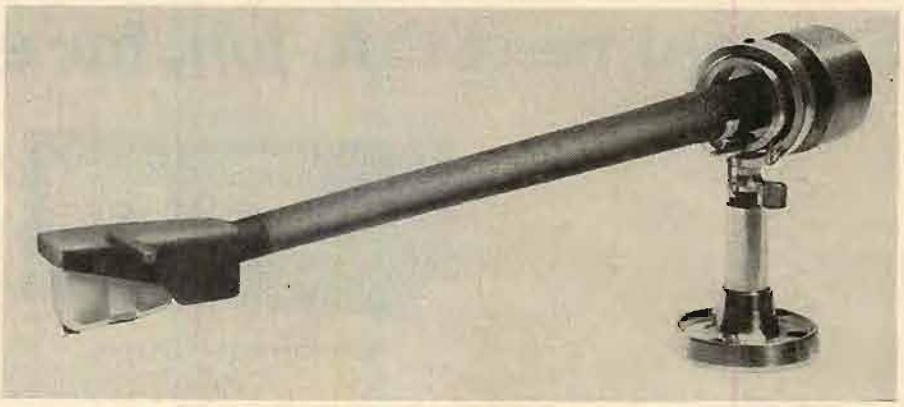


Fig. 2. Audio Dynamics "Pritchard" Pickup System, Model ADC-85.

A Simple Arm

Perhaps one of the most attractive (to us) aspects of this arm is its extreme simplicity of appearance; a tapered walnut shaft with a black-plastic shell at one end and a small cylindrical weight at the other end, supported close to the weighted end by means of two concentric machined metal rings on a machined metal pedestal. In appearance the ADC-85 is the most functional arm we have encountered; there doesn't appear to be an unnecessary *anything* any place on it. This functional thinking on the part of the designers of this system is revealed further in the package it is shipped in, which turns out to be a very handsome display box, and eventually a mounting template. It always impresses us to observe the intelligent use of materials.

The plug-in shell is molded of plastic and mounts the pickup by means of two metal screw-inserts spaced to accept standard American cartridges. Four leads are provided for the cartridge and an additional lead is added to ground the chassis. The five leads terminate in tube-type five-pin sub-miniature socket. Although the socket and the matching plug are not positively keyed, it is not really possible to insert the plug incorrectly since the pins are laid out tube fashion—that is, with much greater space between the first and last pins. Perhaps we had better modify that statement somewhat since we have occasionally heard of errors being made which we would not have believed possible—but surely an audiofan wouldn't be in *that* category!

The suspension system is known as a gimbal type, similar to the type of suspension used on gyroscopes. Essentially it consists of a ring within a ring with the inner ring permitting vertical motion of the arm by means of precision ball-bearing pivots. The vertical pivots are mounted at the ends of a steel shaft which goes through the arm horizontally. For horizontal motion, the inner ring is pivoted to the outer ring through its vertical axis, the pivots again being precision ball bearings. The outer ring is fixed in position by a rigid mounting to the base shaft. A side-thrust (anti-skating) compensator, consisting of a weight at the end of a string, applies a force to the inner ring to compensate for the tendency of the stylus to ride with greater force on the inner wall of the groove. (Note the location of the small weight near the arm rest. Note also the unusually simple arm rest which is simply a bent wire attached to the outer ring that snares the arm by the wire-groove cut in its underside.)

The counterweight is a solid chunk of metal with a hole bored in one side, big enough to accept the diameter of the arm, with a stud centered in the hole. It screws into a threaded metal insert set in the end of the arm. The threaded insert actually contacts a soft rubber collar which in turn contacts the wood of the arm. This arrangement damps the counterweight.

As A System

The manufacturer states that arm resonance in either plane is 6 cps. Actually we could not determine this since our equipment has a lower limit of 10 cps; all that we could say therefore is that the resonance is below 10 cps. As a matter of curiosity we installed two other highly regarded cartridges and checked to see whether the resonance point would rise above 10 cps—it didn't. As to the claim that the System can track at ¾ gram, it can with the ADC-1 cartridge installed—but the best that could be done with the other cartridges was slightly over 1 gram (which is still excellent).

System response was within 2 db from 20 to 15,000 cps and fell off about 1 db per 1000 cps out to 20,000 cps, being about 7 db down at that frequency. Channel separation at 1000 cps was 31 db and the output at this frequency at a lateral velocity of 5 cm/sec was 7.25 mv.

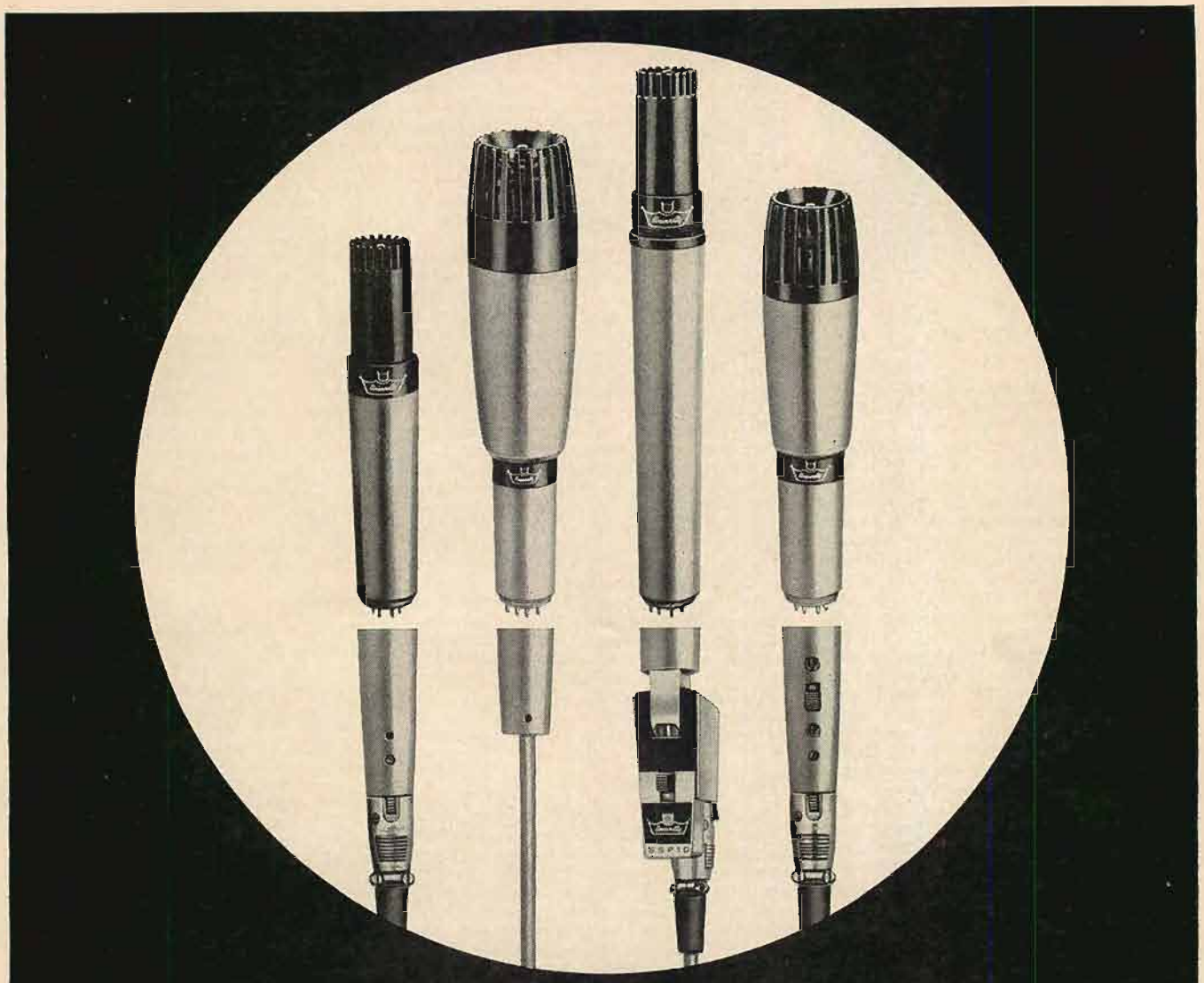
The part of the test we enjoyed most was listening to favorite recordings. Our reaction to this portion of the test is best summed up by repeating what we said in May, 1961; ". . . it does indeed reveal shadings and nuances we had not known were in the recording." K-21

EMI BOOKSHELF SPEAKER SYSTEM, MODEL DLS-529

The EMI Model DLS-529 is a true bookshelf-sized system measuring 24-in. high, 13-in. wide, and 12¼-in. deep, and is far from bookshelf in sound. (Note that the bookshelf should be fairly sturdy since each one of these units weighs 50 pounds.) The DLS-529 is unusual in several ways. First of all it is unusual in that it is finished on all sides including the back so that it may be used on space-divider type of bookshelves. In the modern "compact" home this is a distinct advantage. In addition the front grill is constructed of interwoven metal strips which enhance a variety of styles and designs.

Another unusual feature is the handmade elliptical cone on the woofer measuring 13½ by 8⅛ inches. The cone has a flexible-plastic edge suspension. The enclosure is completely sealed. High frequencies are reproduced by means of two 3½-in. tweeters which have been completely isolated from the low-frequency unit to prevent interaction.

The high-frequency dispersion is unusually smooth and rather wide being about 10 db down at an angle of 60 deg. off the



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For the complete story on University's new line of omni-directional, cardioid and lavalier MODULAR MICROPHONES, send for the free 16-page brochure. Write: DeskR-9A, University Loudspeakers , Inc., 80 S. Kensico Ave., White Plains, New York.

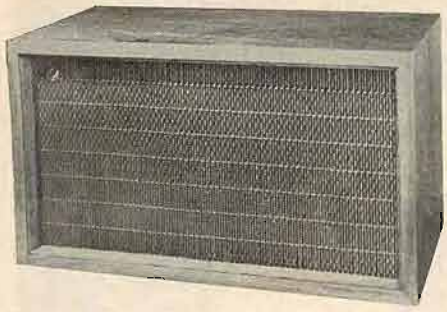


Fig. 3. EMI bookshelf speaker system, Model DLS-529.

forward axis (total included angle of 120-deg.) at a frequency of 10,000 cps. At this same frequency the sound drops 25 db at 90 deg. off the forward axis. As might be expected from a unit with this much high-frequency dispersion, a pair of them provides really excellent stereo coverage. The woofer handles frequencies up to the cross-over point at 4500 cps. Although the model DLS-529 does not have as extended a low-frequency range as some of the larger speaker systems, it handles the range from 40 cps up unusually well. The bass reproduction is of the "tight" variety; it avoids the overblown fullness which was a characteristic of some speaker systems not too many years ago. The DLS-529 handles the frequency spectrum from 40 cps up to 15,000 cps with realism and good precision, responding excellently to the attacks of some especially heavy piano passages. This indicates fine transient response.

As a musical reproducer the DLS-529 is one of the better ones we have heard in its category (meaning price and size). We would certainly recommend it for those with limited space and moderate budget. K-22

KNIGHT-KIT TRANSISTORIZED 50-WATT STEREO AMPLIFIER KIT, MODEL KX-60

The Knight-Kit KX-60 is the first transistorized integrated stereo amplifier from Allied Radio and also is one of the first (if not the first) kit in this category. Naturally it merits interest on this score alone. In addition there are several circuit features which also place the KX-60 in the very interesting category. Of course, with the widely circulating rumors about the incipient switch to transistors we have been searching for all that is new and, we hope, valid, for presentation to our readers. The fact is, however, that to date there have been very few transistorized high fidelity products available in the marketplace although there has been much activity in engineering departments (in some cases, the activity has been furious, we are led to believe). In any case, Allied has certainly cast its stone first.

The amplifier itself, labelled 50 watts (IHFM), is rated for that output at the 4-ohm tap and is rated at 44 watts at the 8-ohm tap and 40 watts at the 16-ohm tap. With transistor amplifiers, the output is usually greatest at the 4-ohm tap and decreases at the higher-impedance taps. Usually the loss is much greater than the 20 per cent drop in the KX-60. The reason we mention this characteristic of transistor amplifiers is to alert the audiofan that the impedance of his speaker system is a significant factor to consider when contemplating the purchase of a transistor amplifier. Another important factor, which seems to be somewhat misunderstood, is that transistor amplifiers require adequate cooling just as tube amplifiers do; not as much perhaps but still more than most people seem to expect. The fact of the matter is that most transistor amplifiers can be very seriously damaged if the ambient temperature becomes relatively high. Of course the KX-60 does employ unusual and effective measures to prevent what is called thermal runaway —one of the measures taken is described by Norman Kramer, the engineer who was responsible for the design of the KX-60, on page 48 of this issue.

The size of the KX-60 is rather surprising at first because we have become accustomed to rather more bulk with amplifiers of this power rating. On consideration it becomes quite obvious that the size is appropriate since the bulky output transformers have been eliminated, as well as the relatively large power tubes.

A full set of stereo controls is provided on the front panel, their placement and size being such as to encourage simplicity of operation. For example, in *Fig.* 4 we can observe that the two most often used controls, Volume and Input Selector, are the largest and highlighted by means of a dark background. Next in size, and use, are the bass and treble controls and the smallest are balance and separation.

There are 5 pairs of inputs (tape head, magnetic phono, ceramic phono, tuner, and auxiliary), and a pair of outputs to permit tape recordings to be made of any of the programs fed to the amplifier. There are two pairs of speaker terminals, which again is a surprise to those of us accustomed to the usual four pairs on tube amplifiers.

Circuit Description

The KX-60 utilizes 20 transistors and 4 silicon diodes and consists of two identical amplifiers mounted on one chassis with a common power supply. Since the channels are identical, only the left-channel circuitry will be explained. The selector switch connects the low-level inputs (phone and tape head) to the first preamp stage, TR-1. Several feedback loops are used around the first and second preamp stages to provide the appropriate equalizations. The high-level driver, TR-5, now handles either the preamplified and equalized low-level signals or the high-level signals, depending upon the position of the selector switch. The high-level driver functions as an emitter follower and feeds its output to the tape recorder output jack and the volume control. At this point the separation control spans the two channels. The signal now goes to the feedback-type tone-control circuit associated with TR-7 and from there to the base of TR-9 which functions as a voltage amplifier. The balance control is connected to both channels at this point. The control acts to shunt part of the signal in one channel while maintaining the level in the other channel, thus changing the relationship between channels. The output of TR-9 is coupled to the base of pre-driver TR-12 which is directly coupled to the driver transistor, TR-14. Transformer T-2 is used as a phase inverter for push-pull operation of the output transistors, TR-15 and TR-16. The output transistors operate modified class B in a single-ended push-pull OTL circuit. The bias arrangement for the output stage is described in Mr. Kramers article. Both output transistors are connected in common-emitter configurations and are in parallel across the single-ended load so that the output impedance of the stage is about 2.2 ohms. This low output impedance is the main reason that this output stage can be coupled directly to the voice coil of the speaker without an output transformer. On the other hand, the need for d.c. blocking capacitors is eliminated because the power supply consists of separate positive and negative 23-volt sources so that the junction of the emitter of TR-15 and the collector of TR-16 is at ground potential. Thus there is no direct current in the voice coil. Silicon diodes are used in the power supply to provide good regulation. In addition, each supply utilizes a transistor series regulation to obtain ripple-free regulated voltage at audio frequency.

Construction

The KX-60 construction procedure contains some 500 steps which are carefully explained and illustrated in a well-prepared instruction manual. Although this manual does not provide all the information that we would like to see, it does provide sufficient and accurate enough information to permit a relatively inexperienced constructor to complete construction without difficulty. Although it took us 17 hours to complete the KX-60, in our opinion the less experienced constructor could take 10 hours longer without wasting time. There are a lot of parts to put in relatively small places. The instruction manual does provide excellent information about setting up the system. There is also a brief, but to-the-point, section of service hints which answers enough questions to get the set operating in case of difficulty.

Performance

Transistor amplifiers are reputed to have much higher intermodulation distortion than one would expect from the harmonic distortion—and the KX-60 confirms this rule. Although harmonic distortion measured slightly over 1 per cent at full output, intermodulation distortion was nearly three times as high. On the other hand, frequency response was quite excellent, measuring within 1 db from 20 to 20,000 cps. The power output was 32 watts (16 per channel) rms, with a 4-ohm load; with an 8-ohm load the output was 27 watts rms (13½ watts per channel). Input sensitivities for full output were within specifications, as were the hum and crosstalk levels. K-23

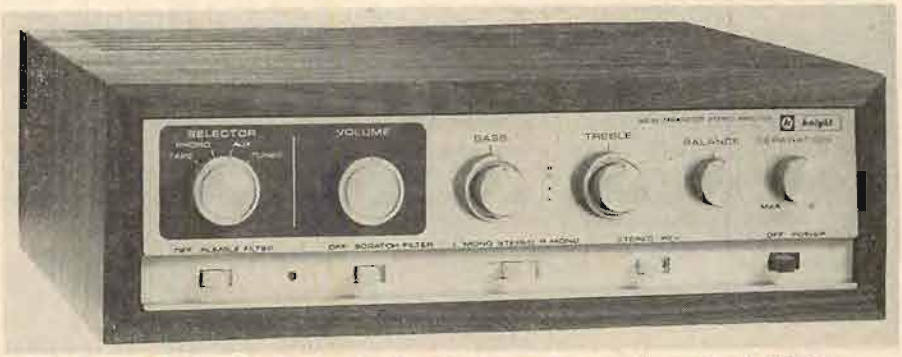


Fig. 4. Knight-Kit transistorized 50-watt stereo amplifier, Model KX-60

• **100-Watt Stereo Amplifier.** Announcing their latest product, the new "Stereo 50-50" amplifier, Ultra electronics stated that this product represents the highest quality currently available in this type of equipment.

SPECIFICATIONS

Power Supply	117 volts, 60 cps
Power Consumption	160 watts at 100-watt output
Power Output	2 x 50 watts continuous
Input Level	0.65 volts for 50-watt output
Frequency Range	10 to 100,000 cps ± 1 db or 15 to 50,000 cps ± 0.1 db
Harmonic Distortion	Approx. 1% at 50-watt output
Intermodulation Distortion	0.64% at 50 watts
Noise and Hum Level	90 db or more below rated output
Damping Factor	14 (for 16-ohm output)
Input Impedance	0.5 meg ohms
Output Impedance	4, 8, 16 ohms

Ultra Electronics, 235 East 60th St., New York 22, N. Y. **K-7**

• **Dust Cover for Miracord.** An attractive, snug-fitting cover is now available for the Miracord. The Miracover, as this convenient dust protector is called, need not be removed when playing records. It consists of two sections. The deck section mounts

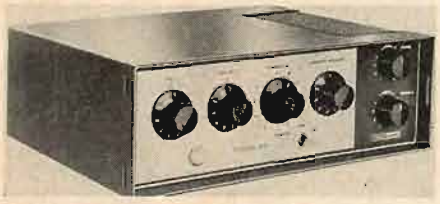
securely between the Miracord unit and its base. The lucite cover is hinged to the deck, and allows the cover to be raised whenever user wishes to place or remove records, or to operate the controls. Slip-hinge design permits complete removal of the cover, when desired. The Miracover also has provision for stowing a spare spindle. Price of the Miracover is $14.95 at high fidelity dealers. Benjamin Electronic Sound Corp., 80 Swalm St., Westbury, N. Y. **K-8**

NEW LITERATURE

• **New University High Fidelity Products Catalog.** Availability of the High Fidelity Products catalog is announced by University Loudspeakers, a Division of Ling-Temco-Vought, Inc. The new catalog, entitled "Your 1962 Guide to Component Stereo High Fidelity," is an informative brochure expanded to 20 pages. It describes all of University's High Fidelity Components and Speaker Systems, and in-

NEW PRODUCTS

• **Transistorized Public Address Units.** The Commercial Sound Division of Harman-Kardon, Inc. has introduced a new series of transistorized public address equipment—the Troubador Series. Products now being marketed are Model TR-1, 15-watt transistorized amplifier, and Model TR-2, 30-watt transistorized amplifier (shown), both designed for mobile, portable, and general use on 6 to 14 volts d.c. Plug-in converters are offered to adapt these amplifiers to a.c. operation. Model TR-1 has marine, police and fire, military, public utilities, and construction applications. It includes a microphone and a music channel, both of which can function simultaneously. Model TR-2 is a 4-channel amplifier said to be the first to ensure uninterrupted operation of a sound system, or provide automatic "panic control" facilities in emergency situations due to a.c. power failure. An optional plug-in device is of-

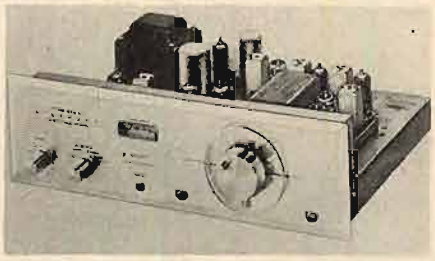


fered which automatically switches to a d.c. power source when a.c. power fails. Among other features of the Troubador amplifiers is an optional, plug-in preamplifier module with a choice of built-in equalization that enables the amplifiers to operate directly from a magnetic phono cartridge or tape head. Thus, only a tape deck is needed as a sound source, which results in savings in equipment cost and improvement in operating performance. Facilities are provided to turn the amplifiers on and off from the microphone or other remote locations to conserve battery power. Electrical damage cannot occur to the amplifiers due to incorrect polarity of the power source. List prices: Model TR-1, $109.75; Model TR-2, $175.00. Harman-Kardon, Inc., Plainview, N. Y. **K-1**

• **"SLENDYNE" Stereo Enclosure.** This enclosure has been specifically designed for the 10-in. Monitor Dual Concentric loudspeaker. It is essentially an infinite baffle, relying upon pressure loading and acoustic absorption of the back radiation. As is typical of this type of enclosure, it produces a well-maintained bass, true and non-resonant. Mid-ranges and upper frequency response continue flat throughout the spectrum, the whole system re-creating a wide range and closely integrated sound source. The cabinet itself is a trim 32½" × 16" × 7⅞" deep, so designed that it

may be used either horizontally or vertically, hung directly on a wall, or used as a free-standing enclosure by affixing the two plinths as required. The finish is oiled walnut and price, complete with 10-in. Dual Concentric Monitor loudspeaker, is $165.00. Tannoy (America) Ltd., N. Y. **K-2**

• **New FM-Stereo Tuner.** H. H. Scott announces a new version of their popular 350 FM-stereo tuner, the model 350B. This new version includes the Scott Sonic Monitor that audibly signals when stereo is on the air. By tuning to the purest tone, you are automatically assured of best stereo separation. Sensitivity of the 350B has been increased to 2.2 μv. A tape output has been added to the front panel. Separate level controls are provided on the rear

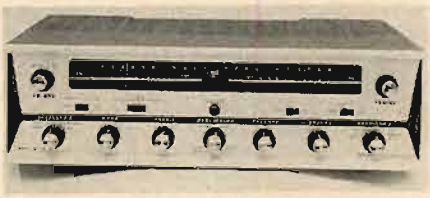


for each channel, making it possible to balance channels. A new balanced detector provides exceptionally low distortion. Signal-to-noise ratio is 60 db; selectivity 35 db. Price is $219.95, East of Rockies. For complete technical specifications write to H. H. Scott, Inc., Department P, 111 Powdermill Road, Maynard, Mass. **K-3**

• **The DYNACO-B&O Portable Radio.** The DYNACO-B&O radio is a fully transistorized FM-AM-Shortwave portable receiver. This high-quality set, styled in black, gray, and chrome, operates on six ordinary "D" cells (flashlight batteries) and gives 300 hours of use for less than 0.5 cents per hour. Deluxe features of this radio include smooth flywheel tuning with a sliderule dial; full-range independent tone controls for bass and treble (with both boost and cut); an external loudspeaker or headphone output; a detector output to enable its use as a tuner, for connection to a component high fidelity system, tape recorder, or TV set; and an external antenna connection. Two telescopic FM antennas, and an internal ferrite rod AM aerial, enable excellent reception of the weakest signals. Nine transistors and three diodes, with a one watt push-pull output

driving a 5 × 7-in. speaker, provide high sensitivity and adequate power, even in noisy surroundings. An accessory slide-in dash mounting bracket will enable easy mounting for traveling, and with a standard automobile antenna and the proper suppressors, this portable doubles as a car radio. Just 13 × 8 × 4¼, and weighing less than 8 lb. with battery, this example of Danish craftsmanship lists at $149.95. Dynaco, Inc., 3912 Powelton Ave., Phila., Pa. **K-4**

• **New Canadian FM-Stereo System.** Designed and manufactured in Canada, the Transwave Electronics TW-50 is a fully integrated stereo system incorporating a high-performance AM-FM tuner, a comprehensive stereo control center, and a 50-watt stereo amplifier. The built-in FM multiplex facilities are designed around



the Ferritron multiplex demodulator, a highly advanced matrix-type circuit. The unit provides complete tape-monitoring facilities, a switchable output for stereo headphones, and a L+R center-channel output. Operating flexibility and convenience is further enhanced by a patented Mode-Blend control which combines continuous adjustment of channel separation with channel-reverse and mono-stereo switching functions, and by an exclusive twin-beam "Stereo Presence" indicator which automatically identifies FM-stereo broadcasts and provides positive indication of their signal strength, in addition to providing highly accurate tuning indication. Transwave Electronics Co., Ltd., 17 Colville Road, Toronto, Ontario. **K-5**

• **Multiplex Filter.** Viking of Minneapolis announces production of an LC-type low-pass filter for use in the music system to eliminate distortion and interference when tape recording from FM-multiplex stereocasts. Designated Model MX-10, the filter removes all extraneous signals produced by the interaction of the 38-kc FM-multiplex carrier (or other r.f. interferences) with the bias oscillator of the tape re-

corder or recording amplifier. The MX-10 filter passes the two audio signals, but provides sharp cut off at 20 kc. It is designed for patch cord connection between the output jacks of any stereo FM tuner and the high-level or tuner inputs of a high fidelity tape recorder. The filter has no adjustments or controls. The MX-10 retails for $14.50. Viking of Minneapolis, Inc. 9600 Aldrich Avenue S. Minneapolis 20, Minnesota. **K-6**

cludes a complete guide to Component Stereo High Fidelity in general. The Guide tells the prospective hi-fi purchaser how to choose and appraise components, compares components to consoles and includes complete "do-it-yourself" information for those who wish to design and build their own speaker system. The catalog is available free of charge from: University Loudspeakers, 80 South Kensico Avenue, White Plains, New York. **K-9**

• **Semiconductor Product Guide.** The RCA Semiconductor and Materials Division now is offering free a new 12-page Semiconductor Product Guide which provides the latest data on RCA's full line of silicon and germanium transistors, silicon rectifiers, special computer diodes, tunnel diodes and varactor diodes. A handy "by-application" classification guide simplifies the process of locating the right transistor for any type of service. A copy of the RCA Semiconductor Product Guide may be obtained by writing RCA Semiconductor and Materials Division, Commercial Engineering, Somerville, N. J. **K-10**

• **Transistor Interchangeability.** The General Electric Company has published a new transistor interchangeability brochure. The 16-page listing contains specification information on 1167 JEDEC-registered transistor types and the closest G.E. types for interchangeability. Outline drawings, construction and general use categories for each transistor are also included. Copies may be obtained by writing to the General Electric Company, Building 7, Electronics Park, Syracuse, N. Y. **K-11**

• **High Fidelity Catalog.** Availability of a free, 6-page catalog introducing its "Eric Series 3000" line of high-fidelity and stereo components is announced by Eric Electronics Corp., 1823 Colorado Ave., Santa Monico, Calif. The fully-illustrated catalog contains features and specifications on Eric tuners, amplifiers and integrated receivers, including the all-new stereo multiplex. **K-12**

• **Tape Erasure Bulletin.** The accidental erasure of magnetic tape by stray magnetic fields is highly improbable, according to studies reported in a technical bulletin issued by the 3M Company, makers of "Scotch" brand magnetic tapes. The pamphlet, "Technical Talk" instrumentation bulletin No. 5, reports an experiment designed to simulate actual aircraft shipping conditions found that the demagnitizing force of a plane's main power cable, where the worst erasing conditions exist, was considerably less than that required for discernible erasure even when an erase force and tape are in close contact. "This would indicate that total signal erasure during transit or in storage is virtually impossible," the bulletin said, "and that . . . complete absence of recorded signal would more likely have been caused by operator or equipment error during recording. It also established that obliteration (of a signal due to stray magnetic fields in shipment) to a point where it is unrecoverable is highly improbable." The bulletin, which details the erasure studies, findings and preferred shipping methods, can be obtained by writing Dept. Y2-289, The 3M Company, 2501 Hudson Road, St. Paul 19, Minn. **K-13**

LIGHT ACTUATED GAIN CONTROL

(*from page 40*)

440-cps signal. Potentiometers both before *and* after the control potentiometer would obviously allow an adjustable control of complete range by using only a signal through the amplifier itself.

A recommended method of initially positioning the cell with respect to the lamp is as follows:

1. Install cell flush against lamp in housing
2. Attach housing to chassis
3. Connect cell leads to ohmmeter
4. Apply maximum selected voltage to lamp
5. Position cell to desired resistance value by pulling cell leads.
6. Fill space in bottom of can with potting compound.

Applications

It should be quite obvious that the circuit described represents a very limited investigation involving only two (of a multitude of commercially available) components, selected for economy considerations only. Further refinement, for example, is easily obtainable for response time, and pilot lamps are available in many other voltage ranges. Should manufacturers become interested, control potentiometers could provide improved tapers to complement the complete assembly—which could be manufactured as sealed miniature units. (Linear taper control pots were used by author.) The potentiometers themselves do not need to be expensive because of the circuit, in that complete isolation exists between the control and the tube, thus giving a noiseless control (pot).

A look at how well this design will satisfy the initial objective might prove interesting. Using the most simple form, one cell, one lamp assembly, and one pot to replace two transformers (out and back) and one attenuation pad, the comparative approximate costs of each type of design might look like this to the design engineer considering a mixer section of 10 positions:

High-impedance design: $50.00 (cell-pot)

Low-impedance design: $1200.00 (transformers-pad)

A d.c. power supply would constitute an additional expenditure to be added to the high-impedance design and the shielded cable required must also be added to the low-impedance design.

The example is of course, just one application and this circuit may be used to design a remote gain control for any circuit where the resistance range required is within the limits of the cell selected. It also may be incorporated into any existing electronics providing the insertion loss is compatible. Examples of possible use are: expanders, compressors, tone controls, bias controls, TV controls, balancing circuits, and so on. In summary, the future of the photo-conductive cell looks bright. Æ

TECHNOLOGY AND BLINDNESS

JOSEPH GIOVANELLI*

On June 2, 1962, the writer had the pleasure of attending a conference on the subject of electronics. At first glance you would assume there is nothing unusual for an audio consultant to attend such a conference. However, it was tinged with some rather unusual aspects. The conference—entitled "The International Congress on Technology and Blindness," and organized primarily by the American Foundation for the Blind—covered a wide panorama of subjects, from the vocational placement of blind people to electronics as related to aiding the sightless in overcoming problems posed by his handicap.

Naturally, my concern was with the electronics aspect of the Congress. From the world over, blind people active in this field discussed this subject within the framework of the Congress. No doubt many of you wonder how a person working under this handicap can function successfully in a field where measuring instruments and their interpretation are of such importance. Had you been there, you would understand how this is possible, you would have seen demonstrations of measuring instruments together with discussions of their operating principles, and you would have realized that this material was prepared and presented with the highest scientific skill and standards.

How are meters read? Two basic methods for accomplishing this were discussed. The first type is what we could call the electronic method. A special circuit is connected across the terminals of a visual meter movement. The voltage developed across this movement can be made to do one of two things. In the first method, it may feed the input terminals of a Wheatstone bridge whose null is indicated aurally by means of a pair of headphones in series with the contacts of a chopper, with this series combination placed between the center arms of the bridge. A potentiometer fitted with a calibrated Braille scale provides the method by which the meter can be read. Also, the voltage developed across the visual meter movement can feed into an oscillator circuit in such a manner that an increase in the voltage developed across the meter can cause an increase in pitch of the oscillator. This latter type of circuit is only used where a control is to be adjusted for some maximum indication, and where the technician is not concerned with the absolute magnitude of the indication. The type of circuitry using the Wheatstone bridge is used where extreme accuracy is required. The accuracy of the device is as good as the ability to read the scale.

In the second method, the visual meter is fitted with an external pointer which can be moved around a transparent Braille scale. The principle upon which the action of this mechanism is based is that there will be a change of capacitance when the external pointer passes directly over the standard pointer used by the sighted. This capacitance shift is made to shift the frequency of an audio oscillator. The Braille scale is then read. This gives a reasonable degree of accuracy. The arrangement finds use in other applications as well as in interpreting electronic instruments, such as the reading of steam gauges, temperature gauges, and the like.

In addition to the aspect of meter reading, some special devices have been worked out and were described. There are too many of these devices having too much complexity to be described in this short paper. Although they were specifically developed to meet the needs of the sightless, the nature of this apparatus is such that it should find wide use and acceptance by sighted operators. For example, the auditory VU meter has been used successfully by sighted technicians at one broadcast station.

The delegates expressed considerable optimism as to the prospects of a blind person making his way in a complex, competitive field such as electronics. However, one serious and challenging note was struck. It was agreed that given the proper training, the proper tools, the ability by which he may dictate and interpret schematic diagrams, the blind technician or engineer can function successfully in the field of electronics—and many are. Unfortunately, industry has been slow to recognize these statements as facts. By and large the blind technician has found it extremely difficult to find his place in industry. Panel members described some of their experiences in this regard. Some employers refused to consider an applicant once it was known that the applicant could not see. Others were given a chance to prove their abilities, but after having successfully done so were again rejected because of their handicap which demonstrably did not interfere with their ability to perform the tasks of the positions they were seeking. In this day where scientists and electronics experts are in short supply, industry's attitude appears short-sighted. The time will come when abilities rather than disabilities will be recognized.

Panel members said, too, that there are some blind electronics technicians who are not so well trained. If these people apply for positions, and if they cannot for technical reasons fill them, industry should not hire them. The blind do not want pity; what they do want is the opportunity to compete with their sighted colleagues solely on the basis of their ability.

In concludion I am happy to be able to say that AUDIO does not share industry's widespread doubts. If it did, AUDIOCLINIC would not have appeared on page 2 as it has for these past few years. Æ

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

TURNTABLE-ARM DESIGN

(*from page 23*)

for minimum tracking error over the whole record will not provide minimum tracking distortion. An arm with the correct minimum tracking-error index will show somewhat higher values of absolute tracking error at the outer grooves than will the former.

Since the overhang (distance by which the needle sweeps past the record spindle) is very critical from the point of view of tracking error, and since there is no agreement among manufacturers about needle-to-mounting-hole distances in cartridge, the needle-to-pivot

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*Patent Pending.

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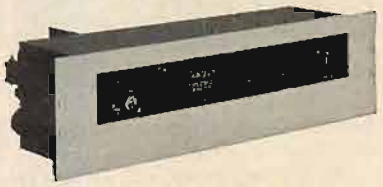

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- **CONAX will reduce distortion in tape recording and tape duplication**
- **CONAX will minimize tracing distortion**

CONAX has been engineered by FAIRCHILD to cope with the problem of distortion produced in recording and broadcasting by excessive, instantaneous high frequency peaks. The CONAX "previews" program material in emphasized form for efficient high frequency control. The device is based on the integrating properties of the human ear. The CONAX action is inaudible and instantaneous — 1/40,000ths of a second. CONAX efficiently eliminates problems of overload from loud cymbals, muted trumpets, bells, and the ever-present sibilant singers without quality degradation.

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Now you can have a compressor for every mike channel with this miniature low cost Fairchild Compact Compressor... **no larger than a slide type attenuator** (actual size 1½x7x4½ inches). This Fairchild Model 663 Compact Compressor will provide up to **20 db of compression with no increase in distortion.** And the attack time of 40 milliseconds with a variable threshold and **variable release time** of .3 to 7 seconds offers complete compressor flexibility and performance. The Fairchild 663 Compact Compressor can be **easily integrated** into your present console to provide the ultimate answer to all level control problems.

Fairchild Model 663: $158.00

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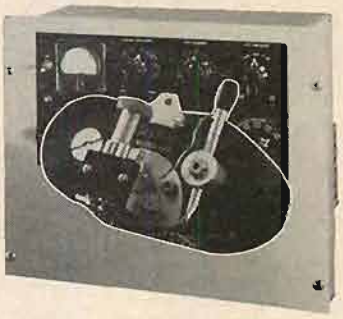

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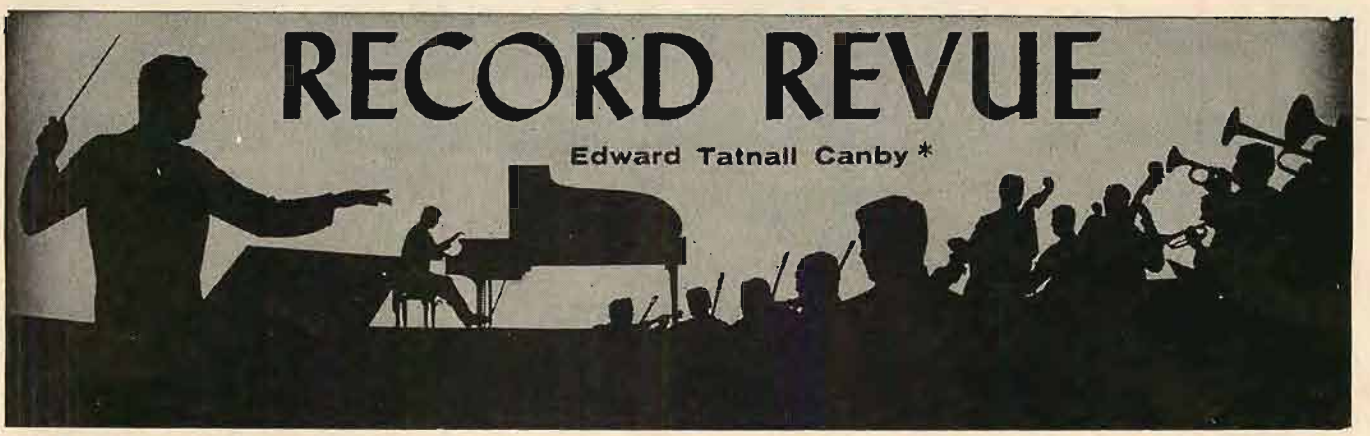

RECORD REVUE

Edward Tatnall Canby *

OFF-BEAT PLEASURE

Eighteenth Century Shakespearean Songs. April Cantelo; English Chamber Orch., Leppard. **L'Oiseau-Lyre SOL 60036 stereo**

Most of the collections of songs to Shakespeare are to be avoided—everybody and his brother has tried latching onto the Bard's coat-tails for a ride to musical fame. Only a few have made it—Schubert, for instance. *Who is Sylvia?* Schubert will tell you—in English, The English fits the music, anyhow.

But in the mid-Eighteenth century, music reached an astonishing pitch of uniformity in technique. There were "great" composers and lesser ones; but virtually nobody composed badly, clumsily, or ineptly. Style was so important, training so excellent, that even amateurs and minor clergymen turned out charming, if superficial music by the ton. Therefore be prepared for some charming music here, and mostly by some very good musicians, like Arne and John Christopher Smith. Or the Linleys of Bath, William and his genius-brother Thomas, who died at 22 and might have been great. (He drowned.) There's even a Haydn setting, composed while in England. Nice, suavely sweet music, warmly, Britishly sung by the soprano April Cantelo.

Wilhelm Friedemann Bach. (Music for piano). Heida Hermanns, piano. **SFM S 2009 stereo**

W. F. Bach was the "big" Bach's oldest son, a semi-ne'er-do-well who, one hears, even tried to palm off his own work as his father's. But like the rest of the family he was plenty musical. This is an interesting cross-section of his keyboard work and shows that he was, as the SFM (Society for Forgotten Music) people say, a prodigeous talent, gone mostly to waste through his own personality problems.

W. F. Bach's music is closest to that of the great Bach, J.S., among the Bach sons. (The youngest of them, Christian Bach, sounds Mozartean and indeed was one of Mozart's strongest influences.) W. F. was conservative but in a time of rapidly changing style made strong efforts to adapt to the new ways without, however, giving in to the superficial glitter of the "galant" style. Thus his piano music is unusually romantic for the period, yet still sounds Bach-like. Interesting, and a lot of this has not been recorded before, notably the set of Polonaises.

C. P. E. Bach: Double Concerto for Harpsichord, Fortepiano and Orch. in E Flat.
J. F. Fasch: Sonata for Flute, 2 Recorders and Continuo.
J. J. Quantz: Trio Sonata for Recorder, Flute and Continuo. Assorted soloists, Orch. of Schola Cantorum Basiliensia. **Archive ARC 3173 mono**

As usual, this Archive recording looks a lot more severe than it sounds. Look closely and you'll find two vividly interesting things here. First, a series of works contrasting "rival" instruments that are seldom heard together—the harpsichord and the piano ("fortepiano" was the pianoforte, reversed, of the mid-18th century period); the flute and the recorder. In each case one instrument supposedly superceded the other, only to find its old rival revived again in this, our later century.

Secondly, these three men were among the composers of the time of Frederick the Great, that conqueror and musician. At his nightly musicals, Bach's middle son, C. P. E., was his regular harpsichordist. Quantz was his flute coach—and wrote hundreds of flute pieces for him. Fasch was merely a contemporary, of similar musical persuasion. My story falls apart at this point, for not a one of these three works was written for Frederick's court—they were earlier, or later, or just elsewhere, but no matter; you will find these works, varying from the Bach style through to the Mozart style, most interesting in their tonal sounds and lively in the musical effect as well. Who but Archive would think of such an LP program?

Flute Concertos by M. Haydn, C. Stamitz, Telemann. Camillo Wanausek; Orch. der Wiener Musikgesellschaft, Heiller. **Vox STDL 500.810 stereo**

Bach: Trio-Sonatas (Flute, Oboe and Harpsichord). Baroque Trio of Montreal. **Vox STDL 500.920 stereo**

Byrd, Masses for Four Voices, Five Voices. La Société de la Chorale Bach de Montréal, Little. **Vox STDL 500.880 stereo**

Bartok: The Miraculous Mandarin; The Wooden Prince. Sudwestfunkorch. Baden-Baden, Reinhardt. **Vox STPL 512.040 stereo**

This modest international series "Music of Five Centuries" (Collection des Cinq Siècles) brings us interesting sideline music from many sources, in its economical French-style shiny folders under a semi-uniform cover design.

Flute Concerti, especially those of the mid-Eighteenth century, tend to sound pretty much alike. These are from the frills-and-furbelows period, after the Bach-Handel era and on into that of Mozart and Haydn (this is Michael Haydn, the younger brother of Franz Josef). Taken one by one, the works are quite lovely to hear, and they are engagingly played by the Viennese musicians.

From Montreal come two good records. The Baroque Trio plays its Bach with spirit, imagination and good phrasing though, it strikes, me, the latest in Baroque styles haven't yet reached that city; the group's ornaments are a bit erratic and the players like an old-fashioned big ritard at the end of each movement. Not important—the playing is good. The Byrd is sung by a part-French group, most of whose members are technically amateurs though with a good preponderance of trained vocal tone. They do not sound a bit Anglican, these singers—but they sing very accurately in tune, their lines are clear and reverent, their Latin diction is excellent. Very lovely.

The jump to Bartok, after these works, is a bit severe, stylistically as well as geographically from Montreal to Germany. These are orchestral suites, tone poems on a large scale, built out of two of the huge stage works that Bartok composed in his first period, in the years of the First War. They aren't easy fare—not even for those who love the later Bartok, as I do. They somehow seem an incogruous combination, big, Romantic-style orchestra, thickly scored music of turgid complexity (though not as complex as the much clearer sounding later music), an immense post-Romantic canvas—and a screaming Romantic dissonance that seems more dissonant than it is. Interminably

Chromatic Scale Test Record. Cook Series 60.

This isn't a new test record but I ran upon it for the first time recently. An interesting idea—instead of fixed numerical frequencies, like 100, 2000, 8000 cps, this one indulges in musical frequencies, to temper pitch. Octaves, of course; but also semi-tones, all up and down the chromatic scale. These are semi-irrational intervals in terms of cycles, since the tempered scale is a synthetic division of the octave into twelve arbitrarily equal intervals none of which hit at the natural overtones, missing them by varyingly small irrationalities. But for the musical ear the divisions make sense—after several centuries of habitude.

There are also interesting tone bursts here for testing equipment ability to resolve sudden transients into clear pitch. And though the two sides of the disc are musically (tonally) identical, one is "flat" to RIAA and the other attempts to equalize the loudness of all tones according to the Fletcher Munson curves.

I say "attempts" because the strain on the recording equipment and the playback is pretty severe; bass tones are mightily blown up, mid-range tones are necessarily lowered below normal level and highs, again, are boosted many db. Even so, the device is roughly helpful, for an approximate listening balance, if you don't think about the implications too hard.

(Since nobody hears low, middle and high tones with any sort of practical equality of loudness, what good is an arbitrary equal-loudness scale or tones? An interesting question.)

Maybe Mr. Cook will re-do this one in stereo some day. If so, I'd suggest a better means of reference, to locate the actual frequencies. With so many high-speed chromatics, rushing up and down scales, I found that even my well-trained musical ear got confused—and I can't multiply and divide when I'm listening to music, anyhow. You'll be lucky if you can locate even the simple octaves here in terms of numbers, since the only audible reference is standard A. at 440 cps and then a large number of Cs in octaves—32.7, 65.4, 130.8, 261.6, 523.2 and so on. A chart gives all the intermediate frequencies, but the "music" doesn't stop long enough for you to identify them individually.

Incidentally, the very heavy bass on the Fletcher Munson side makes a fine tracking test for your super-compliance pickup. Greater excursions than maximum in the old 78 groove. Mine couldn't take a few places—just skittered away an inch or so.

Jean Redpath: Scottish Ballad Book
Elektra EKL214

One of the most charming additions to the folk music circuit is Jean Redpath, a sweet-voiced young visitor from Scotland and a former schoolmam. She was the head of the Folk Song Society while attending the University of Edinburgh and a disciple of folklorist Hamish Henderson of the School of Scottish Studies. In San Francisco, Chicago, and at Gerde's Folk City in New York, she won the affection of patrons after arriving here with eleven dollars in her pocket. Her ability to tell revealing anecdotes about Scottish folkways is equally as entertaining as her singing, and any institution of higher learning should welcome her in concert with open arms. As this debut album is being followed by a second on Prestige, a long and successful recording career seems assured.

The first installment gives a good hint of chapters to come, and it should be snapped up by collectors who were quick to discover Joan Baez, Odetta and other new talents. For all her winsome ways and scholarly background, the singer is never prudish about launching a ribald song or relating a humorously improper story. Included with several Child ballads are such treats as *Bonny Boy*, and an uncommon variation on *I Know Where I'm Going*. Ralph Rinzler, guitar and banjo, and Lloyd Gough, concertina, are the assisting musicians.

THIS MONTH'S COVER

This month's cover shows the living room and audio system of Arthur J. Richards of Bakersfield, California. The chairs which are pictured are solely for "settin' and talkin'." Seating in the listening area consists of a couch which seats 5 or 6 comfortably. It occupies the wall space opposite the equipment, and is about 10 feet distant from the loudspeakers (the speakers are 9 feet apart). The equipment is as follows:

Loudspeaker: Wharfedale 60's supported by wall-mounted Knapp & Vogt adjustable shelf brackets.

Amplifier: Dyna Stereo 70, built from a kit, and out of sight behind the cabinet in the photograph.

Preamplifier: Dyna PAS-2, built from a kit.

Turntable: Empire 208, mounted on a platform riding on heavy-duty drawer slides.

Tone Arm & Cartridge: Shure Studio Dynetic, M212.

Turntable Accessory: Audiotex Dust Bug.

Tuners: AM—Eico HFT-94, built from kit.
FM—Sherwood S-3000II.

FM Antenna: TACO Model 610, mounted on a 30-foot, roof-top mast, connected with standard 300-ohm twinlead, and oriented toward Mt. Wilson near Los Angeles and 95 miles from Bakersfield. FM reception is good, with 75,000 watt station KCBH in Beverly Hills affording the best listening quality of several Los Angeles stations which are received. KMUZ in Santa Barbara is also received quite well; and KFMB in San Diego, 200 miles distant, offers fair-to-good reception during the evening hours.

Cabinetry: The cabinet is an oiled walnut console by Motif Inc. of Los Angeles. Although not intended specifically for the installation of audio equipment, it serves the purpose very admirably with the simple addition of the aforementioned turntable facility.

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Stereo—DFS 7012, Mono—DFM 3012

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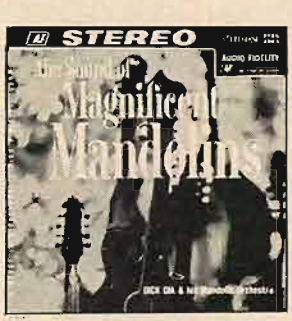
DFS 7013

Fabulous EDDIE OSBORN at the BALDWIN ORGAN—Hey Look Me Over, Down Home Rag, Moon River, Ferdinand the Bull, Some Day, Shine, others.
AFLP 1968/AFSD 5968

GREAT MOVIE THEMES, Johnny Puleo & his Harmonica Gang—Moon River, La Dolce Vita, Tonight, Never On Sunday, Ruby, Col. Bogey, Song from Limelight, others.
AFLP 1969/AFSD 5969

HIT BROADWAY MUSICALS, Jo Basile, Accordion & Orch.—The Sound of Music, 76 Trombones, Bilbao Song, Everything's Coming Up Roses, Steady, Steady, others.
AFLP 1972/AFSD 5972

MERRY-GO-ROUND BAND ORGAN, at Paul Eakins' GAY 90s VILLAGE—You will hear the world's largest, most musical and most beautiful Band Organ, thundering in the full range of high fidelity. **AFLP 1975/AFSD 5975**



The Sound of **MAGNIFICENT MANDOLINS**, Dick Dia & Orch.—Nu Quarto e Luna, Pearl Fishers, Never On Sunday, Samba Brasilia, Summertime In Venice, others.
AFLP 1963/AFSD 5963

SING-A-LONG BAWDY SONGS and Backroom Ballads, Oscar Brand & Orch.—Clementine; Ball of Yarn; Parties, Banquets & Balls; Four Letter Words; Mary Ann McCarthy; others.
AFLP 1971/AFSD 5971

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long on first hearing, too. The boiled-down later Bartok is much better listening, I say.

The "Wooden Prince" music is the earliest and the more diffuse in style with little that is recognizeable in terms of the later Bartok except sheer dissonance. (But it is often incongruously consonant, too, as at the beginning and end). The "Mandarin" music, two years later, is a much better piece for the listener and for the musician too; the sound is sharper, clearer in impact, the ideas less turgid, the contrasts more interesting—and the dissonance gratifying violent! Nobody ever heard such dissonance.

A curious technical job; the "Wooden Prince" music seems oddly unfocused and lacking in presence in spite of sharp stereo separation. Perhaps it is the music itself, since the other side with the "Mandarin" music seems distinctly better! Probably Bartok's fault.

THREE MORE

Instrumental Music from the Courts of Queen Elizabeth and King James. New York Pro Musica, Greenberg.

Decca DL 79415 stereo

Now *here* are the people who have taken on the "authenticity" deal with superpower. True, the Pro Musica is a mass production outfit, aided by foundation cash plus a healthy profit on their large numbers of concerts, and they can go at this sort of thing with dispatch and the wherewithal to get results. Acquire old instruments. Build them. Teach people to play them—expertly, not casually

True, also, that the group tends to play in a hard, business-like, high tension manner, and sing the same way; I find a great deal of their music-making hard to take merely because it is so efficiently unpoetic.

Nevertheless, here you will find really adequate professional playing of an astonishing variety of old instruments, formerly consigned to the outlandish and seen in museums only. If Vox was a pioneer in bringing these sounds out of the museum, a few years back, the Pro Musica has elevated them to musical stature.

What instruments? Well, whole families of recorders, shawms, krummhorns, zinks, sackbuts, and assorted old-time percussion, as well as strings of an elderly sort. Sounds amazingly well, all this! Much recommended. Next year the Pro Musica will have a big grant with which to put on monster performances on these creatures of the past. I'll look forward to it.

Whom God Has Joined. Complete Catholic wedding ceremony with Nuptial Mass. With Bonaventura Choir.

World Library Sacred Music 5
(Cincinnati 14, Ohio)

This is a well done presentation, modest, not "preachy," with a good deal of music of reasonably high calibre. It is the sort of audible account that non-Catholics will find unobjectionable and informative, as well as impressive. Catholics will find it an example of a practical ideal in respect to their wedding ceremony.

The actual nuptials are relatively brief, at the beginning, as in all such services. The following Mass is much longer, occupying most of the LP. Wisely, the sponsors have offered quietly spoken translations in English only of the parts of the Mass specifically concerned with the wedding itself; the rest is left as heard, in Latin. Wisely, too, the musical sections are given importance, rather than presented as perfunctory interludes. The musical Mass in G by Casali is a second class and derivative work but a serviceable one even so and the placement of its sections in the midst of the actual occasion, separated by intervals of non-musical ceremony, is significant for those of us who think of a musical Mass as a single uninterrupted composition.

The bride and groom are Mr. and Mrs. Wm. Miller. We can assume they really *were* married, before the mikes!

Stokowsky The Philadelphia Orchestra Bach. (Brandenburg Concerto No. 5; Three Chorale Preludes arr. Stokowsky). **Columbia MS 6313 stereo.**

Great day for Philadelphia when Stoky came back. He conducted there for 25 years or so—remember? If you do remember, you'll recognize the old Stokowsky style in a trice, right here in stereo. Three lovely Wagnerized Bach preludes, unctuously orchestrated as always, dripping with fervor and sentiment. (Very beautifully played, at that.) A somewhat modernized Brandenburg Concerto—it has a harpischord in it—which nevertheless sounds very Stokowskyesque, in its old-fashioned way. Nice, just the same, if you can take the occasional eccentricities.

One minor technical miracle: the solo harpsichord, which plays inconspicuously as a barely audible accompaniment through most of the first movement then suddenly is given a long solo cadenza, wholly unacompanied, here mnnages to preserve a recorded balance between its two roles. Excellent! In most recordings, somebody suddenly opens up a solo mike just before the cadenza begins and the harpsichord blossoms up like an inflating balloon, maybe 40 db or so. Not here. Æ

TAPE GUIDE

(*from page 34*)

Quarter-track is advantageous over half-track with respect to azimuth alignment (adjusting the head so that the gap is exactly at right angles with the long dimension of the tape). Azimuth is quite critical in order to preserve response out to 15,000 cps at 7.5 ips. But the narrower the track, the smaller is the treble loss for a given degree of azimuth misaligment. In a stereo head, the two gaps are never perfectly colinear, that is, exactly in the same vertical line. Accordingly, it is not possible to obtain perfect azimuth alignment for both gaps; high frequency response must suffer on one track or the other or a bit on both. But with a quarter-track head there is less suffering.

In sum, using a top-quality home tape machine, you should be able to record all that beautiful music with beautiful fidelity on a quarter-track basis.

Q. I will purchase, in the near future, a broadcast-quality professional tape recorder. I have been studying the specification sheets for the following three tape recorders. . . . I know you do not comment on merits of specific tape recorders, but can you tell me where I can get information and specifications on a top quality professional tape recorder, including foreign makes if available? Can you say if some foreign professional recorders are superior or not to American-made recorders?

A. I cannot answer your question as to which of the three American-made machines you mention is best for your purposes. I do know that all three enjoy good reputations, but beyond this your problem is akin to having to choose among a Cadillac, Chrysler Imperial, and Continental. All three have qualities and characteristics in common which put them above the run of the mill and signify that you are not likely to go wrong with any one of them, yet at the same time each has unique features that endear it more to some buyers than to others.

This boils down to analyzing the specification sheets, making a point by point comparison, evaluating the relative importance of each point, and thus arriving at a decision as to which machine comes closest to your wants in terms of operating features. So far as quality of performance is concerned—frequency response, distortion, signal-to-noise ratio, and steadiness and accuracy of motion—there is not apt to be significant audible difference. But in terms of flexibility and ease of operation, you are apt to find differences that suggest one machine in particular is best suited to your needs. You should also take into account the question of availability of service from a qualified local agency.

I further suggest that you contact local radio stations and professional recording studios to query them as to their experience with various tape machines.

I have had no direct experience with foreign professional machines. I do know that in the case of *home* tape recorders there are a few foreign units that give the best U.S. products a close battle. On the other hand, I do not think that there is out-and-out superiority for one against the other. Applying this experience to professional machines, my guess is that you do not stand to gain much by purchasing a foreign product. Moreover, you are apt to run into problems of getting replacement parts and adequate service. Also, you have to contend with the fact that foreign machines generally employ the CCIR equalization curve rather than the domestic NAB curve, unless these machines are made in large quantity for the U.S. market. Æ

JAZZ and all that

CHARLES A. ROBERTSON

STEREO

Shelly Manne and Jack Marshall: Sounds Unheard Of!

Contemporary Stereo S9006

Just when the size of stereo extravaganzas is getting out of hand, along comes this reminder that sources within a lone drummer's reach can generate all the sensations of space and motion required for an exciting sonic journey. Of course, few drummers would attempt to handle so large a kit as the one Shelly Manne assembles here, and a still smaller number can display so much melodic and rhythmic resourcefulness on so many strange implements. Unless some of the empty instrument cases left scattered about the studio floor are also struck, a rough count brings the total to twenty-seven, not including an interlude with tympani mallets on Spanish guitar strings. Manne receives the assistance of Jack Marshall, whose role on unamplified guitar is a relatively stationary one and serves as a focal point for all the surrounding activity. A third and silent partner is Howard Holzer, who engineered the project to conform with his belief that aural geography should be recreated as closely to what is mapped out in the studio as possible.

While stereo throws the spotlight on percussion with great frequency, no other part of the orchestra is more sorely mistreated in the quest for unusual sound effects. Arrangers who would never dare disrupt string or trumpet sections are less hesitant about moving bongos and conga drums hither and yon. At times the sport of bouncing from channel to channel becomes so diverting that the basic rhythm is forgotten or shoved away in a corner. Even on some jazz dates when no attempt at novelty is made, too sharp a focus on one instrument often destroys the normal balance or pulls it out of shape. Hearing a drummer exactly as he goes about his work is enough of a rarity these days to be almost unique in itself, and Manne gets down to business without one pair of bongos in sight.

Manne's assorted playthings are grouped in a semicircle, with the drummer in the middle and Marshall seated near-by, and just about everything takes place in this limited area. A piano materializes briefly, as a metal knitting needle applied to the strings provides a rain-swept introduction to *Stormy Weather*, and the combination of mallets with an extra guitar sets the pace for *Begin The Beguine*. Both Bob Haggart and Ray Bauduc might make a note of the last exploit, while the former should interest John Cage. But when the regular jazz drum setup comes into play, stereo often makes it possible to tell Manne's right hand from the left, besides revealing a good deal of fancy footwork.

Listeners are assured that no effect was added after the event through over-dubbing, although Holzer does admit to giving a little electronic assistance by way of channel switching. This usually happens when Manne handles the melody by himself, and fellow drummers will be the first to grant him the privilege of any help he gets. As a senior member of the fraternity, Manne seems content to pass the search for startling rhythmic figures on to the youngsters, using his experience to investigate new tonal harmonies and ways of phrasing melodically. While Marshall's job is to get themes underway, the drummer often takes part in the development and always uncorks a surprise or two in the process. Two inventions of Bill Loughbrough, the Boo-Bam and the Loo-Jon, are featured on *Poinciana*, along with exotic touches from Turkish finger cymbals and Hawaiian slit bamboo sticks. Among the other oddities are African thumb piano, Chinese wind chimes, Swiss goat bells, Indian elephant bells, and Trinidad steel drum played with fingers. To wind up the tour of nations in this country, American harp and native Indian tom-toms are heard on *Night And Day*.

Lest there be any misunderstanding, the publicity people at Contemporary emphasize the sound aspects over any jazz endeavors on this production, allowing Vernon Duke to speak out boldly for the music in appreciative liner notes. The label always records jazz dates well, but it outdoes itself this time. Parrying so many percussive blows provokes Marshall to greater displays of virtuosity than ever before, and he performs with skill and drive. As several stereo battles on Capitol were masterminded by him, some of the strategy and unheard of sounds should be credited to his lively imagination. Drummers and guitarists of every persuasion will be stimulated by the ideas and envious of the sound. If they go and urge the nearest engineer to do likewise, audio enthusiasts and jazz fans alike can look forward to a more realistic treatment of the rhythm section.

Charlie Mingus: Tijuana Moods

RCA Victor LSP2533

The revitalized jazz program at RCA Victor is bringing from the vaults treasures never released before, and the latest was recorded five years ago for the short-lived Vik label. In characteristic Charlie Mingus fashion, the bassist immediately causes eyebrows to shoot upwards by proclaiming on the jacket, "This is the best record I ever made." As the statement bears this year's date, a few unwary souls might jump to the conclusion that Mingus is saying his peak was reached in 1957. The truth is that individual works at subsequent sessions show continued progress and have turned out fully as well or better. What distinguishes this belated entry is the absence of any weak spots. Every number comes from the top drawer and is performed with sustained brilliance. Not many jazz LPs are so consistently good from beginning to end, so Mingus has reason enough for looking back with satisfaction and bestowing the high rating.

Tying all five themes together is a visit Mingus paid to Tijuana, and the completed package resembles Aaron Copland's Mexican journey as much as it does anything in jazz. Right from the start, however, it is a splendid example of how Mingus writes about things around him or imposes his personality on such works as *Woody 'n' You*, and *Flamingo*. The Dizzy Gillespie piece is altered into a spirited description of the trip to the border, while the second receives a shot of tequila from Clarence Shaw's muted trumpet. Mingus lost sight of Shaw after the date, last hearing that he was teaching hypnotism, and is hopeful of his rediscovery when this release circulates news of his ability. As the rest of the septet turns in an inspired performance, it would be interesting whether Shaw plays over his head in this instance or not. Curtis Porter, alto sax, and pianist Bill Triglia certainly never sounded better, and regulars Jimmy Knepper, trombone, and drummer Danny Richmond rally around as usual.

One blessing of the five year delay is the excellent stereo version, remastered by Brad McCuen from Bob Simpson's original recording, and the extra dimension allows a clear view over the heads of the crowd watching *Ysabel's Table Dance*. Mingus captures the whole scene with flashing castinets, encouraging cries and hot chili pepper choruses, then moves outdoors to wander along with a group of street musicians on *Los Mariachis*. His remaining work is a quieter and more expensive souvenir of a local gift shop.

Bobby Scott: Joyful Noises

Mercury Stereo SR60701

At twenty-five, Bobby Scott stands at the threshold of a great career, whether he moves closer to Broadway or continues to fulfill the promise shown as jazz pianist and composer. The jazz critics were highly receptive to the background music he wrote for the play "A Taste of Honey," even though one noted authority wondered why the vocals were omitted from the LP of the score. Well, the theme now has lyrics to go with the release of the film version, and Scott may find composing for movies and the Top Forty most advantageous. A taste for money has yet to dilute his jazz work, and the sound of lucre is missing from the joyful noises which make up his most ambitious project so far. Of primary importance and full of serious intention is the suite *Four Solemn Thoughts*, but the gravity of the situation soon dissolves when mixed with gospel fervor, brassy sounds, and a striding blue piano. Actually, Scott plays what might be called composer's piano, as his style changes to fit the musical content and even borrows from classical devices. At the other extreme, he deadens the piano pads with thumbtacks to duplicate the early acoustic recordings of James P. Johnson and other blues exponents. It is a tribute to Scott's own good taste that this gimmick never becomes offensive. Five more examples of Scott's works form an appealing supplement to the suite. The large orchestra includes a complement of strings, but for some mysterious reason the liner fails to list personnel. Quincy Jones produced the session, and the stereo version is a joy to hear.

George Russell: The Jazz Workshop

RCA Victor Stereo LSP2534 (e)

This is the album that proved George Russel's Lydian concept of tonal organization not only worked but could swing as well as any other brand of jazz. It disappeared from RCA Victor lists two or three summers ago, and for a time it could be picked up on bargain counters without damaging the wallet at all. Then it disappeared from the stores entirely, and copies soon began to be exchanged at premium prices. Those persons who searched in vain are now amply rewarded, as stereo and excellent re-mastering combine to make this reissue much more desirable than the original pressing. Although the stereo effect is accomplished by electronic reprocessing, the results are quite successful, particularly during the only work on which Russell himself plays. It features an improvised section which consists of a duet between Osie Johnson, on wood drums, and the composer, who employs the chromatic drums created by David Wheat's Musical Engineering Associates of Sausalito, California. Ray Hall engineered the date in 1957, and the sound is now right up to today's standards. Anyone who misses this second chance to obtain an essential album deserves to pay the piper later.

Clara Ward: Come In The Room

Vanguard VRS9101

Norman Luboff Choir: The Gospel Truth

RCA Victor Stereo LSP2548

Gospel choirs often sound less exuberant in a studio than when facing a responsive congregation, but nothing could dampen the enthusiasm of the lead soloists featured on these releases. In fact, the male of the species even manages to ignite a flame under a choral group noted for its suave manner and professional polish. The ladies come first though, and Clara Ward's preeminence in the field is acknowledged in this country and abroad. Concert tours and recent appearances in jazz clubs are still secondary to taking her troupe into churches where it performs best. It arrived in the studio fresh from a ten day series of revival meetings in Baltimore, and little of the fervor generated there seems to have been lost on the way. Besides setting forth a shining vocal example, the leader spurs her followers on with the rhythmic drive of some

of the most righteous piano playing anywhere. In among the rousers for sinners and backsliders are such calmer expressions of devotion as *Just A Closer Walk With Thee*, and *Honor, Honor*. Vanguard's superior sound makes this the most desirable of Miss Ward's recordings, but her songsters deserve a full stereo treatment.

H. P. Barnum is the son of a revivalist minister and started singing in front of tent meetings at the age of two. After a career as a child prodigy, he was awarded a college scholarship in music, now plays nine instruments, and is branching out into arranging and composing pop songs. A big voice is still his main gift, and at twenty-five he uses it to create lightning flashes and glorious thunder. Although the choir works from arrangements scored by Barnum and Norman Luboff, a description of what takes place appears in the notes Langston Hughes prepared for Miss Ward: "The more dynamic the leaders or soloists of gospel groups, the more moved the spirit is likely to become. On the wings of song, the singers get carried away, and there is no telling what may happen in their singing, for something is happening in their souls." Something happens to all director Luboff's sisters and brothers, especially when Barnum preaches his own sermon, *It's The Gospel Truth*. And Al Schmitt fills the stereo version to overflowing with dynamic movement.

Oscar Brand: Rollicking Sea Shanties
Audio Fidelity Stereo AFSD5966

Enticing as it is, the jacket of this album tells only part of the story. First of all, Oscar Brand forsakes his accustomed solo role and welcomes the swaggering vocal support of Eric Weissberg and Dave Sear, who also backs up the leader's guitar with buoyant banjo picking. Secondly, the trio continues beyond the point where other groups stop, and familiar titles give no indication of the extra verses or their lusty content. Shanties of various sorts were researched to a fare thee well by Brand and his crew, assuring authenticity and undoubtedly resulting in the discovery of some material the censors still consider contraband. Safely brought to port are such roisterlug ditties as *Johnny Come Down To Hilo, Come All Ye Young Sailors, Johnson's Ale*, and *The Ocean Waves May Roll*. Mariners and landlubbers alike may feel impelled to give voice with the shantymen, and excellent stereo allows them ample room on deck. For all intents and purposes, this trio is superior to many established groups, but a name like Brand can hardly hide itself in the anonymity of sailing under an organizational flag.

The Catch Club: I'll Tell My Mother
Capitol Stereo ST1726
Ed McCurdy: The Best Of Dalliance
Elektra EKL213

It could only happen in Los Angeles, but now that it has the rest of the country should catch up shortly. After opening at the Ash Grove, where this in person album was recorded, the three young men who make up The Catch Club moved on to San Francisco and were again greeted by an explosive audience reaction. Other clubs are bound to request their presence, but the repertoire heard here will be left behind if they ever appear on television. The verses of catches tell seemingly harmless tales about lads and lasses of old, until the Club members mix them up, and then the lads and lasses become hopelessly intertwined. Oddly enough church organists were remarkably adept at writing catches, perhaps due to the occupational hazards of dealing with youthful choristers. The program includes the contributions of such dignitaries as Henry Purcell, Thomas Arne, John Blow, Thomas Brewer and John Hilton. Dave Reznick, Ted Rusoff and Larry Pack sing tenor, baritone and bass respectively, having formed their exclusive fraternity on the UCLA campus. All three take turns at humorous explanations or scholarly introductions, while stereo helps separate the interweaving of lyrics and voices.

Elektra once produced an album of catches, but no New York club owner deemed it advisable to put the group to work. Should the songs of Elizabethan and Restoration England become a profitable commodity, various impresarios will be combing local coffee houses for talent. They need look no further than Ed McCurdy, whose baritone voice is responsible for a quartet of Dalliance albums. Twenty-eight of the best selections are now being offered in a bonus set of two records for the price of one. Either album, or both together, should please almost any weekend hostess.

Odetta: Odetta At Town Hall
Vanguard Stereo VSD2109

As the older regional singers gradually die out in this country, they are being replaced by folk song personalities and the few individuals capable of making any song seem like a personal experience. In either case, the new generation recognizes no boundaries, and one test of ability appears to be the extent and variety of repertoire covered. When Odetta first performed in public, she sounded stiff and showed the effects of vocal coaching on anything but spirituals, blues and prison songs. Her powerful voice and great natural talent carried the day, and since then she has become thoroughly at ease in many different areas and periods. As impressive as her stage presence is in this concert at New York's Town Hall, she also brings a deep sense of involvement to everything on the bounteous program. Despite winning excursions after *The Fox, Santy Anno, Devilish Mary*, and *The Frozen Logger*, Odetta's strongest point is still such songs as *He Had A Long Chain On*, and *He's Got The Whole World In His Hands*. Stereo serves mainly to bring the audience into the picture, and Vanguard could have expended it on Clara Ward to better advantage. But many listeners will value the feeling of participation conveyed on the closing *Freedom Trilogy*, as well as the extra room for the singer's guitar and bassist Bill Lee.

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* T.M. Borg-Warner

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ADVERTISING INDEX

distance of the AR arm was made adjustable. The turntable is factory-set for a cartridge with a 3/8-in. distance between mounting centers and needle tip. For any other cartridge dimensions the effective arm length is adjusted and tested with a plastic template that fits over the spindle. When the needle rests in the small template hole the overhang is correct—0.688 in.

A 9-in. arm (pivot-to-needle) with minimum tracking-error index (and therefore minimum tracking distortion) whose design is calculated for record radii of 5.7-in. outside and 2.4-in. inside, will show a maximum tracking error index of 0.32 deg. per inch. This means that, at any groove radius, the maximum tracking error that will ever appear will be 0.32 deg. multiplied by the radius. At any given radius the actual tracking error may, of course, be less. The maximum tracking error over the entire record occurs at the outermost groove, and is 1.8 deg. Minor differences in the value of maximum tracking error for a correctly designed 9-in. arm will exist if the arm is designed for a slightly different range of groove radii. However, a conventionally pivoted arm 9 in. or less which is rated as having a maximum tracking error significantly lower than 1.8 deg. reflects either improper design (achieving a lower figure for maximum tracking error at the expense of higher distortion at the inner grooves) or a copywriter's misguided enthusiasm.

To say that the AR arm design provides the theoretical minimum of tracking-error index for a 9-in. length is merely reiterating the validity of equations that have long been known and accepted. The statement applies to any other arm designed from the same equations. There still remains the mechanical embodiment of the theory, in keeping the overhang and offset angles accurate in actual production. One measure taken here for this accuracy is to form the aluminum tubing with a permanent die; another is to provide the plastic overhang adjustment template referred to.

Electrical Capacitance

Some modern cartridges require low capacitance across their output terminals. The shielded cable supplied with the AR turntable has a capacitance of 21 pf/ft., and the length has been purposely kept down to 4.5 feet. Within the arm itself the cables are not shielded until they leave the rear housing in order to keep the capacitance down. The curved section of the arm, being aluminum tubing, acts as the shield. Total capacitance between the cartridge shell and the amplifier input is approximately 135 pf per channel, suitable for any commercial cartridge.

TO BE CONTINUED

MICROPHONE PREAMPLIFIERS

(*from page 44*)

At the frequency f_1, the output from the microphone is down 3 db. At $2f_1$, the output is down 1 db, while at $4f_1$, the output may be considered as not having dropped off at all. The proper procedure for choosing f_1 is to select the lowest frequency which must be reproduced without any rolloff, consistent with the quality of the microphone used. This frequency is $4f_1$. The frequency f_1 in *Eq.* (4) is ¼ of the lowest frequency requiring a nominally flat amplification. Substitute this value for f_1 into *Eq.* (2), as well as the capacitance of the microphone, C, and solve for the resistor R. (The capacitance of crystal microphones varies from 500 pf to 15,000 pf.) The exact value should be obtained from the manufacturer of the particular microphone in question. If the actual value cannot be obtained from the manufacturer, assume it to be 500 pf.

In the test procedure, use the circuit shown in *Fig.* 5. Insert a capacitor, equal in value to the equivalent microphone capacitance, in series with the lead connecting the signal generator to the preamplifier.

Dynamic. The second popular type of microphone is the moving coil, or dynamic, variety. Here, a diaphragm is set in motion by the air pressure emanating from a sound signal. A coil is attached to this diaphragm. This coil moves in a strong magnetic field causing current to be generated in its winding.

The output from this microphone normally would rise with frequency for a constant signal pressure. Careful and proper choice of the mechanical resonant frequency can provide an output uniform with frequency over most of the audible spectrum.

The preamplifier used with each category of microphone should be characterized by a uniform frequency response. Because few microphones can reproduce the extremes of the band, and in the interest of stability, many amplifiers will roll off the upper and lower ends of the spectrum. It is not uncommon to find that 50 and 10,000 cps in one amplifier, or 40 and 15,000 cps in a second amplifier, are 3 db down from the maximum output level.

The procedure for testing microphone preamplifiers varies only slightly from that performed for tape-head or phonograph-cartridge units. In the AUX position, the amplifier is adjusted to perform at its most linear frequency capabilities. The switch is then thrown to the lower output PHONO, TAPE HEAD, and MIC positions. Adjust the level control to about 5 db below the maximum undistorted output at 1000 cps. Proceed to check the relative gain at all other frequencies, using this point as the reference level.

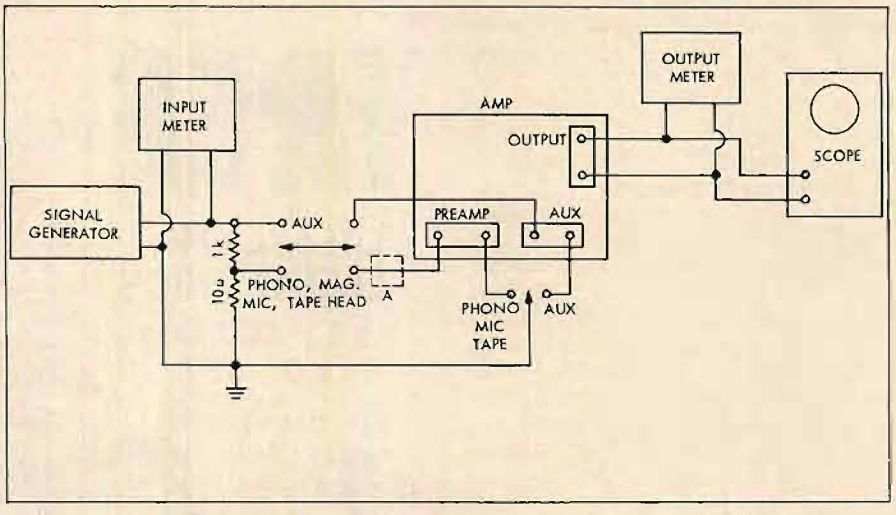


Fig. 5. Setup for measuring phono, microphone, and tape head equalization curves. Transducer is inserted at "A" when it is used in the test circuit.

amplifier.

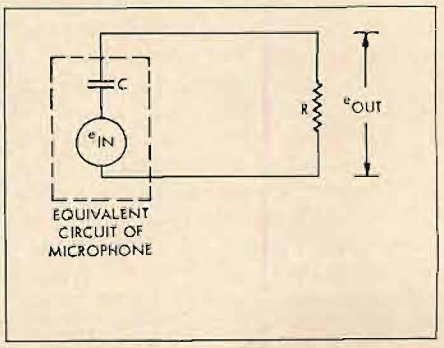


Fig. 6. Equivalent circuit of a ceramic microphone working into a resistive load.

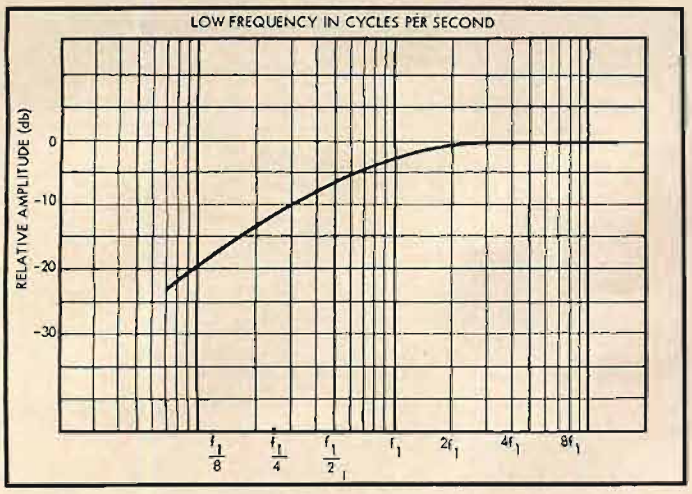


Fig. 7. Response of circuit shown in Fig. 6.

Precise Testing

Just as in the case of the constant-velocity phonograph cartridge, the tape head and dynamic microphone used should be included as an integral component in the test setup. This would take into account the effect of the inductance of these components as well as the effect of the input inpedance of the preamplifier. However, several precautions must be taken to make valid readings (refer to *Fig.* 5):

1. The resistor connected to ground in the divider network at the signal generator, must be small in value. It must be negligible compared to the impendance of the transducers under test.
2. The resistors in the divider network must be non-inductive.
3. The leads from the generator should be of the low-capacitance shielded type.
4. The transducer must be connected in series with the "hot" lead from the generator.
5. The transducer must be shielded so that it does not pick up stray electrical or acoustical signals.
6. The signals fed to the preamplifier through the cartridge, tape head, or microphone must be of the order of magnitude of the signal normally expected out of the particular transducer involved.

Isolation between the signal source and the transducer may be difficult to accomplish. Phono cartridges and tape heads should be placed in magnetically shielded boxes. Microphones should be housed in acoustically as well as magnetically shielded containers. The leads from these transducers should be shielded from stray field pickup.

One further precaution. The divider network should be at the generator. Use 3 feet of stretched shielded lead to connect the generator to the transducer. This will maintain the signal in the shielded lead at a low level, minimizing the probability of stray fields being set up and induced into the transducer. Placing the transducer 3 feet away from the signal generator minimizes direct induction from the generator into the transducer.

The importance of the transducer in the test circuit cannot be overemphasized. In *Fig.* 8, note the different curves resulting from the test made on the transistorized playback preamplifier used in the EICO model RP100 tape deck. Note the difference in the curves with and without the playback head in the test setup. The curve adheres closely to the standard when the head is used in the more accurate method of testing, just discussed. Æ

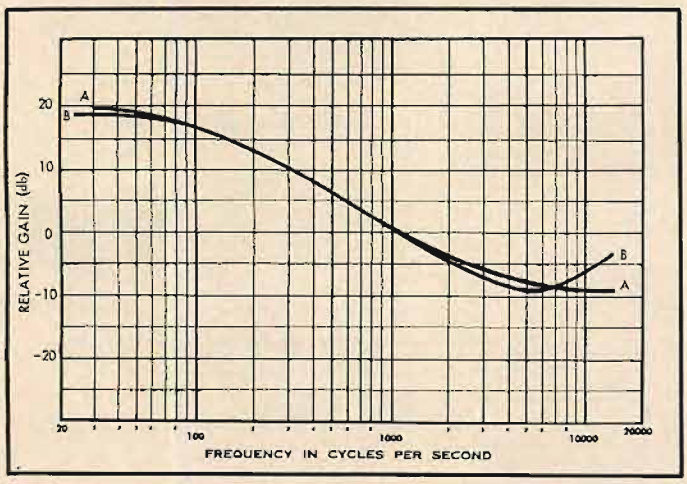
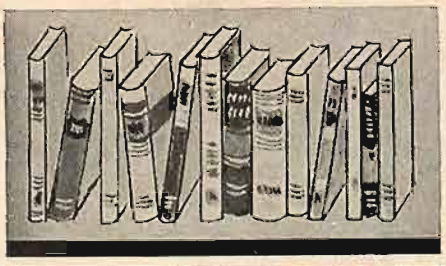
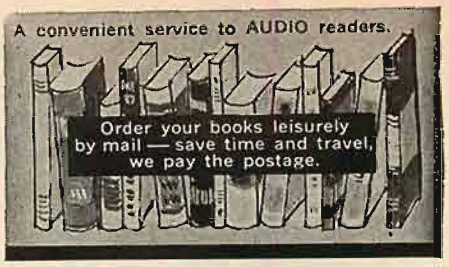


Fig. 8. Response of circuit shown in Fig. 5: A-A with head in setup and; B-B without head in setup. Notice how much closer curve with head approaches standard curve.





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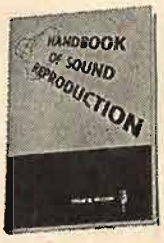

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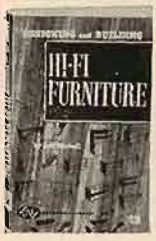

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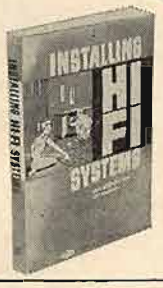

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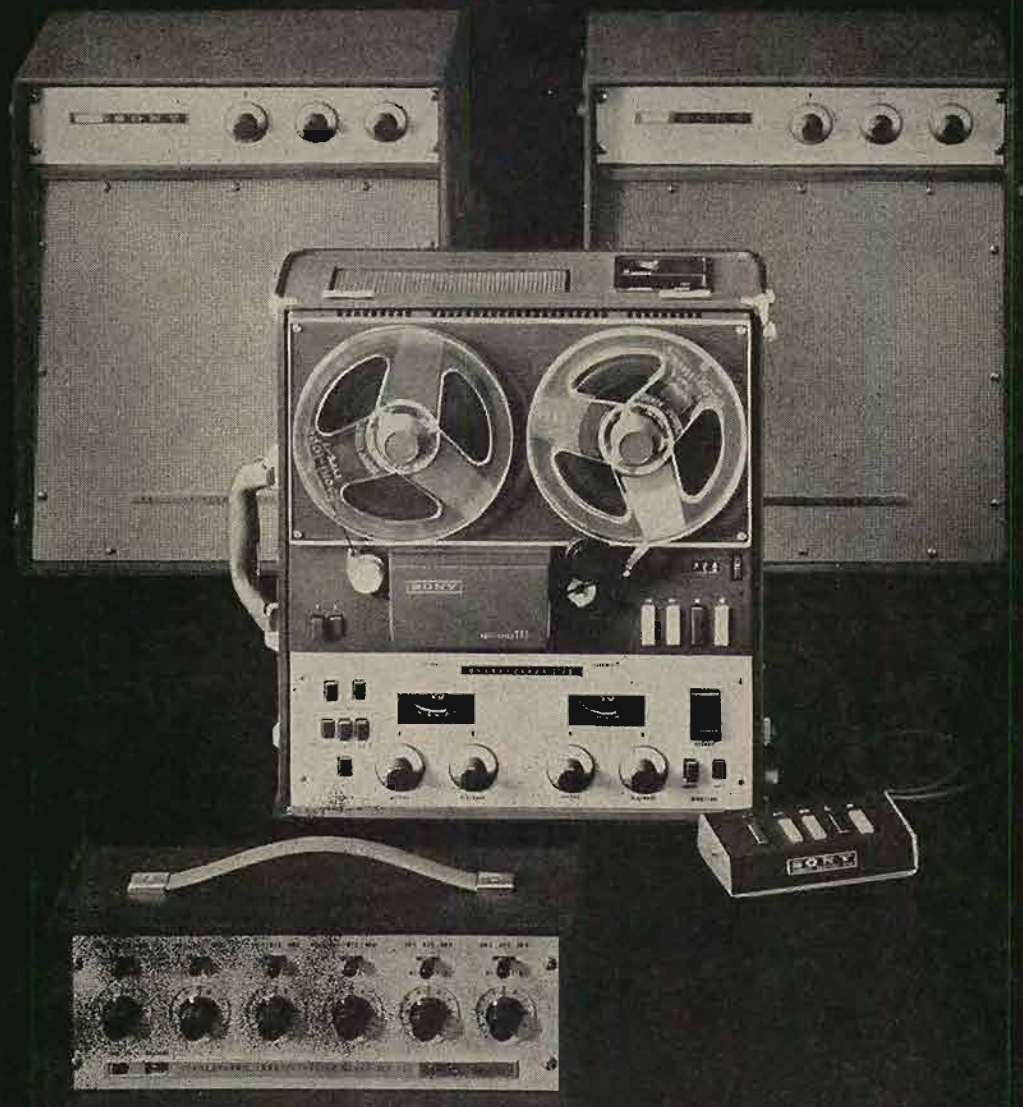

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Industry Notes . . .

• **E-V and G-C Exchange Product Lines.** The exchange of the Electro-Voice owned RME communications equipment line for American Microphones, formerly owned by G-C Electronics, was jointly announced by **Al Kahn,** President of E-V and **Stanley B. Vallulis,** President of G-C Electronics. The transaction, a unique one in the electronics field, is expected to consolidate the product offerings of the two firms, according to the announcement. "An interesting aspect of this exchange," Kahn said, "is the fact that it will enable Electro-Voice to concentrate its efforts within the electro-acoustic field; and, at the same time it will provide G-C Electronics with a communication line which will supplement the products now being produced in the Globe Division." The transaction involved the exchange of tools, inventory, brand name, and patent rights. An undisclosed cash sum was also involved, it is understood. According to George Riley, newly appointed Vice-President and General Manager of the American Microphone Company, "the firm will preserve its individuality intact and will not be integrated with Electro-Voice. The organization, including manufacturing, sales, administration, and engineering, will be completely separate from E-V. The new American Microphone Company will be relocated in Galien, Michigan.

• **H. H. Scott Promotes.** Three new appointments have been announced by Hermon H. Scott, President of H. H. Scott, Inc. **Martin Borish,** previously Assistant Sales Manager, has been promoted to the position of Sales Manager of the Scott Kit Division. The move was necessitated by the greatly increased sales volume of the Scott Kit line. Filling Mr. Borish's previous position as Assistant Sales Manager is **Peter Dyke,** who moves to that post from Customer Relations Manager. The newly appointed Customer Relations Manager for H. H. Scott, Inc. is **Conrad J. White.**

AUDIO ETC

(*from page 14*)

ful lake or perched under shady trees alongside a busy street. Trois-décis (three deciliters)* of Beaujolais red wine—the town lives on the stuff—and a marvelously tasty lunch, in French style, served at your table, sometimes a leg of lamb or veal sliced right off the limb onto your plate, plus heavenly sauces, fruit that is out of our (U.S.) world, a coffee to end, after delicious fresh salad, the dressing in the bottom of the bowl so you can toss when you are ready. (Nice word for that—*fatiguer:* you "fatigue" your salad.) Decidedly, this is the high point of anybody's work day and I find that at 2 o'clock I am ready to work very hard at dozing, and usually do, surreptitiously, over my typewriter. Then on until 6, which seems a moment, and off for the day; the fourth rush-hour in a row.

Now there's something else, you see, that is old and bound to go as Europeans doggedly follow our fine American lead. *Four* rush hours a day? Already, it's pretty bad, and on the way home at six thirty or so I wait for long periods in solid jams of cars. Another five years and nobody'll have time to get home for lunch in the old way. Nor to take two hours off. The daughter of a friend of mine works for a Swiss-American "cold" solder company (Eutectic—also in New York) which currently has an American in charge of the factory a few miles outside Lausanne. Guess what? Nine to five, by golly. And everybody stays at work the day through. However, gallantry isn't dead yet; the company takes its employees to work and back home in shiny blue buses and feeds them (one hour) at a local hotel, table d'hôte.

No, food hasn't changed much, in spite of Club Sandwiches. Eating is still the most leisurely part of European life. And the best thing about it, the most thoroughly un-progressive, is that it still is based very largely on individual marketing of fresh goods. Cans have never caught on much here, except for specialties. (Every picnic produces a rash of little oval cans of delicious pâté and flat cans of tuna and sardine.) Frozen food has, so far, been punk by all accounts, and the frigors (refriges) aren't big enough, anyhow—yet. But the vast Nestlé company, whose main world office is just down the line from here on Lake Geneva, has bought up a batch of other companies and is going into freezing on a big scale. At this moment, anyhow, every mama goes out and buys fresh meat and vegetables at the open markets—and are they delicious! Straight from the country, and not California, either.

Evidently, it hasn't occurred to anybody yet here that food should first of all *look* pretty, and let the taste take care of itself. That is our unique contribution to eating. Bigger, better-looking, more tasteless, every year. Take melons—wow! Sad little green things here and expensive, too, but I haven't tasted such a delight in the U.S. since I was a kid. Tomatoes? Mmm, good! Lettuce? Always fresh and leafy. Ah—for a non-mechanized age. It won't be long now. How much longer will the cuisinières bother to cook their delicious twice-a-day potage (cream soup) when Knorr sells the dried fixings in every shop, and Maggi too? There's only one really progressive mechanical innovation in the food department that has it all over us—the mustard-in-tubes idea. What mustard, to begin with—pure Dijon! Which means 900% better (and hotter) than ours. But all sorts of other lovely things come in tubes for the squeezing—pâté, anchovy paste, mayonnaise, various jams and jellies, anything that is good and squeezable. And then there are the wines—but let's not get into *that*, except to say that every grocery shop carries wines, beer, and liquors with no apparent need for a licence and at prices to make your eyes start. Don't buy any wine under a couple of francs, somebody said to me—you might as well get the best, at say, 50 cents a large bottle.

* * * * * *

I'd be happy to go on like this straight to our back cover but we do have a few other items to get into this issue and so I'll sum up what must seem clear to you, that Europe has finally decided to go American, but is all mixed up about it.

In the rearguard come food and wines, which are as good as ever and not much changed at all, in spite of the Self-Services and hamburger joints in the big cities, the snack bars that dot the ski resorts. (Pron. *Snock*) In between are the building trades. At last, every big city and most small ones in Europe are expanding, with big new apartments everywhere, "villas" (i.e. ranch homes) in identical masses (but not as good looking as ours), huge neon-lit gas stations. But the pace of building is deliberate, mostly. In the vanguard, and expressing the new European character at its most hysterical, come the autos, all the screaming millions of them.

It struck me almost at once that people here have reached a stage surprisingly like our own back in the Twenties in this respect. The huge traffic jams of the Twenties in America appeared just as suddenly after WW I as those of Europe have materialized today, well after WW II. In less than a decade, Europe has suddenly found the automobile, for the masses. And the countries just aren't ready for it, in spite of frantic new road-building. The cars keep coming ten times faster than the roads, the traffic lights, even the traffic rules—which are dismally outdated and fit only for Europe of ten years back.

And so there is, here, the kind of slap-happy, reckless automotive chaos that us oldsters remember from the pre-war years, when we had no superhighways, very few traffic lights, and lots of main roads so jammed with cars and trucks that progress was nil, most of the time, when trucks were big and slow and could not be passed on the jammed two-lane highways that mostly connected our big cities, when all main roads led straight through the center of every town as a matter of course, when football games and Sunday outing traffic led to the most incredible jams imaginable

* *About 10 oz.* Ed.

and not a thing was ever done about it. Takes me back. . . ,

What am I saying? *No traffic jams now?* We have 'em, and bigger than any in the Twenties. But there's a difference. Now, they occur on our six and eight lane "expressways," in and out of the big cities. The trucks are often there, but it's not they who hold things up—they just ooze along as part of the slow-moving flood. It wasn't the same in the old days. It isn't the same on the continent now, in spite of a few autobahnen, autostrade, and France's great thirty-mile Autoroute du Sud that gets you out of Paris and away without a light or a grade crossing.

Last month, for several nights in succession, camouflage-dressed bandits appeared out of the bushes bordering this great road, stopped all the traffic, calmly walked off with all the drivers' documents, from passports and registration to petty cash, and disappeared back into the bushes again. Nobody did anything much about it. Seems it had something to do with Algeria, but don't ask me what. That's the modern super-highway in Europe for you. Probably a good idea to stick to the main roads. They're safer.

* * * * *

Audio? The other half of this column's title will resume just as soon as I get over my trip; but right now I feel so far away from all that sort of thing that I just can't bring myself to think about it. Nor music either. Isn't that what vacations are for—even working vacations?

Sincerely,

ETC

LIGHT LISTENING

(*from page 19*)

of the darndest things I've ever heard. You could swear that the sound stage contained nothing but a lineup of five or six phone booths—each one occupied on a rotating basis by a vocalist or instrumentalist. Granted there is no federal or state law that decrees the amount of stereo acoustics we're entitled to on a recording. If, however, we had laws demanding an absolute minimum of room acoustics in stereo, this little number would have had trouble getting into the country. Æ

CENTER

(*from page 30*)

ment center. The right side of the cabinet contains an Ampex 351–2 tape recorder (removable for on-location taping). The electronic section on the left side has the MacIntosh AM-FM tuner, stereo preamplifier, and, not shown, a pair of 60-watt amplifiers. Thoren's TD-124 turntable, Rek-O-Kut arm, Shure M-3 cartridge complete the system. While not everyone would want a system quite as elaborate, the design does encase a plentiful supply of watts in walnut cabinetry. Æ

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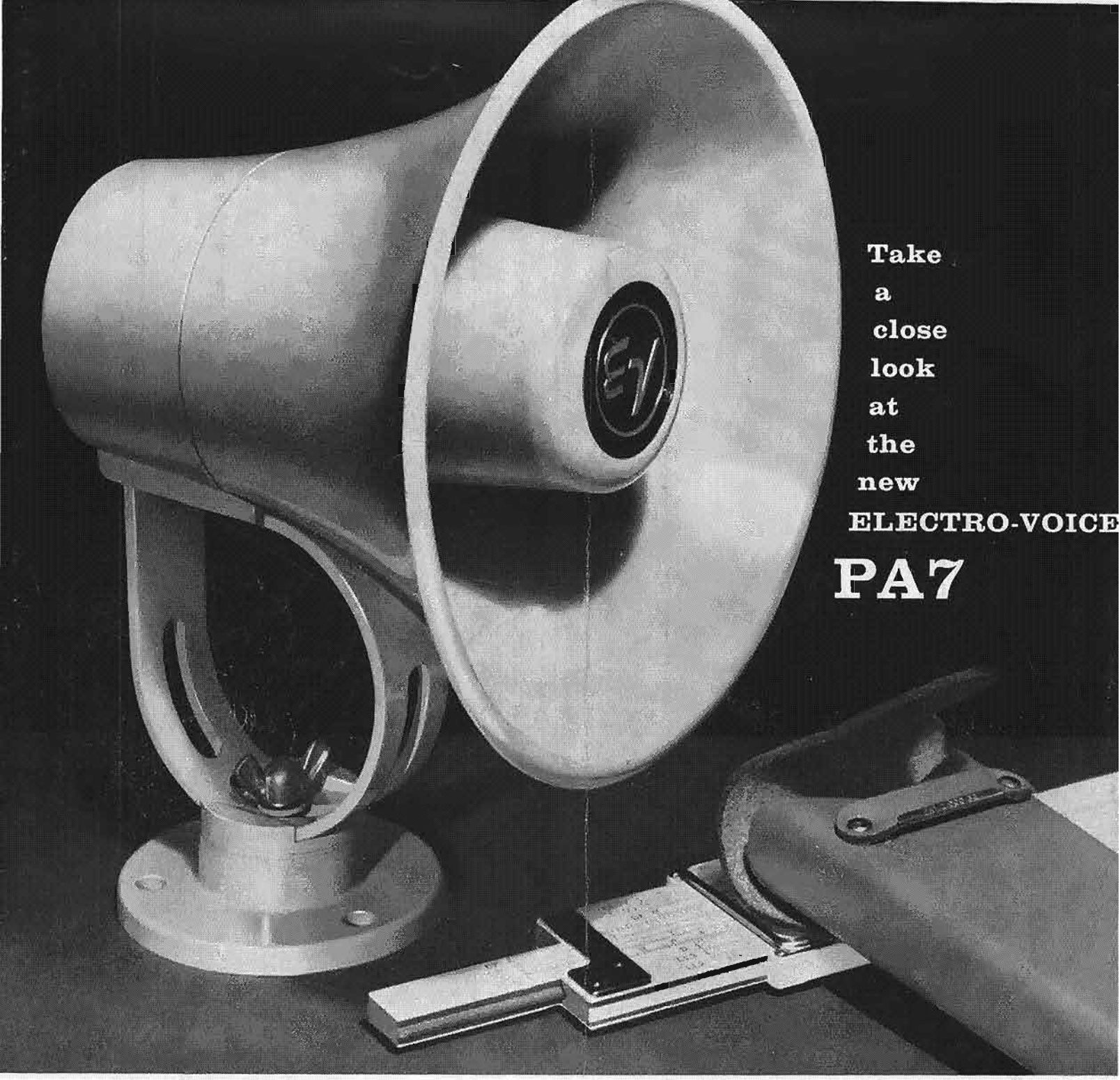

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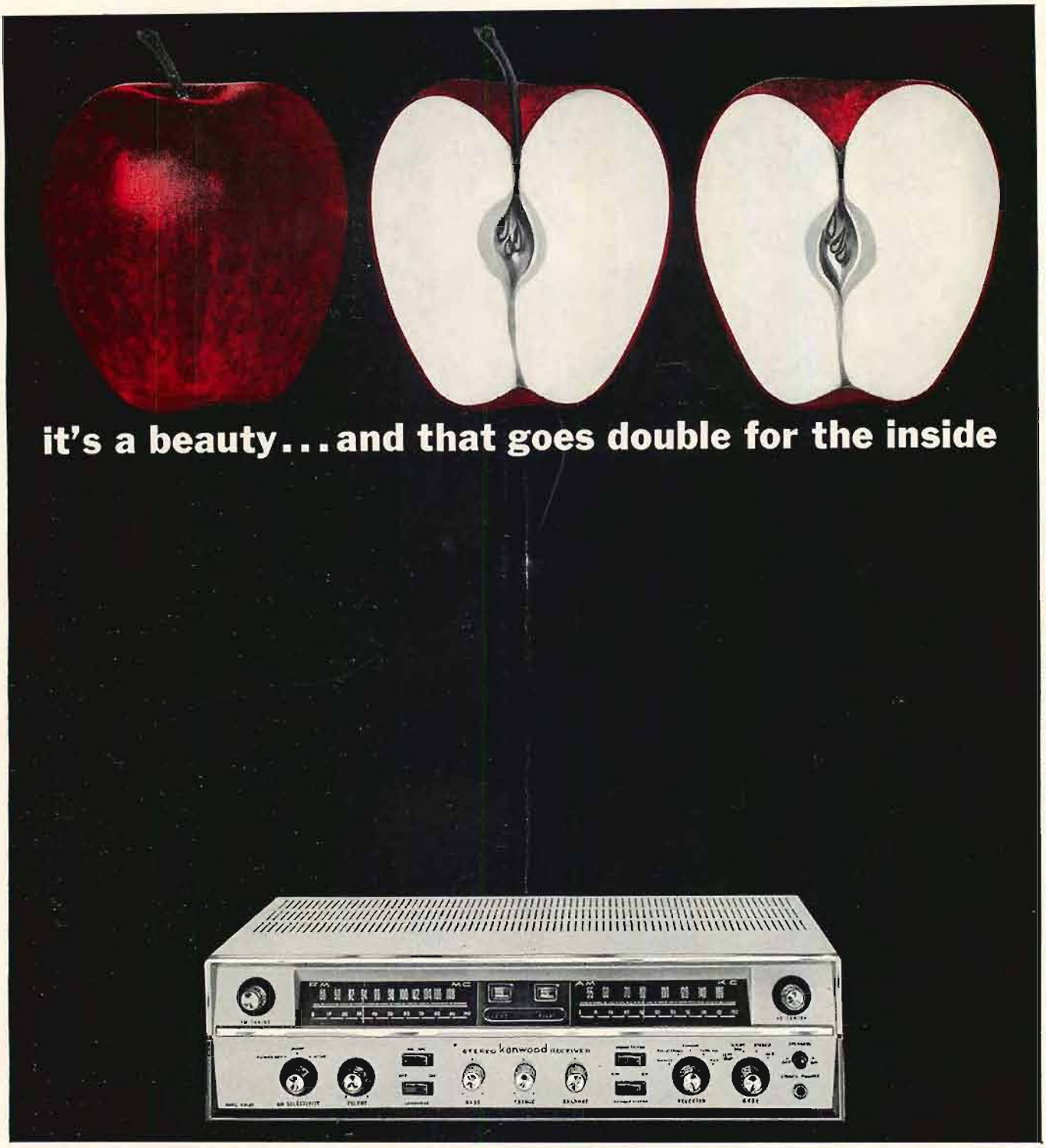

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